

Section I - Common Technical Requirements

1.1 General

In the following sections, this document describes equipment required for the tender. The common technical specifications are to mainly state the general requirements commonly applied for all the Packages. If there is any discrepancy in the requirements between the General Specifications and the Technical Specifications in this Section, the requirements mentioned in Technical Specifications shall prevail.

1.2 Scope of Work

The supply contract includes the design, manufacture, testing, insurance, delivery in complete form (assembly at warehouse if required) unloading and proper handing over the supplies to the Purchaser's Warehouse at Phuentsholing/Pasakha, Bhutan, of the Equipment as specified in the Price Schedule.

All necessary foundation bolts, rag bolts, nuts and washers, grouting packing and the like required for mounting and securing the equipment/assemblies should be included in the supply.

Bidders shall furnish guaranteed technical particulars (GTPs) in the Schedules enclosed. Drawings of all components shall be provided together with the equipment type and reference number to ensure their identification.

The unloading of the goods (items) in the purchaser's warehouse shall be in the scope of the suppliers.

1.3 Units of Measurement

Metric units of measurement (System International) shall be used on all Contract documentation. Angular measurement shall be in degrees with 90 degrees comprising one right angle.

1.4 Standards

The design material, construction, manufacture, inspection and testing of all equipment supplied under this Specification shall conform to the latest editions of the International Electro-technical Commission (IEC) Specifications and other international standards where the material is not covered by IEC. Other national or international standards are accepted if they promise to confer equal or superior quality and performance than IEC or the specified standards.

The Supplier shall provide to the Purchaser, English language copies of any Standards and Codes of Practice, which the Supplier wishes to use. The Supplier shall provide Notarised English language translations of any Standards and Codes



of Practice which the Supplier wishes to use and which are in a language other than English.

1.5 Language

The English language shall be used on all Contract documents, drawings and calculations and in all correspondence between the Supplier and the Purchaser. Any documents and drawings submitted by the Supplier in the language other than English to the Purchaser will be returned to the Supplier without review by the Purchaser.

1.6 Site Conditions

1.6.1 The conditions for the design of the equipment are as follow:

Basic Design Parameters	Basic Design Value
Altitude	3000 metres
Ambient Air Temperature : minimum Maximum	-20°C +40°C
Average Annual Isokeraunic Level	75 thunderstorm days
Average Annual Rainfall & Period	1400 mm (May to September)
Climate	Varied (From tropical to severe winters)
Relative Humidity	20 – 100%
Seismic Acceleration : i. Horizontal ii. Vertical	i. 0.1 g ii. 0.05 g
Snow Incidence and period	150 – 300 mm (December to March)
Wind Pressure : Conductors Towers, Supports	45 kg/m ² 195 kg/m ²

1.6.2 Special Conditions

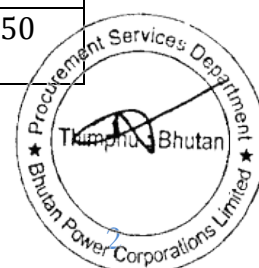
The equipment under this tender shall be designed for 3000m and accordingly shall the equipment/components shall be altitude corrected to 3000m.

1.7 Electrical Design Parameters

The electrical parameters of the equipment in accordance with relevant IEC and IS standards for 33kV and below are shown in following tables.

Medium Voltage

Nominal System Voltage	kV	33	11
Nominal System Frequency	Hz	50	50



Maximum System Voltage	kV	36	12
Rated Impulse withstand voltage (Peak)	kV	170	75
Rated one minute power frequency withstand voltage (rms)	kV	70	28
Rated one second short time current (rms)	kA	16	20
Rated short circuit withstand current (peak)	kA	40	50
Creepage Distance	(mm/kV)	25	25

Low Voltage

Insulation parameters- Low Voltage

Nominal System Voltage	V	400/230
Nominal System Frequency	Hz	50
Maximum System Voltage	V	424/244 ¹
Rated one minute power frequency withstand voltage (rms)	V	3000
Rated impulse withstand voltage (peak)	kA	7500

Note 1: Phase to Phase / Phase to Neutral

System Variation

Parameters permissible at 75 °C		Variation
Voltage Regulation of MV System	33,11,6.6 kV	±10%
Voltage Regulation of LV System	400/230 V	±6%
System Frequency	50 Hz	-2%, +1% ¹
Parameters permissible at 75 °C		Variation

Note 1: Maintain the System frequency between 49.0-50.5Hz.

1.7.1 De-rating

Since various standards or recommendations enforce validity limits on device characteristics, therefore the values mentioned in this specification are for the normal condition of use i.e. below 1000 m. Beyond these limits, it is necessary to deduce certain values, in other words to de-rate the device. De-rating must be considered;

- For insulation level of external insulation.
- For electrical clearances of two conductive parts measured through air.



1.7.2 Basic Insulation Level (BIL) De-rating According to Altitude

For installation at an altitude higher than 1000 m, the correction method recommended in IEC 60694 is convenient to use for purpose of the determination of withstand test voltages.

1.7.3 Electrical Clearance De-rating According to Altitude

If the equipment is specified for operation at an altitude higher than 1000 m, the clearance requirements shall be increased by 1.25% for every 100 m by which the altitude exceeds 1000 m. Requirements are given for phase-to-earth; phase-to-neutral and phase-to-phase clearance.

1.8 Spare Parts, Tools and Appliances

The bidder shall attach the spares, special tools and/ or appliances which are recommended.

The Purchaser may order all, none or any of the recommended items. Those ordered shall be delivered not later than the date of receipt of the last shipment of the associated item of plant. The price of the items shall be subject to the same price conditions as the associated item of plant.

All spares shall be interchangeable with the original parts. They shall be treated and packed for long term storage under the climatic conditions of site.

Each item shall be clearly and permanently labelled on the outside of its container with its description and purpose. When several items are packed in one case, a general description of the contents shall be given on the outside of the case. Spare parts shall not be shipped in the same cases as components, which are used for erection. The cases shall be clearly labelled to indicate that they contain spare parts or tools and each tool or appliance shall be clearly marked with its size and purpose.

All case containers or other packages are liable to be opened for inspection and checking on site.

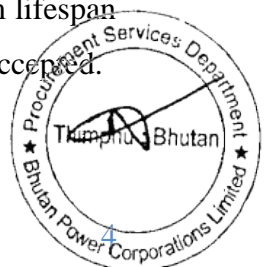
The cost of recommended spares, special tools (other than those specified in the BOQ) will not be taken into consideration when comparing bids.

1.9 Electrical Power Supplies

a) Power Supplies

Auxiliary supply to the operating mechanism and control cabinet shall be normally from compact, seal, and maintenance free internal battery filled with charging system.

The battery shall be easily available in the market and it shall have minimum lifespan of five years. Any specially designed or vendor specific battery shall not be accepted.



- i. The battery system shall be capable of initialing correct operating of recloser including controls and operations for not less than 48 hours or five (5) sequences of operation after loss of AC auxiliary supply.
- ii. The battery system shall incorporate a battery test facility. The following features shall be regarded as typical of the 'test/monitoring' facilities required.
 - Display of battery operating voltage, battery charge/discharge current.
 - An alarm signal in the event of loss of battery system or poor battery condition.
- iii. The charging system shall operate from a Potential Transformer, incorporated into the installation. The Potential Transformer for auxiliary supply shall be designed, manufactured in accordance with IEC 61869-3 suitable for the altitude mentioned in the environmental conditions.

It shall be suitable for mounting on the recloser pole and supplied complete with a pole mounting bracket. It shall be of double bushing on HT side and the required ration shall be of 33000 V/230 V and 11000 V/230 V for 33kV and 11kV reclosers respectively and minimum burden of 50 VA with adequate capacity for provisions of auxiliary supply to operating mechanism, control cabinet including RTU and communication equipment.
- iv. A 2A HRC fuse or a circuit breaker shall be provided in the secondary terminal box of the potential transformer to facilitate the isolation of the secondary wiring in the events of a fault
- v. A nameplate marked with following information shall be provided on the auxiliary potential transformer:
 - a. Manufacturer's name
 - b. Serial number
 - c. Rated impulse withstand level
 - d. Primary and secondary voltage

b) Miniature Circuit Breakers

Means shall be provided for protection and isolation of circuits associated with protection, control and instruments. They shall be of approved type and grouped, as far as possible, according to their functions. They shall be clearly labelled both on the panels and the associated wiring diagrams.

Miniature circuit breakers shall be of the thermal and magnetic tripping type, and comply with IEC 60898 and IEC 60947-2.

c) Terminals



Moulding materials shall be self-extinguishing or resistant to flame propagation, substantially non-hygroscopic and shall not carbonise when tested for tracking. The insulation between any terminal & framework or between adjacent terminals shall withstand a test of 2 kV rms. for one minute. The mouldings shall be mechanically robust to withstand handling while making terminations.

All terminals shall be mounted in accessible positions. Adjacent terminals shall be adequately spaced with respect to each other and to the incoming cable gland plate. Separate terminations shall be provided on each terminal strip for the cores of incoming and outgoing cables including all spare cores.

Terminations for circuits operating at Voltages greater than 60 V shall be protected by transparent insulating covers marked with the working Voltages.

DC circuit terminals shall be segregated from AC terminals.

Unless otherwise specified, all the terminal blocks except the terminal blocks for CTs shall be suitable for connecting minimum two 2.5 sq.mm copper conductors of the external cables at each connecting point. The terminal blocks for CTs and PTs shall be suitable for connecting minimum of 4.0 sq. mm and 2.5 sq. mm copper conductors respectively.

All spare contacts and terminals of the panel mounted equipment and devices shall be wired to terminal blocks.

The terminal assemblies shall give the required number of ways plus 20% spare with a minimum of 5 terminals. These shall be uniformly distributed on all rows of terminal blocks.

d) Electrical Insulation

Insulating materials shall be finished to prevent deterioration of their qualities under the specified working conditions.

Plastics, elastomers, resin-bonded laminates and inorganic materials shall be of suitable quality selected from the grades or types in the appropriate IEC Standard.

All cut or machined surfaces and edges of resin-bonded laminates shall be cleaned and then sealed with an approved Varnish as soon as possible after cutting.

e) Alternating Current Supply Practice

Double-pole switches shall be used to break single-phase ac mains supplies. For multi-phase supplies, each phase shall be switched simultaneously and the neutral should preferably not be switched. If it is switched, it shall be opened after and closed before the phase-lines.



All mains circuits shall be protected only in the phase-lines by MCBs of suitable rating or by other suitably approved protective devices. The neutral shall be connected by a removable link located near the protective devices.

All main transformers shall have an electrostatic screen, which shall be earthed.

f) Direct Current Supply Practice

Double pole switches shall be used to break dc supplies, one pole for the positive line and one pole for the negative.

DC circuits shall be protected by MCBs of suitable rating installed in both positive and negative lines.

Measures shall be taken to prevent arcing across switches or relay contacts which are required to break inductive circuits (e.g. bypass diodes or capacitors connected across coils).

Power supply bus bars in cubicles shall be shrouded.

The duplicate auxiliary power supply feeders shall be provided in Control panels. Auto-changeover facility in DC DB shall be provided so that in case of failure of one power source, other shall cut in automatically. The protective relays shall not give a trip signal for momentary loss of control Voltage or during changeover of control Voltage.

g) Batteries

Electronic equipment shall not use local internal batteries unless the approval has been obtained. Where approval is given, batteries used inside equipment shall be of the totally sealed, leak-proof type.

h) Earthing

Provision shall be made for earthing all equipment intended for connection in an ac mains supply.

All structural metal work and metal chassis shall be connected to earth. Earthing conductors shall be at least equal in cross-sectional area to the supply conductors and shall be capable of carrying the fault current for 1 second.

i) Anti-Condensation Heaters

Any items of electrical equipment which are liable to suffer from internal condensation (due to atmospheric or load variations) shall be fitted with heating devices suitable for electrical operation at 230 Volts ac, 1 phase, 50 Hz of sufficient capacity to raise the internal ambient temperature by 5°C. The electrical apparatus so protected shall be designed so that the maximum permitted rise in temperature is not exceeded if the heaters are energised while the apparatus is in operation.



Where fitted, a suitable terminal box and control switch shall be provided and mounted in an accessible position. A thermostat shall be provided in the heater control circuit to cut-off the heater at 45° C.

j) Interior lighting and Receptacles

The panels shall be provided with a compact fluorescent lamp (CFL) lighting fixture (11 W) rated for 240 V, 1 phase, 50 Hz supply for the interior illumination of the panel during maintenance. Switching of the fitting shall be controlled by the respective panel door switch. All CFL lamps shall be with pin type holder.

The panels shall be provided with a 230 V, 1 phase, 50 Hz, 6 Amps, 3 Pin receptacle with switch. The receptacle with switch shall be mounted inside the panel at a convenient location.

1.10 Materials and Finishes

1.10.1 General

Unless otherwise provided for in the Contract, all materials, fixtures, fittings, and supplies furnished (hereafter called "materials") shall be new and of standard first grade quality. All assembly and construction work shall be done in a neat and professional manner. Materials shall be free of defects. Materials shall be brought to site only after inspection and issuance of proper dispatch clearance. The dispatch clearance shall be issued within three working days after the inspection from the BPC head office. The local materials like bricks, sand aggregates shall be tested in the local laboratories before bulk supply.

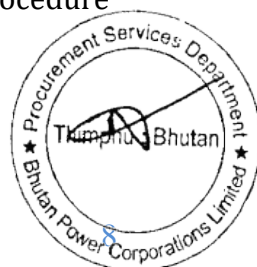
All of the plant, whether temporary or permanent, shall be in accordance with the Contract with respect to character, type, construction, constituent substances, weight, strength, shape, dimensions, etc.

In choosing materials and their finishes, due regard shall be given to the harsh climatic conditions which can occur in the area. Some relaxation of the following provisions may be permitted where equipment is hermetically sealed, but weatherproof materials should be used wherever possible.

All structural members, nuts and bolts shall be galvanised and shall conform to the requirements.

1.10.2 Surface Coating and Galvanising

All ferrous metalwork shall be provided with an effective galvanised or corrosion resistant paint treatment applied in accordance with the best trade practice. The paint treatment for each application shall be selected from the 'Paint Procedure' described in subsequent paragraphs.



The formulation and application procedure for the paint shall be as recommended by the manufacturer for the appropriate exposure conditions.

Coatings shall not be applied before vessels and chambers have passed any required pressure or vacuum tests. Precautions shall be taken to prevent corrosion occurring in the period of time between cleaning of the steel and commencing the painting.

Adequate amounts of each type and colour of finish coat as applied to the major equipment items shall be provided for "touch-up" purposes.

The colour of equipment shall be painted with RAL 7032 (exterior) and glossy white (interior).

1.10.3 Paint Procedure

- (a) For Mild Steel Items Exposed to Weather:
 - (i) Blast clean.
 - (ii) 1st coat - Inorganic zinc primer to give a dry film build of not less than 75 microns.
 - (iii) 2nd coat - Chlorinated Rubber to give a dry film build of not less than 100 microns.
 - (iv) 3rd coat - Chlorinated Rubber to give a dry film build of not less than 75 microns.
- (b) Mild Steel Items Immersed in Oil :
 - (i) Blast clean.
 - (ii) 1st and 2nd coats - Epoxy paint treatment system in accordance with coating manufacturer's recommendation for oil immersion.
 - (iii) Total dry film build thickness shall not be less than 350 microns.

1.10.4 Galvanising

Galvanising shall be applied by the hot dipped process generally in accordance with ASTM A 123-78 for structural steel and ASTM A 153-73 for iron and steel hardware.

For structural steel, galvanising shall average not less than 0.61 kg/m² (no individual specimen shall show less than 0.55 kg/m²) except for 6.35 mm and heavier materials in which case galvanising shall average not less than 0.702 kg/m² (no individual specimen shall show less than 0.61 kg/m²).

For iron and steel hardware, galvanising shall be in accordance with Table 1 of ASTM A 153-73.

The zinc coating shall be smooth, clean, of uniform thickness and free from defects. The preparation for galvanising and the galvanising itself shall not adversely affect the mechanical properties of the coated material.

1.10.5 Castings



All castings shall be free from blowholes, flaws and cracks as far as is practicable. No welding, filling or plugging of defective parts shall be done under any circumstances. All cast-iron shall be of close-grained quality approved by the Engineer.

1.10.6 Welding

All joints shall be bolted joints and welded joints shall not be permitted either during the design stage or the construction stage. However, during erection in case of additional unforeseen requirements by the Employer, if welding needs to be resorted to, the same shall be done with prior approval of the Engineer, and shall conform to BIS specifications. In such a case, the Contractor shall specifically indicate the location and purpose along with the proposed methodology for welding for the Engineers' approval. The welding shall be carried out by a certified welder who have undergone minimum of certificate level training in this trade.

1.10.7 Nuts and Bolts

Nuts and bolts for incorporation in the plant shall conform to ISO Metric. Other sizes or threads may be permitted only for threaded parts not to be disturbed once manufacturing is complete. Each bolt shall have rolled threads, one hexagonal nut and two washers. Thread length shall be 50 percent of bolt length or maximum 150 mm.

All steel bolts and screwed rods shall be galvanised including the threaded portions. All associated nuts shall be galvanised with the exception of the threads which shall be oiled. The thickness of zinc coating shall be not less than 0.45 kg/sq. metre of surface area.

All bolts, nuts and washers shall be of non-corroding material where they are in contact with non-ferrous parts in conductor clamps and fittings and elsewhere where specifically required by the Purchaser.

1.11 Packing and Shipping

- 1.11.1 The goods/materials shall not be shipped/ dispatched unless dispatch clearance from Purchaser/Engineer is issued. The dispatch clearance will be issued from the BPCs office after the inspectors submits its inspection report to BPC, within 4 working days after the submission of the report.
- 1.11.2 Any items liable to be damaged in transit shall be effectively protected and securely fixed in their cases. All cases of over 2 tonnes shall be marked to show where slings should be placed.
- 1.11.3 All cases shall be clearly identified giving particulars of manufacturer's name and type of equipment. All identification marks on the outside of cases shall be



waterproof and permanent. All electrical equipment shall be adequately sealed and desiccating agents used where necessary to prevent damage from condensation. All equipment shall be packed and protected, bearing in mind that it will be shipped to a harsh environment, that a considerable period may elapse between its arrival on site and its unpacking and that covered storage may not always be possible.

- 1.11.4 All wood and other materials used in packing cases shall be insect free. Adequate protection and precautions are to be taken to exclude termites and other vermin, noxious insects, larvae or fungus from the packing materials or plant. All contents are to be clearly marked for easy identification against the packing list.
- 1.11.5 The Supplier shall protect all steelwork before shipment, to prevent corrosion and/or damage. Bundles of steel sections shall be properly tied together by an approved method and care shall be taken to ensure that they are robust and that they can be handled easily during shipment.
- 1.11.6 Bolts and nuts shall be double bagged and crated for shipment. Crating of dissimilar metals is not acceptable.
- 1.11.7 Packing cases where used, shall be strongly constructed and in no case shall timber less than 25 mm in thickness be used. The contents of packing cases shall be securely bolted or fastened in position with struts or cross battens. Cross battens supporting weight in any direction shall not rely for their support on nails or screws driven lengthwise into the grain of the wood, but shall be supported by cleats secured from inside.
- 1.11.8 The following information shall be marked on the containers/cartons as well as boxes:
 - a) Supplier's name, Project title and Contract reference
 - b) Identification number
 - c) Net/Gross weight
 - d) Purchaser's name with other despatch particulars such as destination.

1.12 Labels

- 1.12.1 All equipment shall be provided with labels or name plates, giving a description of the equipment, together with information regarding the rating, nominal voltage, nominal current and the like under which the item of plant in question has been designed to operate. The labels shall be provided on packaging to the Purchaser's approval.
- 1.12.2 Such nameplates or labels are to be of non-corrodible, non-hygroscopic material with lettering of a contrasting colour.
- 1.12.3 Labels on cable drums shall state the cable details, including the length in metres.



1.13 Locks

Provision shall be made for padlocking of mechanism boxes, isolators and outdoor switchgear as required by the Specification or as necessary to limit access or the safety of personnel. All padlocks will be provided by the Purchaser.

1.14 Supplier Documents and Drawings

1.14.1 General

The Supplier shall be responsible for submission, re-submission and obtaining approval as required of all the documents and drawings listed below (but not limited to), so that there shall be no delay to the work due to the absence of such documents and drawings. Any approval by the Purchaser will not relieve the Supplier of any obligations under the Contract.

Any alterations to the documents and drawings which may be required by the Purchaser for approval shall be made by the Supplier at his own expense. All materials and work involved in their manufacture shall be as indicated in such drawings.

No work shall be done on any part of the Goods, the design or construction of which is dependent on the approval of such drawings or data, until such approval has been given.

The following information shall be submitted in following stages

Sl.No	Particulars	Bid	Approval	Pre-Dispatch
1	Details of switching equipment	Required		
2	Wiring diagram (GA and Schematic diagram)		Required	
3	General arrangement for installation on double pole		Required	
4	Procedures for maintenance and operation of all components			Required
5	List of spare parts	Required		
6	Details of service history	Required		
7	Guaranteed Technical Particulars (GTP)	Required		
8	Deviation Sheet, if any	Required		
9	List of software and accessories required for installation/configuration/operation.	Required		
10	Manufacturer's certification for quality standards and performance certificate	Required		
11	Type Test reports for breaker, PT, and LA.	Required		



12	Routine test reports with procedures		Required	Required
13	Detailed manual for installation and commissioning instructions			Required
14	Technical datasheet and Type Test Report of lighting arrestor	Required		
15	Details of battery including technical datasheet	Required		
16	Mounting details of control cabinet		Required	
17	Mounting details of switching equipment		Required	
18	Program for production, testing, training and inspection.		Required	
19	Details of CT, VT and Voltage Sensors	Required		
20	Technical datasheet and Type Test Report of the controller relay	Required		
21	Details of ports and protocol available for local/remote communication	Required		
22	Brochure and technical details of cellular modem	Required		

1.14.2 Manner of Submission and Approval of Drawings

The Supplier shall submit two prints (one copy if it is mailed) of each drawing or document for approval. The Supplier shall provide the same number of further prints for any drawings that are altered. The submission of drawings for approval shall be repeated until 'Approved' or 'Approved with conditions' is given by the Purchaser.

Within fifteen working days after receipt by the Purchaser of any drawing or document requiring the Purchaser's approval, the Purchaser shall either send one copy thereof to the Supplier with its approval endorsed thereon or shall notify the Supplier in writing of its disapproval thereof and the reasons therefore and the modifications that the Purchaser proposes.

All drawings, information, design reports, etc shall be neatly type written and be presented as bound documents. The documents presented shall have neatly drawn title pages that clearly show the name of the Purchaser, identify the project name, the contract number, the date, the revision number, etc, and shall be provided with a table of contents.

1.14.3 Manuals

The Supplier shall submit the instruction manual for all the goods supplied under the contract. The Supplier shall follow the requirements as mentioned in the relevant clauses in the Technical Specifications.



1.15 Quality Assurance

1.15.1 The manufacturer must operate a quality assurance system that complies with ISO 9000. The Supplier shall provide current certification showing the manufacturers' compliance with ISO 9000 or equivalent standard. The certificate must be issued by an independent, accredited issuing authority.

1.15.2 In compliance with the proposed quality assurance system of ISO 9000 or equivalent, Bidder shall submit with Bid the quality assurance plan for manufacturing the Goods. Especially, if the Bidder proposes to form a joint-venture or consortium, such a Bidder shall submit with Bid a quality assurance plan, including explanation how to manage the same quality of Goods by the joint-venture partners.

1.16 Tolerance

The variation in quantity to be supplied against confirmed order shall be permissible up to One (1) percent per item. However, for the short supply the payment shall be made as per the actual supply and for over supply the payment shall be limited to the ordered quantity.

1.17 Training

The supplier/manufacturer should arrange week long workshop or short course on setting, configuration, demonstration on setting up communication, installation and commissioning of ARCBs, Sectionalizer/LBS and all components before inspection. Only after the workshop or the course, inspection shall be carried out and the workshop or short course shall be free of cost. The supplier or manufacturer shall propose appropriate solution to facilitate the workshop or short course in events of natural and unavoidable global catastrophe.

1.18 Inspection and Testing

The materials will be inspected at the Manufacturer's works by the Purchaser's representative. Tests shall be performed in accordance with the relevant IEC standards. In the absence of IEC recommendations the tests must be equivalent at least to the conditions, provisions and definitions of the above-mentioned standards. The supplier shall give at least one month's notice for readiness of equipment for testing at the manufacturer's works. The tests shall be divided into the categories described below.

1.17.1 Routine Tests

All the routine tests specified by the standards shall be carried out. If the tests are not witnessed by the Purchaser's representative, test certificates shall be



submitted to the Purchaser for approval. Despatch clearance will be given only if the test results are approved.

1.17.2 Type Tests

Bidder shall include with his bid type test certificates, issued by an approved, reputed, independent testing laboratory.

In addition, the Purchaser may call for type tests to be carried out at the Manufacturer's Works and to be witnessed by the Purchaser or his representative. Such tests will be on random samples at the discretion of the Purchaser and failure to meet the conditions of test could result in the rejection of a complete batch of equipment. Type testing shall only be performed if the manufacturer is unable to provide type test certificates issued by an independent test laboratory of international repute.

1.17.3 Inspection

The Supplier shall intimate the Purchaser about the detailed program about the tests and inspection at least one month in advance.

Inspection and tests on all the Goods offered shall be carried out in the presence of Purchaser's representative unless inspection waiver has been given to the Supplier. The inspection shall be carried out as per the test procedure that has been approved by the Purchaser. The Supplier shall assist the work of the Purchaser's inspector by providing copies of all relevant Standards and test procedures, and allowing the inspector full use of the necessary tapes, measures and laboratory equipment, together with ample space and assistance in the handling of Goods for inspection.

The Supplier shall submit all final test and inspection reports to Purchaser's representative (inspector) during his stay at the workshop for the inspection. The inspector shall issue a "Dispatch Clearance" to the Supplier when the tests and inspection has successfully completed in compliance with the Technical Specifications.

1.19 Dispatch Clearance

- 1.19.1 The Supplier shall submit all final test and inspection reports to Purchaser's representative (inspector) during his stay at the workshop for the inspection. The inspector shall issue a "Dispatch Clearance" to the Supplier when the tests and inspection has successfully completed in compliance with the Technical Specifications.
- 1.19.2 The goods have to reach to the delivery warehouse within Twenty (20) days from the date of issuance of dispatch clearance (if the goods are supplied/manufactured from India & Nepal).



1.19.3 The goods have to reach to the delivery warehouse within Forty Five (45) days from the date of issuance of dispatch clearance (if the goods are supplied/manufactured from Third Countries).

1.20 Rating Plate

All equipment shall bear a name plate clearly visible, effectively secured against removal and indelibly and distinctly marked in accordance with international standard. In addition, the words '**Property of BPC**' along with the Contract Agreement No. and year/month of manufacture, "Guarantee Years" shall either be punched or marked indelibly on the name plate.

1.21 Manufacturing Experience

The manufacturer of ARCB and Sectionalizer/LBS shall have minimum of 10 years of experience in manufacturing similar products. The product offered shall have been in service in electricity utilities over past 3 years.

The bidder shall furnish list of purchasers with year and quality of the product offered along with the bid to prove his manufacturing experience.

1.22 Spares

1.22.1 Mandatory Spares

Following parts shall be supplied as mandatory spare parts:

Sl.No	Components	Remarks
1	Control panel for 11kV ARCB & Sectionalizer/LBS	For every 8 numbers of ARCB and Sectionalizer/LBS or part thereof
2	Control panel for 33kV ARCB & Sectionalizer/LBS	
3	33000/230 V Voltage transformer	
4	11000/230 V Voltage transformer	
5	Sets of Battery	
6	Sets of Voltage transformer fuses	One set for each equipment
7	Sets of Panel fuses	One set for each equipment
8	Sets of MOV	One set for each equipment

1.22.2 Manufacturer Recommended Spares Parts

A list of manufacturer recommended spare parts with current prices for 5 years trouble free operation of the Sectionalizer/LBS shall be submitted along with the bid.





Test Standards

1. Standards

The design material, construction, manufacture, inspection and testing of all equipment supplied under this Specification shall conform to the latest editions of the International Electrotechnical Commission (IEC) Specifications and other international standards where the material is not covered by IEC. Other national or international standards are accepted if they promise to confer equal or superior quality and performance than IEC or the specified standards.

2. Testing

The tests shall be divided into the categories described below.

2.1 Routine Tests

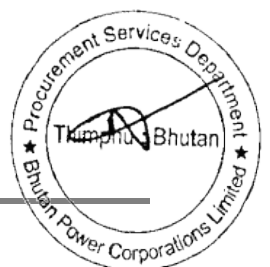
All the routine tests specified by the standards shall be carried out. If the tests are not witnessed by the Purchaser's representatives, test certificates shall be submitted to the Purchaser for approval. The test certificates must show the actual values obtained from the tests, in the units used in this Specification, and not merely confirm that the requirements have been met. No materials shall be dispatched until the test certificates have been received by the Purchaser and the Supplier has been informed that they are acceptable.

Despatch clearance will be given only if the test results are approved.

2.2 Type Tests

Bidder shall include with his bid type test certificates, including thermal, mechanical performance carried out in accordance with IEC575, which are issued by an approved, internationally acknowledged, reputed, independent testing laboratory. **Equipment shall be type tested for all the type tests as per applicable international standard in an accredited lab within last 10 years from the date of bid opening.** Type tests shall be carried out at an independent testing laboratory or be witnessed by a representative of such laboratory or some other representative acceptable to the Purchaser. Type tests may be dispensed with at the Purchaser's discretion, if the Supplier furnishes evidence to the Purchaser's satisfaction, that the relevant tests have already been performed on identical materials and equipment.

In addition, the Purchaser may call for type tests to be carried out at the Manufacturer's Works and to be witnessed by the Purchaser or his representatives. Type testing shall only be performed if the manufacturer is unable to provide type test certificates issued by an independent test laboratory of international repute. Such tests will be on random samples at the discretion of the Purchaser and failure to meet the conditions of test could result in the rejection of a complete batch of equipment.



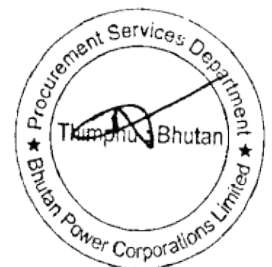
TECHNICAL SPECIFICATION FOR LOT 1 (ARCB)



1. Scope

- The specification covers the design, manufacturing, testing, supply and delivery of SCADA compatible Auto Recloser Circuit Breaker (ARCB also called as Auto Recloser) suitable for 3-phase 11kV and 33kV with bidirectional communication facility.
- For Local Communication/configuration via mobile workstation, the ARCBs shall have serial and TCP-IP port for communication. For remote communication the ARCBs shall have port(s) to facilitate communication with Control center.
- Each Auto Recloser shall include programmable protection features and integrated remote operation capability that are intended for installation on 11kV and 33kV feeders to facilitate complete distribution automation.
- The Auto Recloser shall be along with appropriate lightning arrestor at upstream as well as downstream terminals. The bidder shall provide hardware and clamping structures, conductors and lighting arrestors wherever required.
- The Auto Recloser shall either have its own power supply supplied or an auxiliary power supply by dry type resin cast double bushing transformer. A rechargeable sealed maintenance free battery and battery charger shall also be provided to provide stable power source to the controller and other communication equipment.
- Auto Recloser shall be connected to its controller using suitable connector by means of umbilical cable or equivalent cable.
- The vacuum interrupter shall be versatile to trip or close based on capability of interruption and it should be fully sealed in solid dielectric housing for lifetime of the recloser. Recloser shall be provided with magnetic actuator with all accessories in order to facilitate operation of the reclosers.

The technical specifications for Auto-reclosers in this Specification are minimum requirements. Manufacturer's standard design and/or technical alternative with latest technology may be accepted if the actual functions or performances are equal or of superior grade, compared with this Specification. However, if a proposed recloser does not comply with the major functional requirements, such a proposal will be deemed as technically non-responsive.



2. Standards applicable for ARCB

Unless otherwise specified elsewhere in this specification, the performance and testing of the Auto Reclosers shall conform to the following International Standards and all related International standards to be read with up to-date and latest amendments/revisions, thereof:

Sl. #	Standard No.	Title
1	IEC 62271 – 111	Overhead, pad mounted, dry vault and submersible automatic circuit reclosers and fault interrupters for alternating current systems up to 38kV
2	IEC 62271 – 200	AC Metal-enclosed switchgear and control gear for rated voltages above 1kV and up to and including 52kV
3	IEC 60255	Electrical Relay standards
4	IEC 60529	Degree of protection provided by enclosures
5	IEC 61000-4-2	Electrostatic Discharge standard
6	IEC 61000-4-3	Radiated electromagnetic field
7	IEC 61000-4-4	Electrical fast transient/burst immunity test
8	IEC 61000-4-5	Surge immunity
9	IEC 61000-4-6	Immunity to Conducted Disturbances
10	IEC 61000-4-8	Power Frequency Magnetic Field
11	IEC 61000-4-11	Voltage dips, short interruptions and voltage variations immunity tests
12	IEC 61000-4-16	Conducted common mode disturbances
13	IEC 61000-4-18	Damped oscillatory wave
14	IEC 68-2-6	Vibration in three axes



3. Mounting structure of Auto Reclosers

The Auto Recloser shall be suitable for mounting on existing poles of the distribution network and suitable mounting bracket shall be provided with appropriate lifting lug provided at appropriate position. There should be suitable mounting brackets for surge arrestor as well and all associated nut and bolts shall be galvanized. The terminals or bushings of Auto Recloser shall have laser cut markings indicating incomer side and load side. Means shall be provided to permit manual operation of the Auto Recloser through operating rod or built in extensible lever system from the ground level.

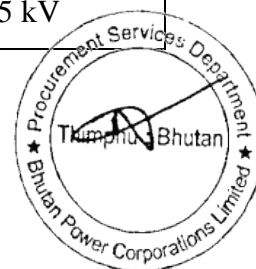
4. Bushing terminals

The material for bushing shall be outdoor Cycloaliphatic epoxy resin / hydrophobic Cycle aliphatic epoxy / HECP and preferred arrangement for connection to overhead conductor is using crimp lugs with holes. There shall be encapsulated CVTs for voltage measurement on bushings required for auto-reconfiguration of the network and CT for current measurement and protection. CT/current sensor shall be for each phase to measure phase currents and detect phase/earth faults. The CT ratio shall be -/1A (The minimum primary current shall be as per the rated continuous current). All components of the equipment shall be de-rated as per applicable international standards.

5. Lightning arrestors

Lightening arresters shall be mounted on the tank. Six numbers of lightening arrester, brackets for arresters, connecting cables, connectors and complete set of bolts, nuts, and washers shall be provided by the Supplier. The surge arresters shall be of the metal oxide, gapless, single pole type, suitable for outdoor use on a three-phase 50 Hz system and shall have the following parameters:

Parameters	33kV	11kV
Applicable standard	IS 3070, IEC 60099-4	
Rated Voltage (rms)	30 kV	9 kV
Nominal discharge current (kA)	10 kA	10 kA
MCOV	24.4 kV	7.65 kV



Maximum Residual Voltage for:		
Steep current impulse (1/20 micro sec.)	85 kV	26.5 kV
Lightning Impulse protection level (8/20 micro sec)	71.8 kV	21.7 kV
Switching impulse protection level (30/60 micro sec)	60 kV	18 kV
Type of housing insulator	Polymer with alternating sheds	
Moisture sealing system	Housing directly molded onto the arrester. Housing pressed on arrester with caps at the end not acceptable.	
Colour	Grey/Brown	

Note: Ground and line lead of the arrester is important. The lead voltage can contribute as much as the arrester protective level for long length. Therefore, arrester lead shall be as short and straight as possible.

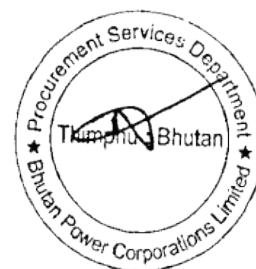
6. Switching Equipment

- 6.1 The pole mounted outdoor type ARCB shall have Current Transformer, Capacitive Voltage Transformer and vacuum interrupter contained in the outdoor circuit switching unit.
- 6.2 The current transformer shall be as per applicable international standards with appropriate ratio not lower than continuous rated current and 5P10 or better protection accuracy class. This shall be able to detect and record the lowest line current in a rural feeder at any instant of time. A capacitive voltage transformer meeting service requirements as per international standard shall be available to measure the voltage.
- 6.3 There shall be manual trip / close or lock options provided externally in the events of faults or line maintenance.
- 6.4 The ARCB shall be provided with position indicator, or other suitable means, which will clearly indicate the position OFF and ON and the indicator shall be visible from the ground.
- 6.5 Switching equipment shall be adequately sealed with ingress protection rating of IP 65 or better.
- 6.6 All accessories required for switching components shall be supplied



7. Control equipment

- 7.1 The pole mounted weather proof outdoor control cabinet for Auto Recloser shall be manufactured from 304 or better grade stainless steel and it should house battery, battery charger, switches, relay and other required communication equipment.
- 7.2 The control cabinet shall be connected to the Auto Recloser with multi-pin weatherproof connector using 10 meters long umbilical cable or equivalent or ultraviolet-resistant cable. It should be possible to disconnect the cable when recloser is connected to power system, without causing damage or malfunction.
- 7.3 Control cabinet shall be adequately sealed with ingress protection rating of IP65 or better.
- 7.4 The supplier shall ensure that the equipment housed in the control cabinet can withstand the heating effect of direct solar radiation without causing failure and/or malfunction.
- 7.5 Cabinet shall be with additional provision for bottom entry of three cables and all holes shall be pre-punched and suitably blanked off. There should be provision at bottom of cabinet for the connector cable to be connect to the switching unit.
- 7.6 The cabinet shall be designed to avoid hydrogen build-up inside the cabinet.
- 7.7 The door of the cabinet shall be fitted with a secure and robust locking arrangement and there should be minimum of two latching points. The door shall be removable for replacement at site and door stay shall be fitted to keep door open while operators are attending the unit.
- 7.8 There shall not have any sharp edges and there shall not be any danger of pinching or guillotining an operator's fingers or hands inside the cabinet.
- 7.9 All connections that could potentially expose the operator to dangerous voltages shall be shielded as per applicable standards. These connections shall include the terminals used for current transformers, primary power supply and voltage measurement inputs.
- 7.10 The controller, upon opening of panel's door, shall also have separate button for manual trip and close of the Auto Recloser from control panel.
- 7.11 The controller shall be equipped with standard size Liquid Crystal Display (LCD) as Human Machine Interface Unit (HMI) to access
- Close/open operation log
 - View configuration or setting
 - View event log and messages



- View, modify and change configuration or setting
- 7.12 There shall be toggle buttons available to select, move up, move down, move left, move right and exit. There shall also be local/remote selector button available with the controller.
- 7.13 The controller relay shall be of same make to that of the outdoor switching equipment.
- 7.14 The components inside the control panel shall be compact and well cabled.
- 7.15 The cabinet shall be easily removable for workshop repair purposes.
- 7.16 The cabinet shall be fitted with an external M10 earthing stud with a nut, lock nut and a serrated washer.
- 7.17 The connector between control cabinet and switching equipment (breaker) shall be detachable from both the ends.

8. Protection characteristics

8.1 General

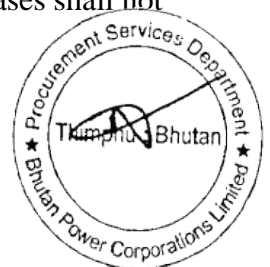
12.1.1 The ratio of drop-off current to pick-up current shall be at least 90% for all protection functions. The SEF function shall be equipped with harmonic filtering to prevent operation when harmonics are present in the primary residual earth currents. A low pass filter with 3rd harmonic rejection $> 28\text{dB}$ shall be supplied. Both the SEF function and its filter shall be described in the tender documentation. All protection functions, i.e. over-current (O/C), earth fault (E/F) and sensitive earth fault (SEF) shall have elements with characteristics that comply with IEC 60255.

8.1.2 The sequence of trip and auto-reclose characteristics for O/C, E/F and SEF shall be programmable to enable:

- the selection of any combination of the available elements for each trip in the trip-and-reclose sequence; and
- separate trip-and-reclose sequences for O/C, E/F and SEF with the same number of reclosing intervals for O/C and E/F.

8.1.3 Loss of Phase (LOP) protection shall be provided to ensure the protection functionality of ARCB as below:

- ARCB should trip with no auto-reclose if there is a loss of voltage on one or two phases on the upstream part of the line. Loss of supply on all three phases shall not generate the protection trip.



- Facility to turn LOP ON or OFF without affecting other protection functions of the device. Password or other form of access control shall be provided
- The parameters of configuration of LOP shall include the voltage level (phase to ground) and time of loss of supply on one or two phases. The voltage level shall be configurable from 5000 to 10000 Volts with steps not greater than 250 V. Time range shall be configurable from 1 to 60 sec with steps not greater than 1 sec.
- The information about LOP operation in case of the protection trip shall be recorded accordingly with indication of the phase(s) causing the trip of ARCB. The information about LOP operation shall be easily assessable.

8.1.4 Directional Blocking shall be provided to ensure the protection functionality of ARCB as specified below:

- ARCB and Control Element shall be capable to detect the direction of the fault current. Minimum time to determinate fault direction for O/C and E/F shall be not greater than 50 msec. For Sensitive Earth Fault (SEF) the time to determinate the fault direction shall not be greater than 1 sec.
- Configuration for Directional Blocking shall include the separate settings for Characteristic Angle for O/C and E/F elements. The range for setting of characteristic Angle shall be from -180 Deg to 180 Deg with the step not greater than 5 Deg.
- The Directional Blocking shall have the facilities to configure ARCB to trip or block for upstream and downstream faults. This shall be configured separately for O/C, E/F and SEF.
- The information about Directional Blocking operation in case of the protection trip shall be recorded accordingly in history.

8.1.5 The ARCB and Control element shall support multiple protection groups and this shall meet the requirements specified below:

- The ARCB shall have minimum 4 independent protection groups. The Protection Groups shall have clear indication and shall be marked as "I, II, III, IV" or "A, B, C, D"
- Each protection group shall have the facility to configure O/C, E/F and SEF trip current and specify the number of the protection trips independently from others.



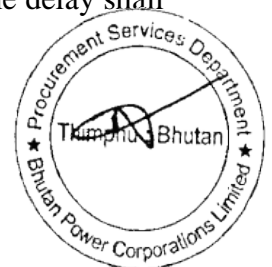
The protection functions and parameters used in one of the protection groups shall be available for use in any or all of the other protection groups.

- Changes to any of the protection parameter to any of the not active protection group shall not affect the protection functionality of the active protection group.
- Information about activation of any of the protection group shall be recorded in history and shall be easily assessable. Information about protection trip shall clearly indicate the protection group, active at the time of fault.
- ARCB and Control element shall have the facility for Automatic protection group selection. Automatic Protection Group Selection shall have the facility to be turned ON or OFF with password protection or other form of access control.

8.2 Over-current function

8.2.1 Delayed protection operation shall be possible by selecting an IDMT protection element with definite time (DT), standard inverse (SI), very inverse (VI), extremely inverse (EI) or long time inverse (LTE) curves. Provision shall also be made for customised protection curves. Both the process and software tools required creating these protection curves should be described in the tender documentation. The over-current pick-up setting range shall be selectable from 5 A to 1250 A in the steps not greater than 5 A. Rapid protection operation shall be possible by selecting a fast curve or instantaneous protection element. Co-ordination of the fast curves or instantaneous protection elements between two devices in series shall be possible either by selecting suitable curves from a family or by addition of a selectable time increment, typically 0.05s to 3s, in 0.01s steps, or any other acceptable solution. Long protection operating times associated with fault levels marginally above the pick-up setting of the IDMT protection element shall be avoided by the provision of a Low Set Definite Time element with the following features:

- it shall be possible to enable or disable the element. When enabled it shall be active simultaneously as an overlay with all selected elements;
- the element shall have the same pick-up current setting as the IDMT element; and
- the time delay shall be selectable from 2s to 10s, in 1s steps. The time delay shall be independent of any curve manipulation.



8.2.2 A High Set Instantaneous element with a selectable time delay shall be provided, with the following features:

- it shall be possible to enable or disable the element. When enabled it shall be active simultaneously as an overlay with all selected elements;
- circuit-breaker lock-out as a result of an operation due to the High Set Instantaneous element shall be selectable;
- the pick-up setting range of this element shall be at least 100% to 1500% of the over-current setting and shall be independent of any curve manipulation; and
- the time delay shall be selectable from instantaneous to 0s to 10s, in 0.01s steps. The time delay shall be independent of any curve manipulation.

8.2.3 A cold load pick-up (CLP) feature shall be provided that allows user selectable modification of protection element characteristics under conditions of system power restoration. The CLP function may be provided in one of the following two ways:

- The instantaneous O/C element and the Low Set Definite Time O/C element could be blocked for the CLP time duration; and
- The pick-up current setting of the IDMT O/C element and the Low Set Definite Time O/C element may be modified with a settable factor to increase the pick-up current of these elements for the CLP duration. The instantaneous O/C element should be blocked for this time. This is the preferred method.

8.2.4 The CLP function shall have the following characteristics:

- the CLP function shall not in any way interfere with any of the other functions'/elements' pick-up current settings except as mentioned above;
- the CLP functionality shall be such that the active duration of the CLP is selectable from 0 min to 200 min in 1 min steps; and
- the modification factor should be settable from 1 to 5 in steps of 0.1.

8.2.5 The Time Multiplier for all IDMT protection element shall be selectable from 0.01 to 2 in steps of 0.01.

8.3 Earth fault function

8.3.1 The earth fault setting range shall detect primary earth fault currents down to 20A.



8.3.2 Delayed protection operation shall be possible by selecting an IDMT element with SI, VI, EI or LTI curve, or a definite time protection element with time delay from 0s to 10s in 0.01s steps. Rapid protection operation shall be possible by selecting a fast curve or instantaneous protection element. Co-ordination of the fast curves or instantaneous protection elements between two devices in series shall be possible either by selecting suitable curves from a family or by addition of a selectable time increment, typically 0.01s to 3s, in 0.01s steps, or any other acceptable solution. A High Set Instantaneous element with a selectable time delay shall be provided with the following features:

- it shall be possible to enable or disable the element. When enabled it shall be active simultaneously as an overlay with all selected elements;
- circuit-breaker lockout as a result of an operation due to the High Set Instantaneous element shall be selectable;
- the pick-up setting range of this element shall be at least 100% to 1500% of the earth fault setting and shall be independent of any curve manipulation; and
- the time delay shall be selectable from 0.01s to 10s, in 0.01s steps. The time delay shall be independent of any curve manipulation.

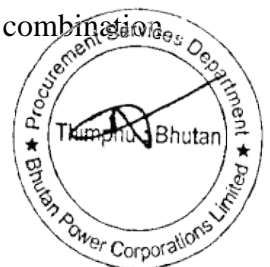
8.3.3 The Time Multiplier for all IDMT protection elements shall be selectable from 0.01 to 2 in steps of 0.01.

11.4 Sensitive earth fault (SEF) function

A primary earth fault current of 4A to 20A in steps not exceeding 1A shall be detectable. Delayed protection operation shall be possible by selecting a definite time protection element with time delay from 3s to 25s, in 1s steps.

11.5 Auto-reclose operation parameters

- The number of sequential trips to reach lockout shall be selectable to be 1, 2, 3 or 4.
- Reset times shall ideally be separately selectable for SEF and the combination of over-current and earth fault functions. The reset time shall be selectable from 5s to 120s in 1s steps. Dead times shall ideally be selectable for SEF and the combination



of over-current and earth fault functions. The dead time between each successive recloser shall be independently selectable from instantaneous to 5s for the first recloser and from a minimum of 2s up to a maximum of 120s for subsequent reclosers. A close instruction initiated locally or remotely during a dead time shall result in lockout if the fault is still present upon closure.

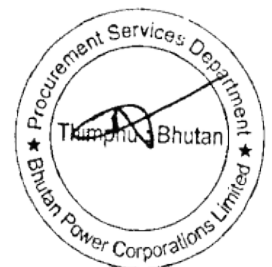
11.6 Over/Under frequency protection

The over frequency protection function shall detect frequencies above the normal system frequency. An over frequency trip setting up to 5Hz, in steps of 0.1Hz, above the system frequency shall be detectable. The number of continuous cycles at and above the Over Frequency threshold before a trip will occur must be selectable from 2 to 1000 cycles. Under frequency protection settings shall be separate to the over frequency setting. The setting range down to 5Hz, in steps of 0.1Hz, below the system frequency shall be provided. The number of continuous cycles at and below the Under Frequency threshold before a trip will occur must be selectable from 2 to 1000 cycles. It shall be possible to separately enable / disable the Over and Under Frequency protection functions. An Auto close function shall be provided to enable the ARCB to close once the frequency returns to normal.

11.7 Over/under voltage protection

The over voltage protection function shall detect voltages above the normal system voltage. An over voltage trip setting of 100% up to 150%, in steps of 1%, above the nominal system voltage shall be detectable. The time delay at and above the Over voltage threshold before a trip will occur must be selectable from 0s to 60s, in steps of 0.1s. Under voltage protection settings shall be separate to the over voltage setting. The setting range of 50% to 100%, in steps of 1%, below the nominal system voltage shall be provided. The time delay at and below the under voltage threshold before a trip will occur must be selectable from 0s to 60s, in steps of 0.1s. It shall be possible to separately enable / disable the Over and Under Voltage protection functions. An Auto close function shall be provided to enable the ARCB to close once the voltage returns to normal.

9. Auto Recloser Measurement characteristics



9.1 Measurement of following parameters shall be done either by three phase 3 wire method or three phase 4 wire method

Sl. No.	Measurement values
1	Phase Voltage
2	Line Voltage
3	Phase Current
4	Frequency
5	Active power (kW)
6	Apparent Power (kVA)
7	Reactive power (kVAR)
8	Power Factor
9	Energy (kwh)
10	Daily Peak Load

9.2 The real power energy and maximum demand measurement shall be integrated with respect to time. Energy values shall be calculated with selectable time integration periods of 5 min, 15 min, 30 min or 60 min. The data buffer shall work on the FIFO principle and a minimum size for the data buffer shall store values for 4 months on the 30 minutes' integration period.

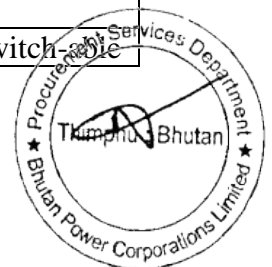
9.3 Auto recloser and Control element shall have the facilities to record the cumulative number and duration of outages. The information shall be assessable locally or remotely using a SCADA system. The following parameters shall be recorded:

- Cumulative total number of outages;
- Cumulative total outage duration; and
- Time and duration of each outage in the form of an event log.

10. Local control and indication

1. The local control and indication shall be as given below (minimum specification of local controls and indications)

1 - Item	2 - Features	3 - Remarks
Local control	Local/Remote	2 position key switch



Technical Specification Lot 1 (ARCB)

	Circuit-breaker open Circuit-breaker close AR ON/OFF SEF ON/OFF Protection ON/OFF Earth protection ON/OFF	(See note 1, 2 & 3) Secure control Secure control Secure or Toggled control Secure or Toggled control
Local indication	Local/Remote	(See note 1, 2 & 3)
	Circuit-breaker open Circuit-breaker closed Circuit-breaker lockout AR ON/OFF SEF ON/OFF Protection ON/OFF Earth protection ON/OFF	
	Protection operation	
	Controller not healthy	(See Note 1, 2&3)
	AC fail	
	DC fail	
Local Analog indication (See note 1, 2 & 3)	<ul style="list-style-type: none"> • r.m.s. phase-to-phase and phase to ground voltage of all three phases • r.m.s current per phase • three-phase active power in kW three-phase reactive power in kVARs • total three-phase active energy in kWh • Power factor • Maximum demand 	

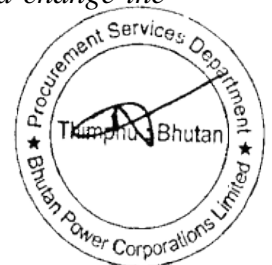
Notes (preferable)

Note 1: The local control and the local indication features on the control panel shall be labeled as presented in column 2, where applicable. The type of switch used for local control shall not allow for a conflict to exist between the switch position and the function status.

Note 2: The 'Controller not healthy' indication shall indicate the control equipment not healthy (watchdog) function operated. It shall not operate during the normal pole-mounted switch operating cycle. This indication should remain active until the unhealthy state that initiated it returns to normal.

Note 3: The two-position switch (labeled as below) shall allow the ARCB controller to be set in the following modes:

Remote: In this mode a local operator can trip the ARCB and change the mode. A remote operator can trip or close the ARCB.



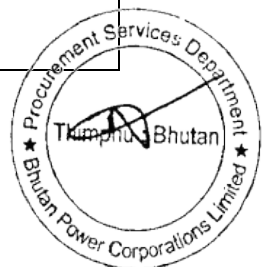
Local: In this mode a local operator can trip and close the ARCB. A remote operator can only trip the ARCB.

2. All local controls and indications shall be accessible in adverse weather condition. The ARCB shall be provided with external levers to permit manual operation, using an insulated operating stick, to open, close, lock-out and reset the ARCB from ground level. Where these operations can be performed at the control cabinet, it shall only be necessary to provide a mechanical means to open and lockout the circuit breaker using an insulated operating stick. The ARCB status shall be clearly visible from ground level. "Opened" shall be indicated with a green "O". A red "I" shall indicate "Closed". Alternative indications shall be subject to approval by the purchaser. Pressure relief facilities shall be provided to enable the ARCB to withstand safely the effects of excessive pressure rise due to an internal fault. Malfunction of the ARCB shall not pose a safety hazard to the operator due to the recoil or backlash of items such as external operating rods, cranks and levers.

11.Remote control and indication

1. Minimum specification of remote controls and indications shall be as follows:

Item	Features	Remarks
Remote control	Circuit-breaker open Circuit-breaker close AR ON / OFF SEF ON / OFF Protection ON/OFF Earth protection ON/OFF	Secure control Secure control Secure or Toggled control Secure or Toggled control
Remote indication	Local/Remote Circuit-breaker open Circuit-breaker closed AR lock-out AR ON / OFF SEF ON / OFF IDMT O/C Trip Low Set DTL O/C Trip Rapid O/C Trip High Set O/C Trip IDMT E/F Trip Rapid E/F Trip	(See Note 4, 5&6)



	High Set E/F Trip SEF Trip AR Controller not healthy A.C. fail D.C. fail	
Analog indication	<ul style="list-style-type: none"> • r.m.s. phase-to-phase and phase to ground voltage of all three phases • r.m.s current per phase • three-phase active power in kW • three-phase reactive power in kvars total three-phase active energy in kWh • Power factor • Maximum demand 	

Notes (Preferable)

Note 4: The 'Controller not healthy' indication shall indicate the control equipment not healthy (watchdog) function operated. It shall not operate during the normal pole-mounted switch operating cycle. This indication should remain active until the unhealthy state that initiated it returns to normal.

Note 5: The two-position switch (labeled as below) shall allow the ARCB controller to be set in the following modes:

Remote: In this mode a local operator can trip the ARCB and change the mode. A remote operator can trip or close the ARCB.

Local: In this mode a local operator can trip and close the ARCB. A remote operator can only trip the ARCB.

Note 6: The ARCB indication shall give an alarm with any ARCB attempt.

2. The switchgear should be configurable for remote monitoring and control using specified communication protocols through specified ports. The device in the field should be able to automatically dial in to the monitoring computer and report the abnormal conditions. Similarly, user should be able to dial to the switchgear/control panel and make necessary setting changes. There should be a provision to supply power to modem/FRTU/RTU.

12. Local engineering

1. The ARCB controller shall contain a clock (with leap year support) that can be set both locally and remotely. The accuracy of the clock shall be stated in the tender

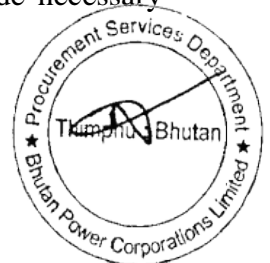


documentation. A facility for selecting all the protection, operating and communications characteristics shall be locally available in the control cabinet. Optional password protection against unauthorized changes shall be available.

2. Non-volatile memory storage shall be sized to store the following minimum data:
 - a. All operating, protection and communications parameters.
 - b. An event record containing at least 3000 events (a protection event is defined as all operations in a sequence until successful sequence reset or lockout).
3. Maximum demand information shall have the facilities to be configured for weekly and/or monthly demand. A pointer shall be provided to indicate up to where the data was last read. This will enable regular uploading of the data without re-loading of previously read data. All events shall be time and date stamped with a resolution of at least 10ms relative to the on board clock.

13. Software

- 13.1 It shall be possible to download data stored in control unit and configure the ARCB settings using a portable computer locally or remotely. Local interfacing should be via USB port.
- 13.2 Computer software compatible with Windows 10 or later to upload and download settings, to provide history information (event data logs, load profile, etc.), to display breaker contact erosion data etc., shall be supplied. The software shall be capable of connecting to control system locally or remotely via communication system. The protocol for data transfer shall be in accordance with telecommunication clauses.
- 13.3 The software shall have the facility to install on any computer without separate license and records the even history to get the information of the access user. The software should have separate authority level for:
 - Programming, operating and Monitoring
 - Operating and Monitoring
 - Monitoring
- 13.4 The offered software should be backward-compatible with the previous version. A copy of the manual of the software shall accompany the bid. Required set of interface cables shall be provided with every unit.
- 13.5 The downloaded data shall be stored in a suitable fool proof database. The data shall be able to be extracted as a delimited text format or MS Excel format.
- 13.6 Software shall be valid or provided with necessary keys and upgrades for at least the full life span of the equipment. The manufacturer/supplier shall provide necessary



support throughout this period. The software should facilitate remote data downloading individually from each equipment.

14. Telemetry and Telecommunications

1. As a minimum, two independent serial communication ports (up to 9600 bauds per seconds), one TCP/IP (10/100 mbps) port and a USB port that allow for simultaneous operation shall be provided. These are to be used as follows-

- To upload the non-volatile data to and from a mobile workstation.
- To interface to remote communications equipment (e.g. modems, radio-modems).
- To be used for a mobile workstation from reputed brands (Dell/Apple/HP) and workstation with following description shall be supplied for configuration of recloser:

Processor: 11th Generation Intel® Core™ i7-1185G7 (4 core, 12M cache, base 3.0GHz, up to 4.8GHz, vPro)

Operating system: Windows 10 Pro English, French, Spanish.

Graphics Card: Intel® Iris®Xe graphics for Intel® i7-1185G7 (vPro®) processor with 32 GB memory.

Memory: 32 GB, 4266MHz, LPDDR4x, Non-ECC.

Hard Drive: M.2 1TB PCIe NVMe Class 35 Solid State Drive.

Display: Laptop, 15.0" UHD16:9(3840 x 2160) Non-T, AG, IR Cam + P-Sensor, Shutter, Mic, SLP, Cmft view+(500 Nits).

Primary Battery: 88 WHr Polymer, Express Charge capable

AC Adapter: 90W Type-C Epeat Adapter

Essential accessories: Dell USB-C mobile adapter – DA310, Dell Premier Backpack 15 – PE1520P, Dell Premier Rechargeable Wireless Mouse – MS7421W.

2. The ARCB controller shall be capable to communicate to remote SCADA control center using the specified ports.



3. The protocol to be supported by the ARCB controller for remote communications shall be of:
 - IEC 60870-5-104 Protocol using TCP/IP port
4. An inbuilt/modular-hot pluggable DC powered cellular modem shall be provided with the recloser. It shall work fully in GSM/GPRS/3G/4G-LTE technologies and have full backward compatibility in all technologies. It shall work fully in all mobile communications of both the Bhutanese operators (Bhutan Telecom and TashiCell). This modem shall be the means of communication between control center and recloser of BPC's private RF network isn't deployed in the recloser location. Full details and technical brochure including operating bands details on the cellular modem shall be provided along with the proposed recloser equipment.



TECHNICAL SPECIFICATION FOR LOT 2 (SECTIONALIZER)



1. SCOPE

This specification covers the design, manufacturing, testing, supply and delivery of SCADA compatible Sectionalizer or Load Break Switch (LBS) with sectionalizing feature suitable for 3-phase 11kV and 33kV distribution system of Bhutan Power Corporation Limited (BPC).

Note: LBS in this document shall refer to Load Break Switch with sectionalizing feature.

2. APPLICABLE STANDARDS

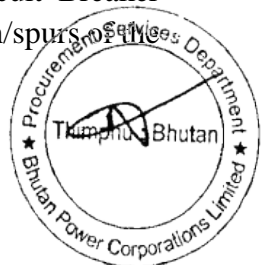
Unless otherwise specified elsewhere in this specification, the performance and testing of the Sectionalizer/LBS shall conform to the following International Standards and they are to be read with up to-date and latest amendments/revisions, thereof:

Sl. #	Standard No.	Title
1	ANSI / IEEE C37.63	Requirements for Overhead, Pad-Mounted, Dry Vault, and Submersible Automatic Sectionalizer
2	IEC 62271 – 200	AC Metal-enclosed switchgear and control gear for rated voltages above 1kV and up to and including 52kV
3	IEC 60255	Electrical Relay standards
4	IEC 60529	Degree of protection provided by enclosures
5	IEC 61000-4-2	Electrostatic Discharge standard
6	IEC 61000-4-3	Radiated electromagnetic field
7	IEC 61000-4-4	Electrical fast transient/burst immunity test
8	IEC 61000-4-5	Surge immunity
9	IEC 61000-4-6	Immunity to Conducted Disturbances
10	IEC 61000-4-8	Power Frequency Magnetic Field
11	IEC 61000-4-11	Voltage dips, short interruptions and voltage variations immunity tests
12	IEC 61000-4-16	Conducted common mode disturbances
13	IEC 61000-4-18	Damped oscillatory wave
14	IEC 68-2-6	Vibration in three axes

3. DESIGN AND TECHNICAL REQUIREMENTS

3.1 Functionality

The Sectionalizer/LBS will be installed in the downstream of Autorecloser Circuit Breaker (ARCB) to protect the distribution lines by isolating (sectionalizing) the faulty section/spurs line in coordination with upstream ARCB.



The Sectionalizer/LBS will be in normally closed position and will only open during the dead time of the specified count of the reclosing sequence upon detection of downstream overcurrent or earth fault.

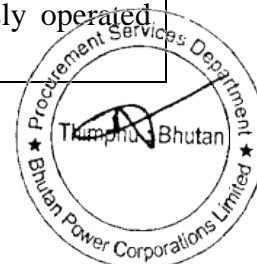
However, the Sectionalizer/LBS shall also be used as a load break switch (LBS) for manual switching operations of the power lines. In such application, the automatic sectionalizing functionality should be disabled.

3.2 Design Criteria

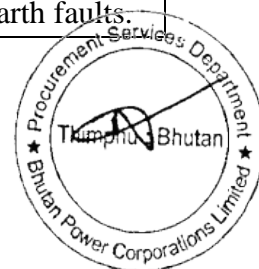
The Sectionalizer/LBS shall have rated characteristics and design features as detailed in Table 1 and be able to operate with minimum maintenance and suit the conditions as stated under site conditions (Clause 1.6, Common Technical Requirement).

Table 1: Sectionalizer/LBS Design Criteria

	33kV	11kV
Continuous Carrying Capacity		
Rated Continuous Voltage, kV	33	11
Maximum Continuous voltage, kV	36	12
Frequency, Hz	50	
Minimum rated continuous current, A	300	
Minimum Short Circuit		
Breaking current, A	300	
Short Time Withstand Current (1 Sec), kA	12.5	
Short Circuit Making Current, kA (peak)	31.5	
Insulation Level		
Rated Impulse withstand Voltage (kV)	170	75
Rated Power Frequency withstand Voltage (kV)	70	28
Insulator Creepage Distance	Altitude corrected upto 3000 meter above sea level	
Sectionalizer/LBS Design		
Insulation Medium	Cycloaliphatic epoxy resin/ hydrophobic Cycloaliphatic epoxy	
Operating Chamber	The Sectionalizer/LBS shall have self-contained switching chamber for each phase including operating mechanism	
Interruption Medium	Vacuum	
Operating Mechanism	All three poles shall be simultaneously operated through magnetic actuator mechanism.	



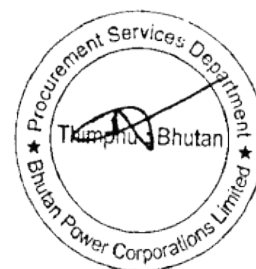
Instrument Transformers/Sensors	
Current Transformer (CT)/Current Sensor	CT/current sensor shall be for each phase to measure phase currents and detect phase/earth faults.
Voltage Transformer (VT)/Voltage sensor	PT/Voltage sensor shall be each phase on both load side and source side to measure and enable fault detection.
Ratio	CT: - /1 A, (The minimum primary current shall be as per the rated continuous current.)
Minimum Accuracy	CT: 5P10 VT: $\pm 1\%$
Opening/Closing/Locking/Tripping	
Sectionalizing	<p>Sectionalizer/LBS shall trip during the dead time of the specified count of reclosing sequence upon detection of downstream overcurrent or earth fault.</p> <p>Sectionalizer/LBS shall be able to be closed onto fault during fault restoration operation via local or remote control</p>
Load Breaking	<p>Sectionalizer/LBS shall be able to perform on-load opening and closing via local or remote control. Automatic sectionalizing functionality shall be disabled during this operation.</p>
Manual Locking/Unlocking	<p>Manual locking/unlocking facility by means of a liver mechanism operated using operating rod from ground level. In lock position all operations shall be disabled and Sectionalizer/LBS shall be in open position.</p> <p>Lock and Unlock position shall be clearly visible from the ground even during adverse weather condition.</p>
Fault Detection and Sectionalizing	
Fault Detection	The Sectionalizer/LBS shall be able to detect downstream phase and earth faults based on the minimum actuating current level set by the user. Upon fault detection, shall trip during the dead time of the specified count of reclosing sequence.
Minimum actuating current	User shall be able to set values for minimum actuating current levels for phase and earth faults.



Interruption Count and Reset	Sectionalizer/LBS shall record number of counts of ARCB close-open operations. User shall be able to set the values for 'counts to open.' Count reset should be available and it shall be possible to set the count reset time by the user.
Communication Features	
Communication Interface features	Local: Serial/TCP/IP and USB port
	Remote: TCP/IP
Communication Protocols	IEC 60870-5-104 Protocol using TCP/IP

3.3 Design and Construction

- 3.3.1 Three phase Sectionalizer/LBS shall be provided as a single unit with solid insulation Cycloaliphatic epoxy resin/ hydrophobic Cycloaliphatic epoxy / HECP bushings with integrated Vacuum Interrupter, integrated instrument transformers/sensors and stainless steel base tank housing operating mechanism, complete with stainless steel Control Cubicle and all other components and cables necessary for installation and operation.
- 3.3.2 All three poles of the Sectionalizer/LBS shall be operated simultaneously via magnetic actuator mechanism.
- 3.3.3 Sectionalizer/LBS lockout shall be clearly indicated with Open/Close positions. "Opened" shall be indicated with a green "O". A red "I" shall indicate "Closed". This indicator shall be light reflecting so that the position of the switch can be clearly seen from the ground level even under bad weather conditions. It shall be possible to manually open the Sectionalizer/LBS which will trip the same to Lockout position and disable sectionalizing sequence until it is closed again. Provision shall be made to achieve the manual tripping by pressing a trip button on the control panel or by a manual control lever or by a remote operator via modem interface.
- 3.3.4 Mechanical and electrical endurance of Sectionalizer/LBS shall be minimum of 10,000 operations. Sectionalizer/LBS operations shall be recorded by a mechanical or electrical counter which can be accessed in the field via control panel display unit and field computer using the associated computer software package.
- 3.3.5 All non-metal parts including insulating materials of cables shall be able to withstand effects due to ultra violet radiation.
- 3.3.6 The Sectionalizers/LBS shall be suitable for mounting on existing poles of the distribution network and suitable pole mounting steel frame shall be provided with lifting tackle.
- 3.3.7 The Sectionalizers/LBS shall have laser cut markings indicating source side and load side.



- 3.3.8 Earthing terminal suitable to accommodate two Nos. 5 mm diameter to 15 mm diameter earthing conductors shall be provided for bounding the Sectionalizer/LBS base tank, mounting frame and LA earth terminals to the local earthing electrodes.

3.4 Vacuum Interrupters

The vacuum interrupters shall be of a reputed make with proven track record. The interrupters shall be of proven and tested design that provide high fault-interrupting capacity, fast low energy arc interruption, minimum and even contact wear, and minimum heat generation.

Number of full load interruptions, rated fault closing operations that could be performed by the interrupter during its life span shall be furnished. Remaining percentage contact wear shall be recorded in the Sectionalizer/LBS and shall indicate in the control panel.

3.5 Operating Mechanism

The Sectionalizer/LBS operating mechanism shall be 3-phase gang operated. It shall consist of a bi-stable magnetic actuator capable of fast opening and closing operations with no recharging delay. Bi-stable refers to that no operating power is required to hold the unit open or closed. Close and trip capacitors shall be used to store the necessary energy for operating the magnetic actuator. The magnetic actuators shall be of reputed make with proven track record.

3.6 Insulation

Sectionalizer/LBS bushing shall use Cycloaliphatic epoxy resin / hydrophobic Cycle aliphatic epoxy / HECP as the dielectric insulating medium and be highly resistant to ozone, oxygen, moisture, contamination and ultraviolet light. No coatings or UV protective covers will be accepted. It shall provide high resistance to damage. The hydrophobic cycloaliphatic epoxy shall provide complete encapsulation of the internal interrupter. The encapsulation shall also be completely bonded to the source and load side busing terminals. The creepage distance of bushing shall altitude corrected to minimum altitude level as mentioned in Site Conditions clause under Common Technical Requirement.

3.7 Surge Arrester

Surge Arrester shall be supplied for each phase for both source side and load side of Sectionalizer/LBS with the provision to mount on the tank. Brackets for Surge Arrester, connecting cables, connectors and complete set of bolts, nuts, and washers etc., shall be supplied.



The Surge Arrester shall be of the metal oxide, gapless, single pole type, suitable for outdoor use on a three-phase 50 Hz system and shall have the following parameters:

Parameters	33kV	11kV
Applicable standard	IS 3070, IEC 60099-4	
Rated Voltage (RMS), kV	30	9
Nominal discharge current, kA	10	
MCOV, kV	24.4	7.65
Maximum Residual Voltage for:		
Steep current impulse (1/20 micro sec.), kV	85	26.5
Lightning Impulse protection level (8/20 micro sec), kV	71.8	21.7
Switching impulse protection level (30/60 micro sec), kV	60	18
Type of housing insulator	Polymer with alternating sheds	
Moisture sealing system	Housing directly molded onto the arrester. Housing pressed on arrester with caps at the end will not be accepted.	
Colour	Grey/Brown	

Note: Ground and line lead of the arrester is important. The lead voltage can contribute as much as the arrester protective level for long length. Therefore, arrester lead shall be as short and straight as possible.

3.8 Fault Detection and Sectionalizing

- 3.8.1 The Sectionalizer/LBS shall be able to detect downstream phase and earth overcurrent faults based on the minimum actuating-current levels set by the user. Upon fault detection, shall trip during the dead time of the specified count of reclosing sequence.
- 3.8.2 The Sectionalizer/LBS shall not operate when the phase or earth overcurrent fault are not present before the count of reclosing sequence but rather shall assume loss of supply to be caused by the ARCB in response to source-side overcurrent fault.
- 3.8.3 User shall be able to set values for minimum actuating current levels for phase and earth faults.
The minimum actuating current for overcurrent and earth fault shall be 100 A and 10 A respectively.
- 3.8.4 Sectionalizer/LBS shall record numbers of counts of ARCB close-open operations. User shall be able to set the value for 'counts to trip' from 1 to 4. Count reset should be available and it shall be possible to set the count reset time by the user.



- 3.8.5 The 'counts to trip' count shall reset to zero if reclosing sequence count expires before the counter reaches the set value. The reset time shall be programmable from 5 sec to 120 sec in steps of 1.
- 3.8.6 The successful bidder shall establish settings for Sectionalizer/LBS in order to ensure proper coordination with upstream ARCB and other sectionalizing devices installed in the line.

3.9 Control Cabinet

- 3.9.1 The Sectionalizer/LBS shall be supplied with Control Cabinet manufactured from 304 or better stainless steel with an integrated microprocessor based control system incorporating all control and fault detection features specified in this specification.
- 3.9.2 The control cabinet shall have the provision to house a modem or a similar communication equipment for remote operation from a control center to achieve Distribution Automation.
- 3.9.3 Control cabinet shall have a display panel with backlit LCD and keypad to provide navigation. Navigation keys shall be able to disable with password protection. Navigation menus should be presented in easily understandable test for the operators. Basic configurations (detection settings, operating, clock with leap year support, and communication characteristics, etc., as stated in this document) shall be carried out using navigation keys and LCD display. It shall be possible to read instantaneous current, voltage and system logs values through LCD display.
The following minimum feature shall be available in the display panel besides the navigation keys:

1 - Item	2 - Features	3 - Remarks
Local control	Local/Remote	2 position key switch-able
	Sectionalizer/LSB Open	(See note 1, 2 & 3)
	Sectionalizer/LBS Close	Secure control
	Sectionalizer/LBS Lockout Battery Test	
Local indication	Local/Remote	(See note 1, 2 & 3)
	Sectionalizer/LBS Open	
	Sectionalizer/LBS Closed	
	Sectionalizer/LBS Lockout	
	Controller not healthy	(See Note 1, 2&3)
	AC Fail	
	Battery Fail	

Notes (preferable)



Note 1: The local control and the local indication features on the control panel shall be labeled as presented in column 2, where applicable. The type of switch used for local control shall not allow for a conflict to exist between the switch position and the function status.

Note 2: The 'Controller not healthy' indication shall indicate the control equipment not healthy (watchdog) function operated. It shall not operate during the normal pole-mounted switch operating cycle. This indication should remain active until the unhealthy state that initiated it returns to normal.

Note 3: The two-position switch (labeled as below) shall allow the Sectionalizer/LBS controller to be set in the following modes:

Remote: In this mode a local operator can trip the Sectionalizer/LBS and change the mode. A remote operator can trip or close the Sectionalizer/LBS.

Local: In this mode a local operator can trip and close the Sectionalizer/LBS. A remote operator can only trip the Sectionalizer/LBS.

3.9.4 Non-volatile memory storage shall be sized to store the following minimum data:

- a. All operating, detection, and communication parameters
- b. An event record containing at least 3000 events (a detection event is referred as all operations in a sequence until successful sequence reset or lockout)

3.9.5 The control cabinet shall be provided with auxiliary power supply, battery system and battery charging system as specified in clause 1.9 (a), Common Technical Requirements.

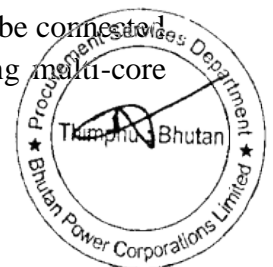
3.9.6 The enclosure of the control cabinet shall have IP65 or higher rating. Cabinet shall be designed for the specified service conditions, adequately ventilated and fitted with substantial door securing devices capable of ensuring entry by only authorized personnel. Cabinet shall be adequately sealed and dust protected and shall be internally treated to prevent moisture condensation.

3.9.7 The door of the cabinet shall be fitted with a secure and robust locking arrangement and there should be minimum of two latching points. The door shall be removable for replacement at site and door stay shall be fitted to keep door open while operators are attending the unit.

3.9.8 The equipment housed in the control cabinet shall withstand the heating effect of direct solar radiation without causing failure and/or mal-operation.

3.9.9 The cabinet shall make provision for bottom entry of at least two additional cables. The cabinet shall be pre-punched with at least one 21 mm and one 32 mm hole. The holes shall be suitably blanked off. The cabinet shall be fitted with an external M12 earthing stud, with a nut, lock nut, and a serrated washer.

3.9.10 The control cabinet shall be mounted below Sectionalizer/LBS and shall be connected to the Sectionalizer/LBS switchgear by a minimum of seven meter long multi-core



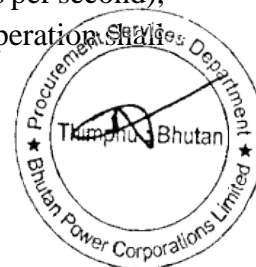
control cable. The multi-core cable shall be ultra violet stabilized and adequately screened against electromagnetic interference, which can cause malfunctioning of the protection or control cabinet. This cable shall connect to both the Sectionalizer/LBS and the control cabinet by means of plug and socket arrangements. Entry of the cable into the control cubicle shall be from the bottom.

3.10 Software

- 3.10.1 It shall be possible to download data stored in control unit and configure the Sectionalizer/LBS settings using a portable computer locally or remotely. Local interfacing should be via USB port.
- 3.10.2 Computer software compatible with Windows 10 or later to upload and download settings, to provide history information (event data logs, load profile, etc.), to display breaker contact erosion data etc., shall be supplied. The software shall be capable of connecting to control system locally or remotely via communication system. The protocol for data transfer shall be in accordance with telemetry and telecommunication clauses.
- 3.10.3 The software shall have the facility to install on any computer without separate license and records the even history to get the information of the access user. The software should have separate authority level for:
 - Programming, operating and Monitoring
 - Operating and Monitoring
 - Monitoring
- 3.10.4 The offered software should be backward-compatible with the previous version. A copy of the manual of the software shall accompany the bid. Required set of interface cables shall be provided with every unit.
- 3.10.5 The downloaded data shall be stored in a suitable fool proof database. The data shall be able to be extracted as a delimited text format or MS Excel format.
- 3.10.6 Software shall be valid or provided with necessary keys and upgrades for at least the full life span of the equipment. The manufacturer/supplier shall provide necessary support throughout this period. The software should facilitate remote data downloading individually from each equipment.

4. TELEMETRY AND TELECOMMUNICATIONS

- 4.1 The Sectionalizer shall have the facility to monitor and control remotely from control station and shall have the provision for incorporating Remote Terminal Unit (RTU) with controller.
- 4.2 As a minimum, two independent serial communication ports (up to 9600 bauds per second), one TCP/IP (10/100 mbps) port and a USB port that allow for simultaneous operation shall be provided. These are to be used as follows-



- a. To upload the non-volatile data to and from a mobile workstation.
 - b. To interface to remote communications equipment (e.g. modems, radio-modems).
- 4.3** Any software required for mobile workstation to configure the sectionalizer locally shall be supplied free of cost along with the sectionalizer.
- 4.4** The sectionalizer controller shall be capable to communicate to remote SCADA control center using the specified ports.
- o The protocol to be supported by the sectionalizer controller for remote communications shall be one of IEC 60870-5-104 Protocol using TCP/IP port.
- 4.5** An inbuilt/modular-hot pluggable cellular modem shall be provided with the sectionalizer. It shall work fully on GSM/GPRS/3G/4G-LTE technologies and have full backward compatibility in all technologies. It shall work fully in all mobile communication bands of both the Bhutanese telecom operators (Bhutan Telecom and Tashi Cell). This modem shall be the means of communication between control center and the sectionalizer if BPC's private RF network isn't deployed in the sectionalizer location.
- Full details and technical brochure including operating bands details of the cellular modem shall be provided along with the proposed sectionalizer equipment.**
- 4.6** Details of remote communications facilities and interfaces shall be listed in the tender documentation.

