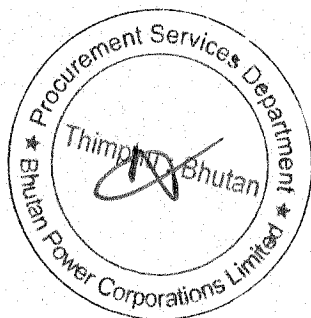


# **TECHNICAL SPECIFICATIONS**

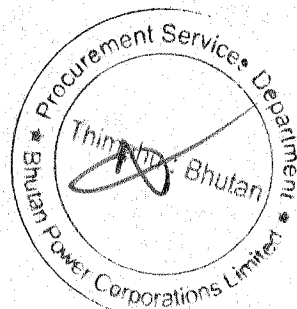
## **Lot 6: FAULT PASSAGE INDICATOR**

### **COMMUNICABLE FAULT PASSAGE INDICATION SYSTEM FOR OVERHEAD 33KV AND 11KV NETWORKS**



## Table of Contents

1. Scope.....	3
2. Quality Insurance.....	3
3. Applicable standards.....	4
4. Testing.....	5
<b>4.1 Routine test</b> .....	5
<b>4.2 Type test</b> .....	5
5. General information.....	5
<b>5.1 System parameters</b> .....	5
<b>5.2 Environmental conditions</b> .....	6
<b>5.3 Service conditions</b> .....	6
<b>5.4 Purpose of equipment</b> .....	<b>Error! Bookmark not defined.</b>
6. Constitution.....	7
7. Fault Passage Indicator.....	7
8. Communication Features.....	8
12. Interface enclosure.....	10
13. Operational specifications.....	11
<b>13.1 Fault detection:</b> .....	11
13.2 Detection of voltage presence and absence.....	13
13.3 Event time-stamping.....	13
14. Configuration and maintenance.....	13
15. Additional requirements.....	14
16. Deviation.....	14
17. Inspection.....	14
18. Training.....	15
19. Packing and Transportation.....	15
<b>20. Delivery</b> .....	<b>16</b>
21. Submittals.....	16



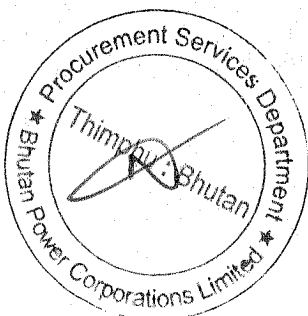
## 1. Scope

- 1.1 This specification for design, manufacture, testing, supply and delivery of communicable fault passage indicator with communication interface with all accessories.
- 1.2 The communicable fault passage indication system applies to a system allowing to remotely monitor appearance of faults on an overhead medium voltage network in order to localize faulty sections and reconfigure the network accordingly. The system shall be made of Faultdetection systems with wireless communication to be installed on medium voltage overhead electric networks.
- 1.3 Supplier/Manufacturer shall supply Fault Passage Indicator (FPI) of this specification with RFcommunication facility, GPRS/GSM technology interface and 125kV insulated 12meter- long Suitable Hot stick, device adaptor required for installation and Magnet/other equipment for manual reset and all other accessories.

The technical specifications for FPI 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 upper grade, compared with this Specification. However, if a proposed FPI does not comply with the major functional requirements, such a proposal will be deemed as technically non-responsive.

## 2. Quality Insurance

The Supplier/manufacturer shall supply documentary proof that the manufacturer possesses ISO 9001 and ISO 14001 Quality insurance certification, from an independent internationally recognized body, for the design, manufacture and testing of Fault Indicators and remote monitoring and control equipment for medium voltage lines

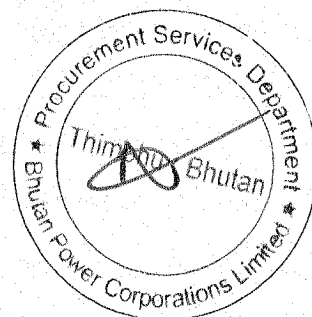


### 3. Applicable standards

The supplier/manufacturer shall comply to all applicable international standards including, but not limited to following

SI No	Standard	Descriptions
1	IEC 62689-1	Minimum requirements, classification and test of fault passage indicators
2	IEC 60068 -2-30	Suitability of components under conditions of high humidity
3	IEC 60068-2-6	Vibration resistance
4	IEC 60068-2-27	Shock resistance
5	IEC 61000-6-2	Magnetic immunity
6	IEC 61000-4-2	Electrostatic Discharge standard
7	IEC 61000-4-3	Radiated electromagnetic field
8	IEC 61000-4-5	Surge immunity
9	IEC 61000-4-6	Immunity to Conduced Disturbances
10	IEC 60529	Degree of protection
11	IEEE 495	Testing fault circuit indicators

Note: In case of any conflict on any Standards in the specification, the stricter requirement mentioned in the relevant standard shall be valid.



## 4. Testing

### 4.1 Routine test

Routine tests in conformance with the applicable clauses of international standards shall be performed on all fault passage indicators and copies of the test reports shall be submitted for each batch to be delivered prior to issuance of the dispatch clearance.

### 4.2 Type test

Type test shall be performed in complete conformance with the applicable clauses of applicable international standards. Purchaser reserves the right to attend and witness the tests.

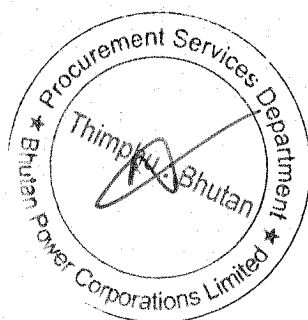
## 5. General information

### 5.1 System parameters

The Fault detection systems shall be designed to operate on a Medium Voltage overhead network with the following characteristics:

Sl. No	Particulars	Unit	33kV	11kV
1	Nominal voltage	kV	33	11
2	Maximum system voltage	kV	36	12
3	Frequency	Hz	50	
4	Conductor diameter	mm	10 to 25	
5	Short Circuit Current	kA/3 sec	25	

One single product shall be proposed to cover the whole range of above characteristics



## 5.2 Environmental conditions

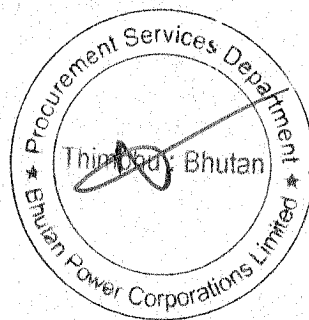
All materials supplied shall be capable of operating under following environmental conditions

SI No.	Particulars	Unit	Value
1	Minimum ambient temperature	°C	-20
2	Maximum ambient temperature	°C	+50
3	Relative humidity	%	0 to 95
4	Minimum Altitude	m above sea level	300
5	Maximum Altitude	m above sea level	350 0

## 5.3 Service conditions

The Fault detection system shall be designed to operate in the following conditions:

Symmetrical Fault Current	25kA/170ms (maximum phase current that the system shall withstand)
Shocks & vibrations	120 minutes of sine vibrations and 2000 negative and 2000 positive shocks, in OX, OY and OZ axes
Lightning surge	125kV shocks

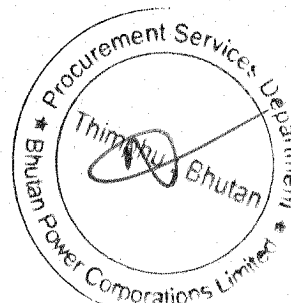


## 6. Constitution

- 6.1 Fault passage indicators are clipped on the overhead lines. One such device shall be clipped on each phase to measure current and voltage presence in this phase and compute fault detection algorithm accordingly.
- 6.2 The fault passage indicator shall have a short-range radio interface embedded in the device to communicate with another communication interface which shall communicate to the control center.
- 6.3 In communicable fault passage indication system, a radio communication interface, pole mounted, acting as a communication gateway between fault passage indicators using short range radio and the remote-control center using applicable communication protocols.

## 7. Fault Passage Indicator

- 7.1 The fault passage indicators shall be designed to be clipped on the Overhead MV line. 3 fault passage indicators shall be clipped on one segment of line, one on each phase.
- 7.2 It shall measure current running in the phase it is clipped on
- 7.3 It shall detect voltage absence/presence on the phase it is clipped on
- 7.4 It shall detect phase-to-phase and phase-to-earth faults
- 7.5 In communicable fault passage indicator, there shall be short-range radio communication to communicate with long range radio device up to 100 meters.
- 7.6 It shall be self-powered from a battery of a minimum life time 10 years, in the temperature conditions specified in environmental conditions, including at least 1(one) short range radio communication with the communication interface every hour and 300 hours flashing for fault indication all over these 10 years. The battery shall be easily replaceable and readily available in market. Vendor specific battery, specially designed battery or soldered battery terminals shall not be accepted. The battery of fault passage indicator shall be easily detachable.
- 7.7 The fault passage indicators shall be suitable for outdoor use in the sub-tropical and temperate climate conditions.



**7.8** The components used in the fault passage indicators shall be suitably protected from direct sunlight to prevent malfunctioning due to solar radiation. The maximum operating temperature shall not be less than 50° C.

**7.9** The fault passage indicators shall be suitable for mounting on live line conductors of a diameter ranging between 10 and 25 mm.

**7.10** Clamps shall be designed so that the fault passage indicator can withstand winds of 150km/h without falling from the line.

**7.11** The fault passage indicator shall be fully self-contained type without any external connection, indicator or sensors. The fault passage indicators shall be suitable for use on multiple lines supported by the same pole.

**7.12** The fault indication shall be easily seen from 50 meters and shall have 360 Degree visibility.

**7.13** The fault indicator shall have a minimum of IP 55

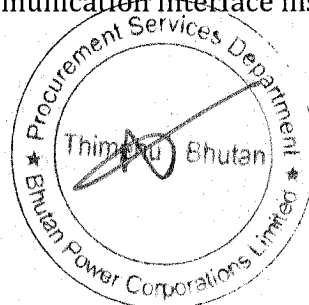
## **8. Communication Features**

**8.1** One such device clipped on each phase to measure current and voltage presence in this phase and compute fault detection algorithm accordingly. A short-range radio interface shall be embedded in this device to communicate with the communication interface.

**8.2** The communication interface shall have short range radio Interface to communicate with maximum of nine fault passage indicators in a 100 m range.

**8.3** Configuration of the communication interface and fault passage indicators shall be carried out by connection of a laptop using the configuration software to an RS232/RS 485/RJ 45 port on the communication interface. The same software shall also include full diagnostic capabilities and software shall be free of cost.

**8.4** Connection cables between communication interface and solar panel and battery block shall be provided. Cable of minimum length 10m for each interface unit shall be provided for connection to the communication interface installed on the same pole.





**8.5** The communication interface shall support GSM, GPRS, 2G, 3G and LTE/4G and 5G with fall back features and shall support various frequency bandwidths used by Bhutan's two telecommunication services operators, Bhutan Telecom Ltd. and Tashi Cell Ltd

**8.6** As minimum, the interface shall be able to send messages to three field personnel and all contact numbers shall be user configurable.

**9. Short-range radio**

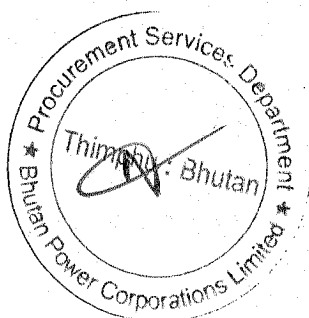
Short range radio shall use license-free radio in the frequency bandwidth as specified in the "Guidelines for the Operation of Industrial, Scientific and Medical (ISM) Frequency Bands for Radio communication Services in Bhutan" by BICMA which is given in the following table:

Frequency band for ISM in Bhutan			
Sl. No	Frequency Range		Bandwidth
	From	To	
1.	6765.00KHz	6795.00KHz	30KHz
2.	13.5530MHz	13.5670MHz	140KHz
3.	26.9570MHz	27.4050MHz	448KHz
4.	40.66MHz	40.70MHz	40KHz
5.	433.05MHz	434.79MHz	1.74MHz
6.	2.4GHz	2.5GHz	100MHz
7.	5725MHz	5875MHz	150MHz
8.	24GHz	24.250GHz	250MHz
9.	61.00GHz	61.50GHz	500MHz
10.	122GHz	123GHz	1000MHz
11.	244GHz	246GHz	2000MHz

**9.1** The short-range radio shall be designed to allow a maximum distance between interface and the fault passage indicators equal to 100m or more.

**9.2** Indicators of short-range radio transmission quality shall be available and displayed by connection of a PC to the interface.

**9.3** Antennas for short-range radio communication shall be embedded in or fixed on the products (interface and Fault Passage Indicator) so that no additional installation is required.



## 10. Battery features for the communication interface

- 10.1** Communication interface equipment shall get supply from battery/battery charger with a solar supply kit made of a solar panel and a rechargeable battery, mounted on the same pole, appropriately dimensioned to continuously supply the communication interface considering the average sun radiation in India or Bhutan.
- 10.2** In solar powered system, solar panel stand shall be mounted on the same pole where gateway is mounted and solar panel stand shall be supplied accordingly.
- 10.3** Battery of reputed make shall be rated for at least 12 hours backup for the system shall be supplied. VRLA (maintenance free) Compact Battery and constant voltage charger with current limiting facility shall be provided as part of the supply. The battery shall be easily available in the market and specially designed battery or vendor specific battery shall not be accepted.
- 10.4** The minimum life expectancy of the battery shall be 5 years. All accessories required for termination/connection shall be supplied accordingly.

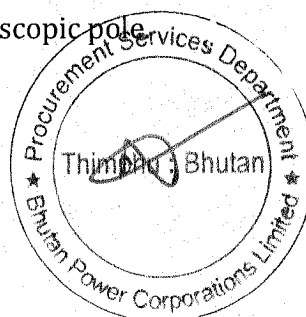
## 11. Solar panel

The minimum requirement of the solar panels is mention in the table below, the Voc of the solar panel shall be greater than the battery rated voltage.

Sl. No	Particulars	Unit	Value
1	Peak Power (Pmax)	Wp	50
2	Voltage (Vmp)	V	More than rated voltage of battery
3	Open Circuit Voltage (Voc)	V	More than rated voltage of battery

## 12. Interface enclosure

- 12.1** The communication interface shall be fitted in a compact enclosure suitable for mounting on existing steel tubular or telescopic pole.

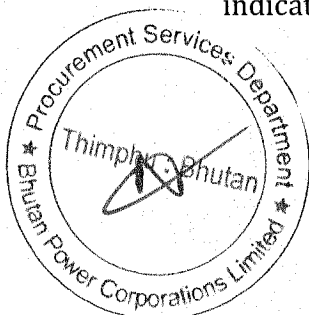


- 12.2** The pole mounted weather proof outdoor enclosure shall be manufactured from 304 or better grade stainless steel and house battery, battery charger, switches, communication interface unit and other required communication equipment.
- 12.3** Interface shall be adequately sealed with ingress protection rating of IP55 or better.
- 12.4** The supplier/manufacturer shall ensure that the components housed in the enclosure can withstand the heating effect of direct solar radiation without causing failure and/or malfunction.
- 12.5** The door of the enclosure should be fitted with a secure and robust locking arrangement and there should be minimum of two hinge points. The door should be removable for replacement at site and door stay shall be fitted to keep door open while operators are attending the unit.
- 12.6** 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 enclosure.
- 12.7** Firm enclosure mounting brackets suitable with all accessories shall be provided accordingly.
- 12.8** Drawing and list of accessories shall be submitted for approval.

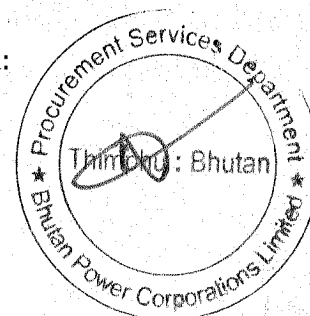
### **13.Operational specifications**

#### **13.1 Fault detection:**

- 13.1.1 Fault sensing shall be made from current measurement and voltage presence detection, based on detection of the electromagnetic field and its variations.
- 13.1.2 The fault passage indicator shall be of the programmable type, suitable for sensing short circuit faults up to 12.5 kA for 1s and 25kA for 170ms and low earth leakage faults of 6A. (spec- voltage level)
- 13.1.3 The fault passage indicators shall detect faults based on 02(two) simultaneous indication criterion as follows.



1. In order to detect strong fault currents (typically phase-to-phase faults), it shall indicate when the phase current exceeds an absolute threshold for a minimum duration of 50ms. It is recommended that the absolute threshold must be user configurable up to a minimum value of 40A based on the nominal currents.
  2. In order to detect low fault currents (typically resistant phase-to-earth faults), it shall indicate when it detects increase in phase current within a fixed duration (50ms) that exceeds a relative threshold. This threshold must be configurable to at least 6 different values between 6A and 160A.
- 13.1.4 When a fault occurs on the network, the upstream protection will indicate within 70s maximum (inverse time protection). Therefore, in order to prevent indication due to a load increase, on detection of one of the above criteria, the fault passage indicators shall confirm the fault by checking if the voltage disappears within the next 70s and start to indicate the fault only under this condition.
- 13.1.5 In case of faults, the fault passage indicators which are detecting the variation of the electromagnetic field due to fault current (Fault Passage Indicators installed between the circuit breaker and fault point) shall provide a fault indication, while fault passage indicators in downstream of the fault or on non-faulty branches shall not provide any indication.
- 13.1.6 The fault indication shall be provided by the means of a flashing light system offering a good contrast against sunshine (red colour) and Mean Time Between Failure of the light emitting system shall be at least 45000 Hours (LEDs for instance). It shall provide a very high visibility of an intensity of at least 40 Lumens and give a 360° visibility angle from a distance of at least 50m in sunny day conditions, and at least 300m at night. Total flash duration shall not be less than 400hrs and flashing period for permanent faults shall be 1 or 2 flash in every 6s.
- 13.1.7 The Fault indication shall remain until:



1. a time-out, configurable to possible values between 2 and 16 hours, has expired,
2. the medium voltage is back,
3. the fault passage indicator is reset manually,
4. whichever conditions comes first

13.1.8 Since the load current might be very low upon MV return, load current reset is not acceptable.

13.1.9 The fault indication reset shall consist in:

1. Stopping the local light indication flashing
2. Sending an alarm to the communication interface according to its configuration

13.1.10 The fault passage indicator shall include some self-test possibility usable when it is on the line whether it is powered or not.

13.1.11 The fault passage indicator shall be selective in action as indicated below

1. It shall not respond to any sudden variation (increase/decrease) in load current
2. It shall not respond to over current not due to a fault
3. It shall not respond to high magnetizing inrush currents, created upon line energizing.

### **13.2 Detection of voltage presence and absence**

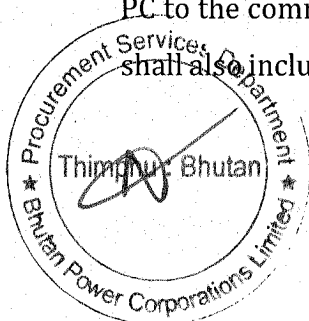
The fault passage indicator shall send a message to the communication interface as soon as it detects disappearance or appearance of voltage on the MV conductor. The communication interface shall then memorize the information as a time-stamped event and send an alarm to the control center according to its configuration.

### **13.3 Event time-stamping**

Any change of state of information shall generate a time-stamped event stored in the communication interface memory. The event storage capacity shall be at least 100 stamped events.

## **14. Configuration and maintenance**

14.1 Equipment configuration and diagnostic shall be performed by connection of a laptop PC to the communication interface using the RS232 or RJ45 interface. Configuration shall also include scanning of all fault passage indicators in the short-range radio and



assigning of an identification to each of them in order to allow identification at the control center whenever line faults or voltage absence are detected. Configuration of fault detection thresholds and other characteristics shall be there.

**14.2** Configuration of communication: IP address to communicate via IEC-61850-104 protocol, Configuration of alarms, as explained above shall also be included.

**14.3** Diagnostic shall include at least display of the current value of all information monitored by fault passage indicators, list and status, fault indications from fault passage indicators, digital inputs, measurement and an embedded protocol analyzer showing frames received and sent.

## **15. Additional requirements**

### **Marking**

Each fault passage indicator shall carry a weather and corrosion proof plate indicating the following particulars:

1. Manufacturer's identification.
2. Model or type number
3. Manufacturing year in characters big enough to allow reading from the ground
4. Property of Bhutan Power Corporation Limited (BPC).

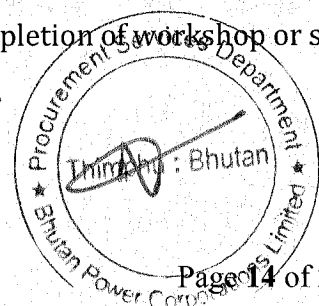
## **16. Deviation**

Deviation from this specification may be acceptable and supplier shall list all deviations with alternate options, clearly specified against each deviation. However, BPCL reserves the right to accept or reject the options and if deviation list is not submitted, it shall be assumed that the supplier accepts to this specification fully.

## **17. Inspection**

**17.1** All components shall be duly tested and sealed by the firm at their premises prior to inspection.

**17.2** The employer shall carry out inspection only upon completion of workshop or short course mentioned in Training section of this document.



**17.3** The Inspecting Officer of the Employer will inspect the fault passage indicator and components as per sampling plan for acceptance test according to international standard.

**17.4** Apart from above test, the fault passage indicator shall also be tested for all functional requirement through communication as part of acceptance test. After testing, these sample shall be additionally sealed by the inspecting officer and one copy of the inspection report will be handed over to the manufacturer.

## **18. Training**

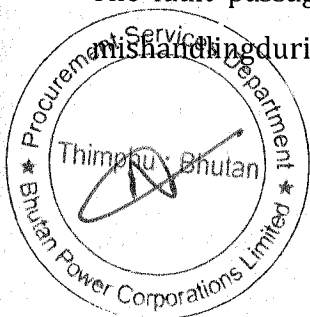
**18.1** The supplier/manufacturer should arrange four-day workshop or short course on setting, configuration, installation and commissioning of fault passage indicator including establishing communication before carrying out inspection. Only after the workshop or the course, inspection shall be carried out and the workshop or short course shall be free of cost.

**18.2** The supplier or manufacturer shall propose appropriate solution to facilitate the workshop or short course in events of natural and unavoidable global catastrophe.

## **19. Packing and Transportation**

The fault passage indicator and other components shall be suitably packed for vertical/horizontal support to withstand handling during transport. The bidder shall be responsible for any damage during transit due to inadequate or improper packing. It shall be packed appropriately to ensure safe transportation, handling, identification and storage. All packing materials shall be environment friendly and not in conflict with law in force. The primary packing shall ensure protection against humidity, dust, grease and safeguard its performance until its installation. The secondary packing shall provide protection during transport. The packing case shall indicate "Fragile in nature" and direction of placement of box. Each packing shall indicate marking details like Manufacturer's name, Serial. No. of material, quantity, address of destination, etc.

The fault passage indicator and components shall not be exposed to undue shock and mishandling during transportation. The stacking of box inside transport media shall be such



as to avoid their free movement. The packing shall also be protected from rain and dust by transport media. The Bidder shall be responsible for any damage during transit due to inadequate or improper packing.

## 20. Delivery

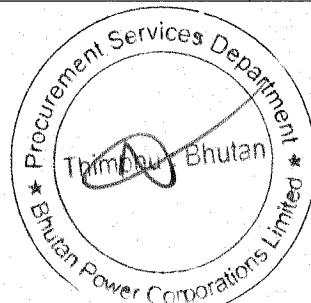
**20.1** All components of the equipment shall be delivered to Regional Stores Division, BPC, Phuentsholing.

**20.2** The supplier shall submit all tests report and as-built drawing when the equipment is ready to dispatch and dispatch it only upon receiving dispatch clearance.

## 21. Submittals

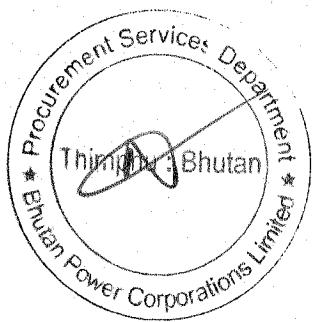
The supplier/manufacturer shall submit documents as required in following table

Sl.No	Particulars	Bid	Approval	Pre-Dispatch
1	Guaranteed technical particulars	Required	Required	
2	Wiring diagram		Required	
3	General arrangement for installation of interface unit enclosure box on single pole.		Required	
4	Procedures for maintenance and operation of all components			Required
5	Details of battery used in fault passage indicator. State if battery is soldered or not?	Required		
6	Details of service history	Required		
7	Details of battery used in communication interface unit	Required		
8	Deviation Sheet, if any	Required		
9	Detail of communication interface / component	Required		
10	Details of software and accessories required for installation/ operation.	Required		
11	Manufacturer's quality assurance plan and certification for quality standards	Required		
12	Type Test reports	Required		

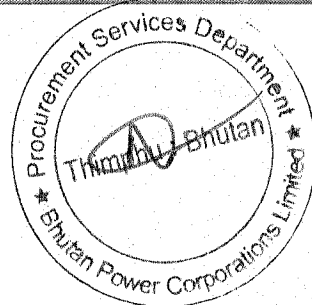
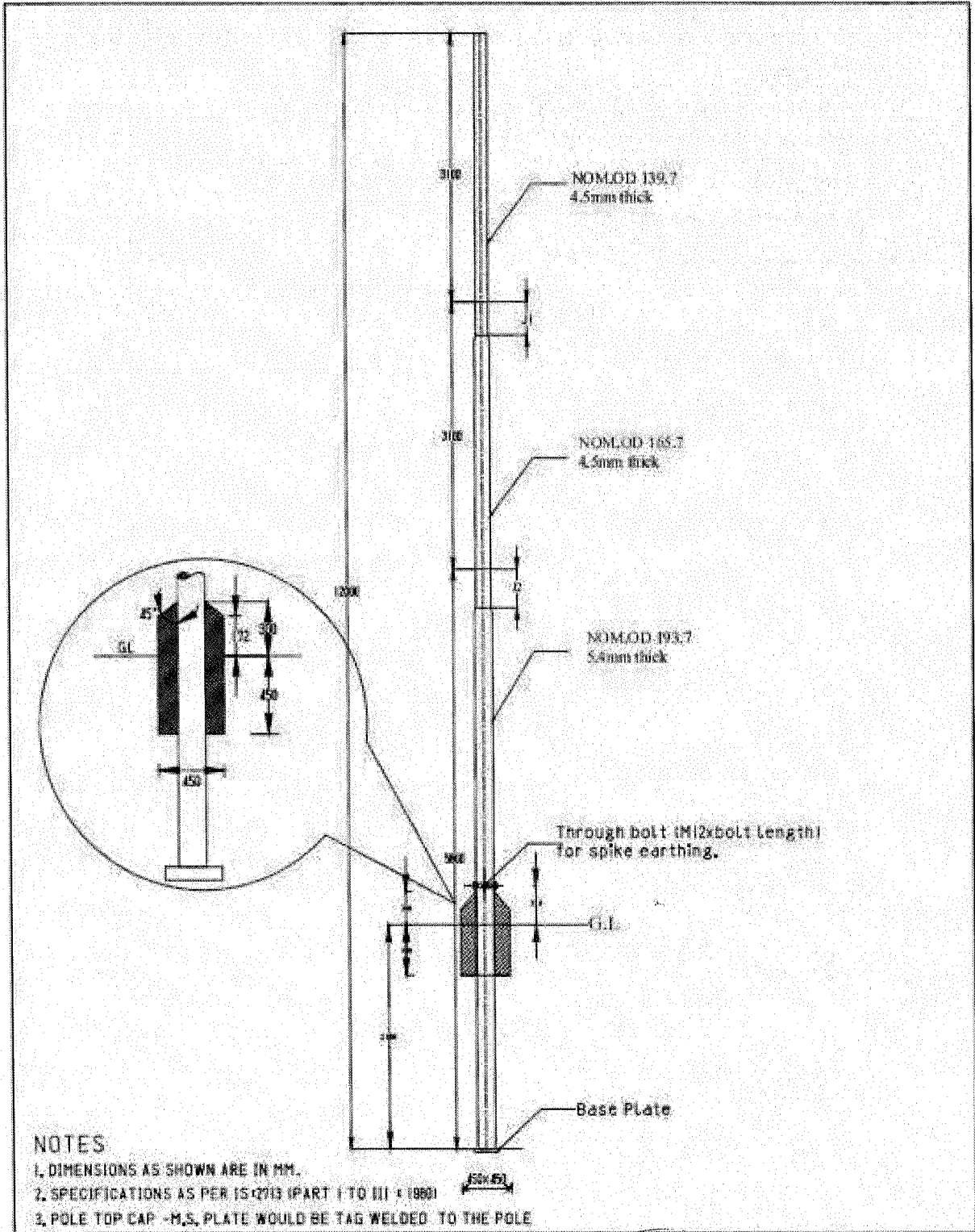




Sl.No	Particulars	Bid	Approval	Pre-Dispatch
13	Detailed manual installation and commissioning instructions			Required
14	Routine test reports with procedures for all components.		Required	Required
15	Details of solar panel for auxiliary power supply unit, battery and battery charger	Required		
16	Program schedule for production, testing, training and inspection.	Required		
17	Drawing of solar panel mounting structure		Required	



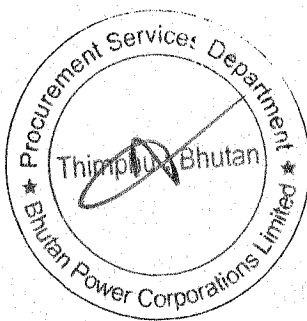
## Annexure II: Details of existing pole



# **TECHNICAL SPECIFICATIONS**

## **Lot 6: Fault Passage Indicator**

**Non-communicable Fault Passage Indication System  
for Overhead 33kV and 11kV Networks**



## 1. Scope

- 1.1 This specification for design, manufacture, testing, supply and delivery of non-communicable fault passage indicator with all accessories.
- 1.2 For the non-communicable fault passage indication system, the 360-degree distinct indication by the device shall be clearly visible from the ground so that faulty section is localized and network is reconfigured accordingly.
- 1.3 Supplier/Manufacturer shall supply 125kV insulated 12 meter- long Suitable Hot stick, device adaptor required for installation and Magnet/other equipment for manual reset and all other accessories.

The technical specifications for FPI 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 upper grade, compared with this Specification. However, if a proposed FPI does not comply with the major functional requirements, such a proposal will be deemed as technically non-responsive.

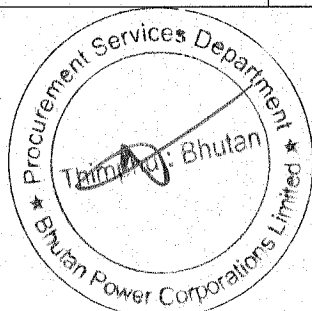
## 2. Quality Insurance

The Supplier/manufacturer shall supply documentary proof that the manufacturer possesses ISO 9001 and ISO 14001 Quality insurance certification, from an independent internationally recognized body, for the design, manufacture and testing of Fault Indicators for medium voltage lines

## 3. Applicable standards

The supplier/manufacturer shall comply to all applicable international standards including, but not limited to following

SI No	Standard	Descriptions
1	IEC 62689-1	Minimum requirements, classification and test of fault passage indicators



2	IEC 60068 -2-30	Suitability of components under conditions of highhumidity
3	IEC 60068-2-6	Vibration resistance
4	IEC 60068-2-27	Shock resistance
5	IEC 61000-6-2	Magnetic immunity
6	IEC 61000-4-2	Electrostatic Discharge standard
7	IEC 61000-4-3	Radiated electromagnetic field
8	IEC 61000-4-5	Surge immunity
9	IEC 61000-4-6	Immunity to Conduced Disturbances
10	IEC 60529	Degree of protection
11	IEEE 495	Testing fault circuit indicators
<p>Note: <i>In case of any conflict on any Standards in the specification, the stricter requirement mentioned in the relevant standard shall be valid.</i></p>		

#### 4. Testing

##### 4.1 Routine test

Routine tests in conformance with the applicable clauses of international standards shall be performed on all fault passage indicators and copies of the test reports shall be submitted for eachbatch to be delivered prior to issuance of the dispatch clearance.

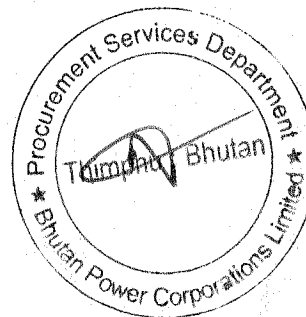
##### 4.2 Type test

Type test shall be performed in complete conformance with the applicable clauses of applicable international standards. Purchaser reserves the right to attend and witness the tests.

#### 5. General information

##### 5.1 System parameters

The Fault detection systems shall be designed to operate on a Medium Voltage overhead networkwith the following characteristics:



Sl. No	Particulars	Unit	33kV	11kV
1	Nominal voltage	kV	33	11
2	Maximum system voltage	kV	36	12
3	Frequency	Hz	50	
4	Conductor diameter	mm	10 to 25	
5	Short Circuit Current	kA/3 Sec		

One single product shall be proposed to cover the whole range of above characteristics

## 5.2 Environmental conditions

All materials supplied shall be capable of operating under following environmental conditions

Sl No.	Particulars	Unit	Value
1	Minimum ambient temperature	<sup>0</sup> C	-20
2	Maximum ambient temperature	<sup>0</sup> C	+50
3	Relative humidity	%	0 to 95
4	Minimum Altitude	m above sea level	300
5	Maximum Altitude	m above sea level	350 0

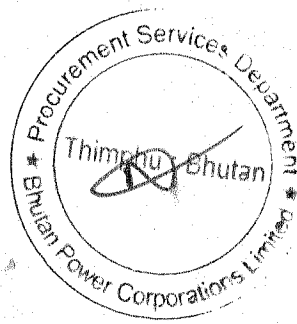
## 5.3 Service conditions

The Fault detection system shall be designed to operate in the following conditions:

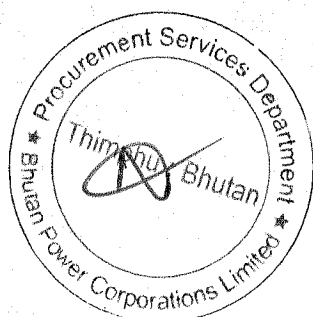
Symmetrical Fault Current	25kA/170ms (maximum phase current that the system shall withstand)
Shocks & vibrations	120 minutes of sine vibrations and 2000 negative and 2000 positive shocks, in OX, OY and OZ axes
Lightning surge	125kV shocks

## 6. Fault Passage Indicator

- 6.1** The fault passage indicators shall be designed to be clipped on the Overhead MV line.  
3 fault passage indicators shall be clipped on one segment of line, one on each phase.



- 6.2** It shall measure current running in the phase it is clipped on.
- 6.3** It shall detect voltage absence/presence on the phase it is clipped on
- 6.4** It shall detect phase-to-phase and phase-to-earth faults
- 6.5** It shall be self-powered from a battery of a minimum life time 10 years, in the temperature conditions specified in environmental conditions, and with 300 hours flashing for fault indication all over these 10 years. The battery shall be easily replaceable and readily available in market. Vendor specific battery, specially designed battery or soldered battery terminals shall not be accepted. The battery of fault passage indicator shall be easily detachable.
- 6.6** The fault passage indicators shall be suitable for outdoor use in the sub-tropical and temperate climate conditions.
- 6.7** The components used in the fault passage indicators shall be suitably protected from direct sunlight to prevent malfunctioning due to solar radiation. The maximum operating temperature shall not be less than 50° C.
- 6.8** Clamps shall be designed such that the fault passage indicator can withstand winds of 150km/h without falling from the line.
- 6.9** The fault passage indicator shall be fully self-contained type without any external connection, indicator or sensors. The fault passage indicators shall be suitable for use on multiple lines supported by the same pole.
- 6.10** The fault indication shall be easily seen from 50 meters and shall have 360 Degree visibility.
- 6.11** The fault indicator shall have a minimum of IP 55



## 7. Operational specifications

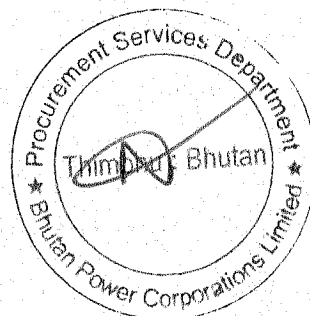
### 7.1 Fault detection:

7.1.1 Fault sensing shall be made from current measurement and voltage presence detection, based on detection of the electromagnetic field and its variations.

7.1.2 The fault passage indicator shall be of the programmable type, suitable for sensing short circuit faults up to 12.5 kA for 1s and 25kA for 170ms and low earth leakage faults of 6A.

7.1.3 The fault passage indicators shall detect faults based on 02(two) simultaneous indication criterion as follows.

1. In order to detect strong fault currents (typically phase-to-phase faults), it shall indicate when the phase current exceeds an absolute threshold for a minimum duration of 50ms. It is recommended that the absolute threshold must be user configurable up to a minimum value of 40A based on the nominal currents.
2. In order to detect low fault currents (typically resistant phase-to-earth faults), it shall indicate when it detects increase in phase current within a fixed duration (50ms) that exceeds a relative threshold. This threshold must be configurable to at least 6 different values between 6A and 160A.





---

7.1.4 When a fault occurs on the network, the upstream protection will indicate within 70s maximum (inverse time protection). Therefore, in order to prevent indication due to a load increase, on detection of one of the above criteria, the fault passage indicators shall confirm the fault by checking if the voltage disappears within the next 70s and start to indicate the fault only under this condition.

7.1.5 In case of faults, the fault passage indicators which are detecting the variation of the electromagnetic field due to fault current (Fault Passage Indicators installed between the circuit breaker and fault point) shall provide a fault indication, while fault passage indicators in downstream of the fault or on non-faulty branches shall not provide any indication.

7.1.6 The fault indication shall be provided by the means of a flashing light system offering a good contrast against sunshine (red colour) and Mean Time Between Failure of the light emitting system shall be at least 45000 Hours (LEDs for instance). It shall provide a very high visibility of an intensity of at least 40 Lumens and give a 360° visibility angle from a distance of at least 50m in sunny day conditions, and at least 300m at night. Total flash duration shall not be less than 400hrs and flashing period for permanent faults shall be 1 or 2 flash in every 6s.

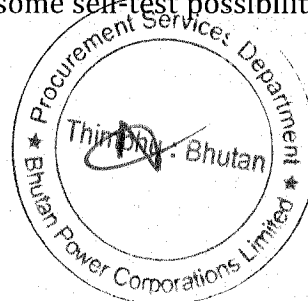
7.1.7 The Fault indication shall remain until:

1. a time-out, configurable to possible values between 2 and 16 hours, has expired,
2. the medium voltage is back,
3. the fault passage indicator is reset manually,
4. whichever conditions comes first

7.1.8 Since the load current might be very low upon MV return, load current reset is not acceptable.

7.1.9 The fault indication reset shall consist in stopping the local light indication flashing.

7.1.10 The fault passage indicator shall include some self-test possibility usable when it is on the line whether it is powered or not.



7.1.11 The fault passage indicator shall be selective in action as indicated below

1. It shall not respond to any sudden variation (increase/decrease) in load current
2. It shall not respond to over current not due to a fault
3. It shall not respond to high magnetizing inrush currents, created upon line energizing.

## 8 Configuration and maintenance

8.1 Equipment configuration and diagnostic shall be performed by connection of a laptop PC to the device using the PC RS232 or RJ45 interface. The required software shall be supplied for free of cost.

## 9 Additional requirements

### Marking

Each fault passage indicator shall carry a weather and corrosion proof plate indicating the following particulars.

1. Manufacturer's identification.
2. Model or type number
3. Manufacturing year in characters big enough to allow reading from the ground
4. Property of Bhutan Power Corporation Limited (BPC).

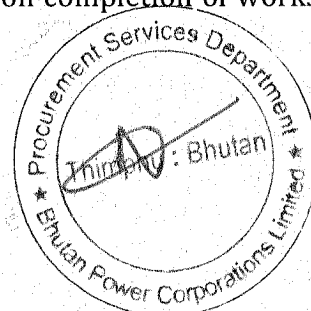
## 10 Deviation

Deviation from this specification may be acceptable and supplier shall list all deviations with alternate options, clearly specified against each deviation. However, BPC reserves the right to accept or reject the options and if deviation list is not submitted, it shall be assumed that the supplier accepts to this specification fully.

## 11 Inspection

11.1 All components shall be duly tested and sealed by the firm at their premises prior to inspection.

11.2 The employer shall carry out inspection only upon completion of workshop or short course mentioned in Training section of this document.



11.3 The Inspecting Officer of the Employer will inspect the fault passage indicator and components as per sampling plan for acceptance test according to international standard. After testing, these sample shall be additionally sealed by the inspecting officer and one copy of the inspection report will be handed over to the manufacturer.

## **12 Training**

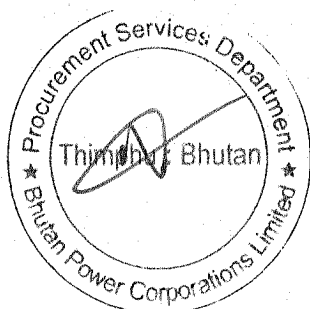
12.1 The supplier/manufacturer should arrange four-day workshop or short course on setting, configuration, installation and commissioning of fault passage indicator before carrying out inspection. Only after the workshop or the course, inspection shall be carried out and the workshop or short course shall be free of cost.

12.2 The supplier or manufacturer shall propose appropriate solution to facilitate the workshop or short course in events of natural and unavoidable global catastrophe.

## **13 Packing and Transportation**

The fault passage indicator and other components shall be suitably packed for vertical/horizontal support to withstand handling during transport. The bidder shall be responsible for any damage during transit due to inadequate or improper packing. It shall be packed appropriately to ensure safe transportation, handling, identification and storage. All packing materials shall be environment friendly and not in conflict with law in force. The primary packing shall ensure protection against humidity, dust, grease and safeguard its performance until its installation. The packing case shall indicate "Fragile in nature" and direction of placement of box. Each packing shall indicate marking details like Manufacturer's name, Serial. No. of material, quantity, address of destination, etc.

The fault passage indicator and components shall not be exposed to undue shock and mishandling during transportation. The stacking of box inside transport media shall be such as to avoid their free movement. The packing shall also be protected from rain and dust by transport media. The Bidder shall be responsible for any damage during transit due to inadequate or improper packing.



## 14 Delivery

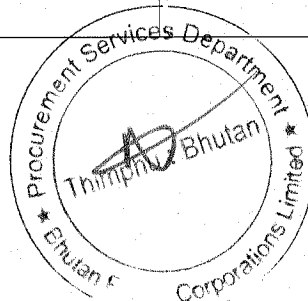
14.1 All components of the equipment shall be delivered to Regional Stores Division, BPC, Phuentsholing.

14.2 The supplier shall submit all tests report and as-built drawing when the equipment is ready to dispatch and dispatch it only upon receiving dispatch clearance.

## 15 Submittals

The supplier/manufacturer shall submit documents as required in following table

Sl.No	Particular	Bid	Approval	Pre-Dispatch
1	Guaranteed technical particulars	Required	Required	
2	Wiring diagram	Required		
3	Procedures for maintenance and operation of all components			Required
4	Details of battery used in fault passage indicator. State if battery is soldered or not?	Required		
5	Details of service history	Required		
6	Deviation Sheet, if any	Required		
7	Details of software and accessories required for installation/ operation.	Required		
8	Manufacturer's quality assurance plan and certification for quality standards	Required		
9	Type Test reports	Required		
10	Detailed manual installation and commissioning instructions			Required
11	Routine test reports with procedures for all components.		Required	Required



12	Program schedule for production, testing, training and inspection.	Required		
----	--	----------	--	--

