

## LOT 9: CABLE JOINTING KITS AND DISTRIBUTION PILLAR

### CABLE JOINTING KITS

#### 1. General Specifications

- a. The cable accessories should be suitable for storage without deterioration in properties at temperatures up to 50 deg C and should have unlimited shelf life.
- b. Fluorinated Silicon Grease should be provided for filling up the minor nicks & scratches on the insulation that may occur while removing the Semi conducting screen of the Cable.

#### 2. END TERMINATIONS

- a. Class of Termination: The End termination should be Class - I as defined by IEEE 48 Standard & amended upto date.
- b. Stress Control :
  - The stress control at the screen cutback should be provided by a Heat Shrinkable tubing having a minimum volume resistivity of  $10^{10}$  Ohms cm. The relative permittivity of the tubing should be at least 15.
  - To eliminate voids caused at the step due to semiconducting screen cutback , the manufacturer should provide a high permittivity mastic the permittivity of which should be at least 15.
  - The impedance of the stress control tubing should not change over a range of temperature of 0 deg C – 125 deg C, which is the temperature range over which an XLPE cable is expected to operate
- c. Protection to Insulation :

A heat shrinkable tubing should be applied over exposed cable dielectric.  
The material should be:

- (1) Non tracking
- (2) Weather resistant
- (3) Erosion resistant
- (4) U. V. radiation resistant

Test reports conforming that there is no degradation of the material after prolonged exposure to elevated temperatures This should include

- Thermal endurance- An Arrhenius plot to confirm the life expectancy on



continuous at a temperature of 90 deg C.

- The materials should pass Tracking & Erosion Resistant test in accordance with ASTM D 2303.
- For weather resistance the materials should be tested on Atlas weather-O- meter test.
- The materials should be tested as per EMMAQUA test procedure for evaluating it's resistance to Ultra Violet radiations.

d. Environment sealing :

At the lug end the sealing against ingress of moisture should be provided by non-tracking sealant strips followed by heat shrinkable non tracking, erosion & weather resistant tubing precoated with non tracking sealant.

For 3 core cable the sealing at the crutch area should be provided by a heat shrinkable non tracking erosion & weather resistant breakout internally coated with a non tracking hot melt adhesive.

e. Provision for Earthing

The Copper tape screen and armour of the cable should be earthed by tinned copper braids of appropriate size provided with lug at one end.

### 3. STRAIGHT THROUGH JOINTS

a. Conductor Continuity

Proper conductor continuity should be ensured either by Crimping or by using Shear head bolted connector.

b. Stress Control :

- The stress control at the screen cutback should be provided by a heat shrinkable tubing having a minimum volume resistivity of  $10^{10}$  Ohms cm. The relative permittivity of the tubing should be at least 15.
- To eliminate voids caused at the step due to semiconducting screen cutback , the manufacturer should provide a high permittivity mastic the permittivity of which should be at least 15.
- The impedance of the stress control tubing should not change over a range of temperature of 0 deg C – 125 deg C, which is the temperature range over which an XLPE cable is expected to operate.



c. Reinstatement of Insulation:

- This should be affected by means of a heat shrinkable, flexible, polymeric tubing made from discharge resistant polymer. The tubing after complete recovery should have a minimum wall thickness of 3 mm to ensure provision of adequate insulation in one step .
- To ensure a void free bond between the rebuilt tubing and screen the manufacturer should supply a single dual walled tubing. This enables the final insulating layer to be installed complete with a conductive polymeric screen.
- The kit should be provided with a high permittivity hot-melt mastic for applying over the ferrule to eliminate voids and sharp edges.

d. Armour/ Screen Continuity

The continuity of the copper tape screen should be affected by tinned copper Mesh and that of the armour by tinned copper braids of adequate cross section.

e. Environment Sealing :

The joints should be protected against ingress of moisture by a polymeric flexible heat shrinkable tubing precoated with hot melt adhesive. This should completely cover metallic sheaths/ earth connections .

**4. TEST**

- a. The kits should be tested as per test sequence of VDE 0278 or IS: 13573 as per latest amendments
- b. The Joints/ Terminations should be type Tested for series 1 and series 2 along with **SALT FOG TEST** at per testing procedures.
- c. All Heat Shrinkable components should be tested as per ESI-09-13. The bidder shall furnish test reports along with the bid.
- d. The manufacturer should provide life assessment test (accelerated ageing test) reports to prove that the heat shrinkable components are capable of retaining their properties within acceptable limits during the course of long term usage.
- e. TERT (Track Erosion and Resistance test) should be conducted on heat shrinkable tube used in termination to prove that they are non tracking.



- f. The manufacturer should also furnish graphs showing the variation of impedance of the stress control tubing with respect to (1) change in temperature and (2) Time (aging at constant temperature).



## DISTRIBUTION PILLAR

### 1.0 Scope

This specification covers the design, manufacture, testing at manufacturer's work before dispatch, packing and transportation to BPC stores.

### 1.1 Code and Standard:

The construction, inspection and testing of the Distribution pillar shall comply with all currently applicable status, regulations and safety codes in the locality where the distribution pillar shall be installed. The distribution pillar drawing is attached herewith.

The applicable standards: IS 5039 and IS 13703 part 2

### 1.2 Construction Features:

- 1.2.1 The Distribution Pillar shall be sheet steel enclosed and should be robust, dust, weather and vermin proof providing a degree of protection of IP 52 for indoor use and IP 55 for outdoor use. Sheet steel used shall be cold rolled grain oriented (CRGO) and at least 2.5 mm thick smooth finished, leveled and free from flaws and properly braced to prevent wobbling.
- 1.2.2 The Distribution pillar shall be provided with hinged doors openable from the centre. It should be also provided with the three-point lock system.
- 1.2.3 Doors, removable covers, if any and plate shall be gasketed all around with neoprene gaskets, and this is essential to prevent ingress of dust and vermin.
- 1.2.4 All live parts shall be provided with at least phase to phase and phase to earth clearance in air of 25 mm and 20 mm respectively at an attitude of 1000 m. For the design of distribution pillar, the altitude correction factor considering altitude of 2400 m has been maintained to determine the electrical clearance (drawing attached).
- 1.2.5 The suitable removable cable gland plate of 2.5 mm cold rolled sheet steel should be provided. The interior cabling space should strictly adhere to the distribution pillar drawing attached.
- 1.2.6 The external earthing terminal shall be of M10.



**1.3 Painting:**

1.3.1 All parts shall be cleaned in a six stage surface prep machine prior coating, including but not limited to:

- Heated alkaline wash;
- Fresh Water rinse;
- Heated iron phosphate coat;
- Fresh water rinse;
- Recirculated deionised water rinse;
- Fresh deionised water mist

1.3.2 After prepping, the equipment shall be dried at 250 degrees for 5-1/2 minutes.

1.3.3 Epoxy polyester hybrid power plant shall be electrostatically applied.

1.3.4 The coated parts are then oven cured for 20 minutes at up to 450 degrees to provide a furniture quality finish. The hot parts are cooled to ambient temperature prior to packaging.

1.3.5 After curing, the paint finish is inert and no volatile emissions are present. There are no fugitive (stray) emissions in the finished product.

1.3.6 Gloss: 50 – 60 degrees  
Impact Resistance: 18.07 Nm  
Flexibility: 180 degrees, ¼ "mandrel  
Pencil hardness: 2H  
Cross hatch adhesion: 100%  
Salt spray: 200 hours minimum  
Humidity resistance: 200 hours minimum  
Micron thickness: 80 microns



**1.4 Main Busbar:**

1.4.1 Main busbar shall be of Aluminium alloy of grade E91E, and as specified in drawing and conforming to relevant standard IS: 5082.

1.4.2 Busbar shall be located in horizontal formation but with gradual gradient as indicated in drawing.

1.4.3 All busbar shall be a solid strip without joints except for the joints necessary from MCCB/Changeover switch to the main Bus bar and shall be rated continuously. The maximum temperature of the busbar

under operating conditions when carrying rated normal current at rated frequency should not exceed 85°C.

1.4.4 Busbar shall be adequately supported on insulators to withstand dynamic stresses due to short circuit current. Busbar support insulators shall conform to relevant standard IS: 2544.

1.4.5 Busbar should not be painted and all performance characteristics specified shall be obtained with unpainted busbars.

### **1.5 Fuses:**

1.5.1 Generally, fuses shall be of HRC cartridge fuse link (Blade contact type), mounted on fuse base support required for 630A (*as per the recommendation from ESD, BPC, Thimphu*). HRC fuses having a rupturing capacity of 100 kA at 415 V, A.C. 50 Hz.

### **1.6 Interior Lighting**

1.6.1 The Distribution Pillar shall be provided with two numbers of a 230V, single phase, 50 Hz, 40W, preferably Bayonet LED Bulb fixture placed diagonally opposite for interior illumination and controlled by a piano switch and HRC fuse link HF of 2 Amps for LED Bulb.

1.6.2 The Distribution Pillar should be supplied completely wired, ready for the Bhutan Power Corporation Limited's external connections at the terminal blocks. All wiring should be carried out with 650 V grade, PVC insulated, 7/20 standard copper wire.

### **1.7 Labels and Danger Plate**

1.7.1 The Distribution Pillar shall be provided with individual component labels with pillar designation or rating. The danger sign as indicated in drawing should be drawn on every pillar. Both external-earthing terminals shall be levelled.

### **1.8 Colour of the Enclosure**

1.8.1 The colour of enclosure should be RAL 7032

### **1.9 Submission of Test Certificate & Drawings**

1.9.1 The supplier shall provide the type test certificates done within Ten (10) years from the reputed testing laboratory.



1.9.2 The Supplier shall provide to the Purchaser the drawings if the contract is awarded for the final approval.

**1.10 Cable Requirement**

1.10.1 The **incomer** cable shall be 2 numbers of 4X1C-400mm<sup>2</sup> (1Run/Phase), unarmoured, PVC insulated UG cable and the **outgoing** cable shall be 6X4C-150mm<sup>2</sup>, Armoured, PVC insulated UG cable for **Type A (with Changeover Switch)**.

1.10.2 The **incomer** cable shall be 4X1C-400mm<sup>2</sup> (1Run/Phase), unarmoured, PVC insulated UG cable and the **outgoing** cable shall be 6X4C-150mm<sup>2</sup>, Armoured, PVC insulated UG cable for **Type B (with MCCB)**.

**1.11 Phase Spreader**

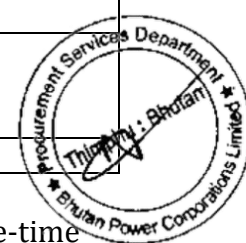
A 4 pole Phase spreader shall be required to both Type A (with Changeover Switch)& Type B (with MCCB) for 800A.

**2.0 Technical Requirements of MCCB**

2.1 The Moulded Case Circuit Breaker shall be generally confirming to IS: 13947-2/ 1993 or IEC: 60947-2 as amended up to date.

**2.2 Electrical Parameters**

Sl.No.	Descriptions	Parameters
1	Standard	IEC: 60947-2 & IS 13947-2
2	Poles	4
3	Frequency (Hz)	50
4	Rated Current (Amps)	800
5	Rated Insulation Voltage (V)	800
6	Rate Operating Voltage (V)	415
7	Impulse withstands voltage (kV)	8
8	Rated ultimate short circuit breaking capacity (kA)	75
9	Utilization Category	A



2.3 The MCCB shall have overload trip- release with inverse-time characteristics for overload protection and magnetic trip-release for instantaneous tripping in the wake of short circuits.



**2.4** All the necessary tests shall be carried out as per the stipulations of IS:13947/1993-part-2 (latest amended) / IEC60947-2 or equivalent International Standards.

**2.5** The Moulded Case Circuit Breaker shall be designed and constructed in such a way as to avoid introducing any danger in normal use and under normal working conditions, so as to ensure especially Personal safety against electric shock/ against effects of excessive voltage and Safety against spread of fire etc. The design of the equipment should be based on IEC: 60947-2 safety standards enabling safe operation.

**3. Technical Requirements of Manual Changeover Switch**

**3.1** The Changeover switch shall comply with IEC 60947-6-1 and other equivalent International Standard.

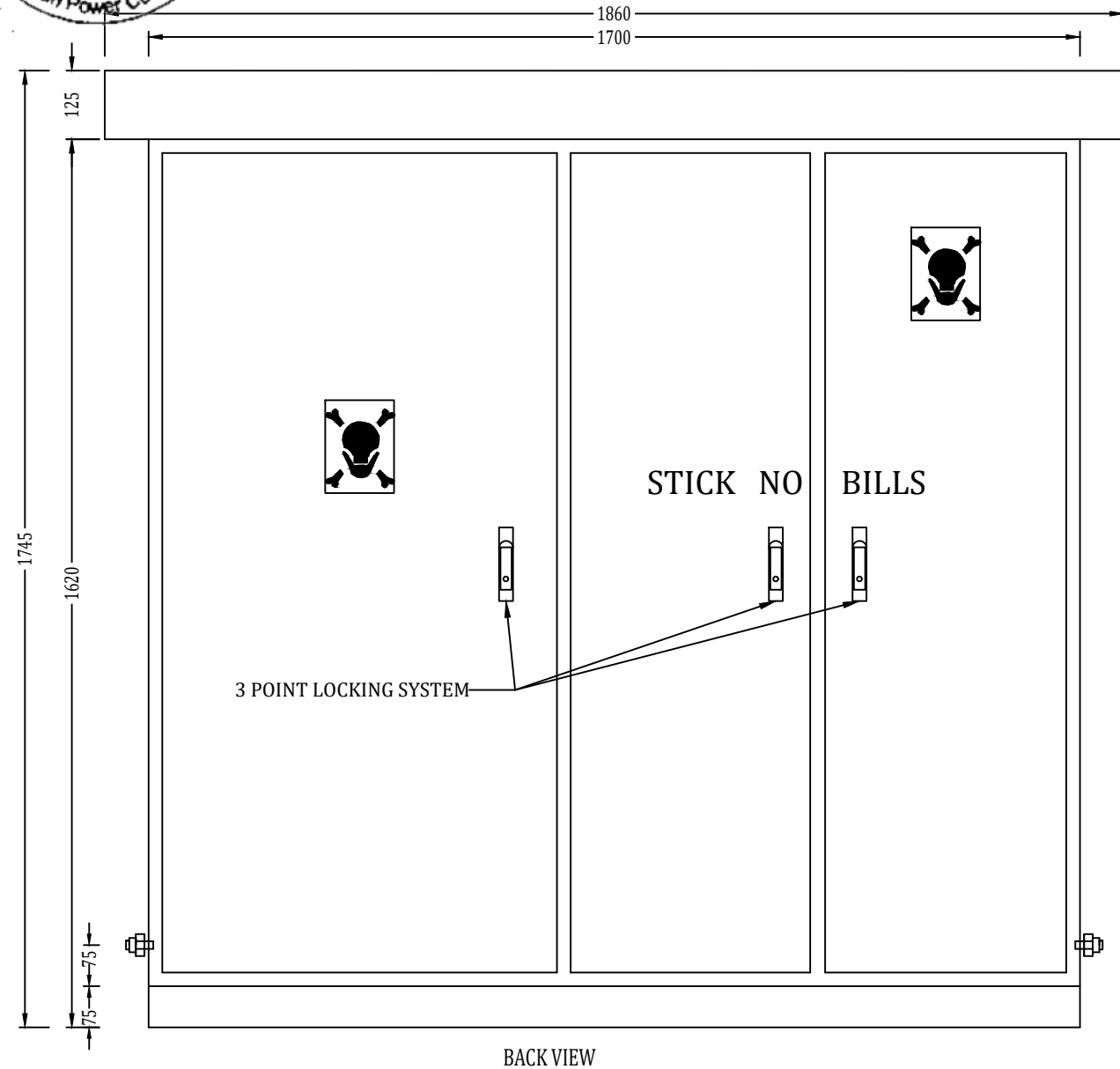
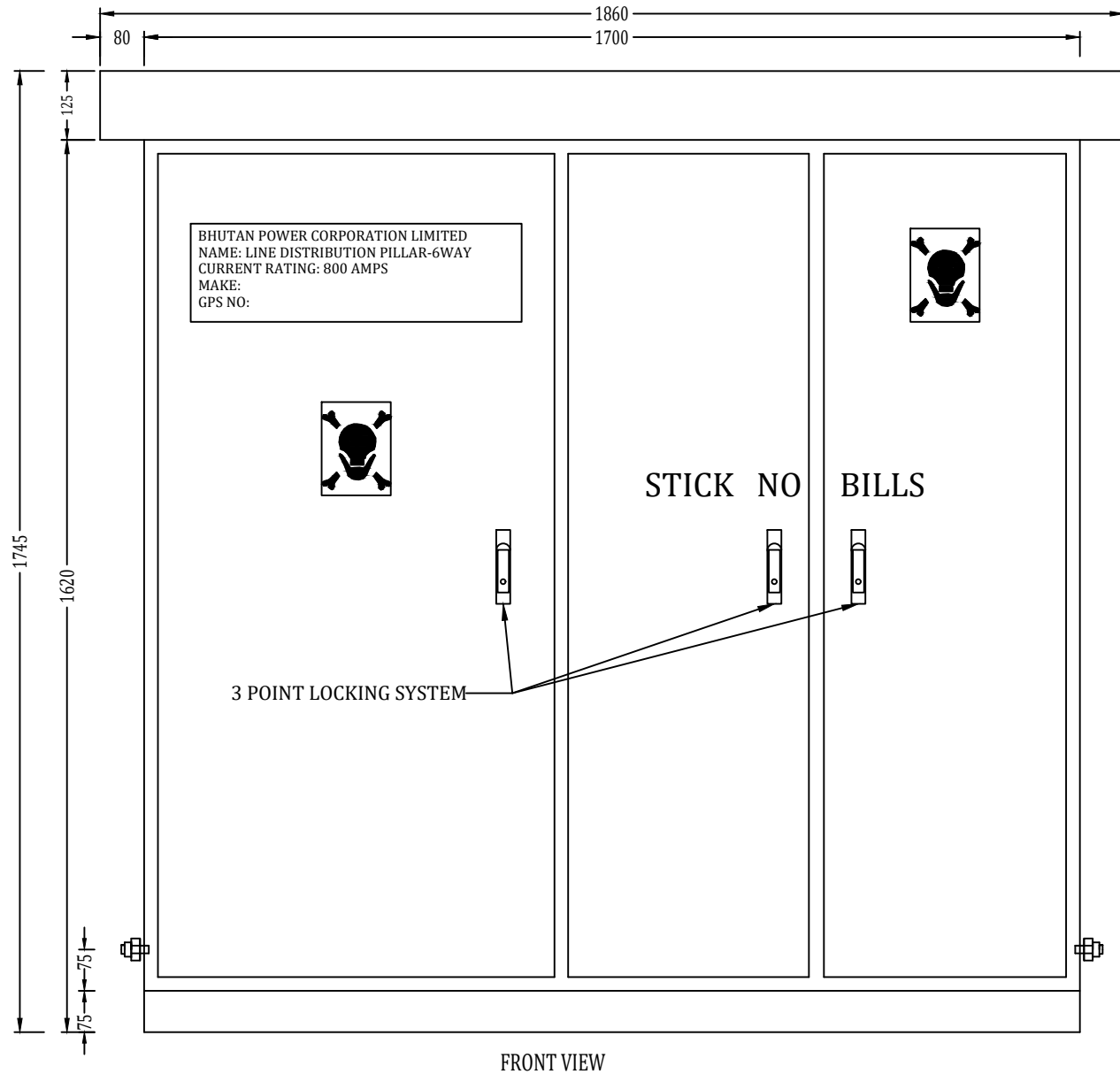
**3.2 Electrical Parameters**

Sl.No.	Descriptions	Parameters
1	Standard	IEC 60947-3
2	Rated Current (A)	800
3	Rated Impulse Withstand Voltage ( $U_{imp}$ )kV	12
4	Rated Insulation Voltage ( $U_i$ )(V)	11000
5	Rate Operating Voltage (V)	1000
	Rated Short-Circuit Making Capacity ( $I_{cm}$ ) (kA)	80
6	Rated Short-time Withstand Current ( $I_{cw}$ ) for 1 second ( $kA_{rms}$ )	20
7	Pole	4
8	Terminal Type	Lug
9	Handle Type	Handle and shaft included
10	Handle IP	65
11	Fourth Pole Position	Right Side
12	Switches Operating Mechanism	Mechanism at the End of the Switch 04 (Left Side)
13	Utilization Category	CAT-A(AC-22A)

**3.3** All the necessary tests shall be carried out as per the IEC 60947-3 (latest amended).



This drawing and design is the property of BPC and must not be passed on to any person who is not authorized by organization nor can be copied or lent without prior permission in writing from the concerned authority.



SIX (6) WAY DISTRIBUTION PILLAR GENERAL ARRANGEMENT

ALL DIMENSIONS ARE IN MILLIMETERS

	<b>BHUTAN POWER CORPORATION LIMITED</b> <b>ENGINEERING &amp; RESEARCH DEPARTMENT</b>	<b>PROJECT:</b> <b>SIX (6) WAY DISTRIBUTION PILLAR DESIGN</b>	DATE		NAME/ DESIGNATION	SIGN	DRAWING TITLE:	SCALE
			18.01.2022		DESIGN & DRAWN	E&RD TEAM		
			DRG. No	E R D / B P C / E L E C - A		SIZE A3	REV. B	REVIEWED BY





