CORRIGENDUM -9 FOR NIT NO CMC/BR/24-25/FK/PR/KG/1231 for Survey, Design, Supply, Erection, Installation, Testing, Commissioning, Handing over of 03 Nos GIS Grid Substations along with associated Civil work and 08 Nos Cable In-feed/ Laying works on Turnkey Basis

CORRIGENDUM DATE: 17-02-2025

Sl. No.	Clause No.	Clause Description	Revised Clause Description
1	Technical Specs Approved Makes & Vendors 1.0 Power Transformer	**1.0 Power Transformer** 1.1 BHARAT BIJLEE Limited 1.2 ABB Limited 1.3 Schneider Electric Limited. 1.4 BHEL 1.5 CGL 1.6 Toshiba	**1.0 Power Transformer** 1.1 BHARAT BIJLEE Limited 1.2 ABB Limited 1.3 Schneider Electric Limited. 1.4 BHEL 1.5 CGL 1.6 Toshiba 1.7 **Voltamp**
2	TECHNICAL SPECIFICATION OF HT INDOOR SWITCHGEAR (33 & 11kV)	Energy meter is not in supplier's scope. Only space and CT/PT wiring is to be provided in all panels except bus coupler and bus PT. Space for Energy meter shall be 200(w) X 350(h) mm2	Energy Meter will be part of 11 KV panels and Control and Relay Panel. So kindly consider energy meters in all panels except bus coupler & bus PT panel for all 03 Grids. The energy meters shall be of "Secure" make and should meet the following specifications: •3P4W meter •Modbus communication protocol •Secondary CT/PT configuration: •PT: /110V, root 3 •CT: /1A, 0.2S class •160,000 pulses per kWh, kVArh, kVAh Serial numbers of the energy meters will be shared during the detailed engineering.
3	Technical Specs for Bus Duct	Not Provided	Attached herewith
4	Technical Specs for OFC Cable	Not Provided	Attached herewith

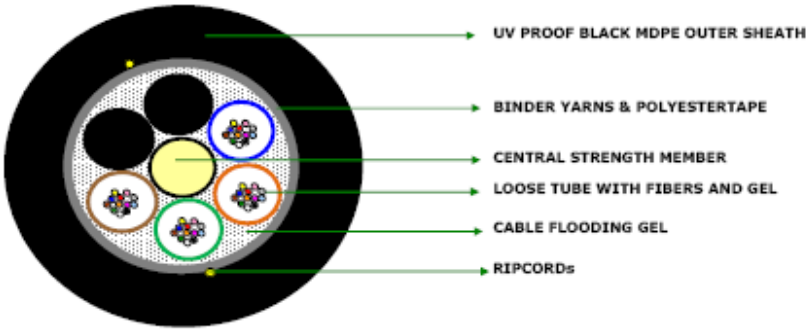
Annexure I:
Details of Optical Fiber Cable

48F Composite Fiber Multitube (MDPE) Single Sheath Duct Lite Optical Fiber Cable

PRODUCT INFORMATION

Fiber			
Single Mode Optical Fiber	**36 Nos.**	**Fiber ITU.T - G.657A1**	
Maximum Cabled Fiber Attenuation dB/Km		1310nm : 0.36 & 1550nm : 0.23 & 1625nm : 0.26	
Multi Mode Optical Fiber	**12 Nos.**	**Fiber OM2 : 50/125**	
Maximum Cabled Fiber Attenuation dB/Km		8500nm : 3.5 & 1300nm : 1.5	
Loose Tube			
Filling Gel		Thixotropic gel to prevent water ingress in loose tube (ITCO T 250)	
Fiber Per Tube	12 Nos.		
Tube	4 Nos.	Thermoplastic Material (PBT)	
Core			
Central Strength Member		Fibre Reinforced Plastic (FRP) to provide tensile strength and antibuckling properties.	
Filler	2 Nos.	Polyethylene Black	
Water blocking elements		Cable flooding gel is added in interstices of core to prevent water ingress in the cable core (ITCO C 480)	
Core Covering		Binder and Polyester Tape	
Cable			
Rip Cord	2 Nos.	Polyester Based Twisted Yarn	Applied below Outer Sheath
Outer Sheathing		UV Proof Black MDPE (ME 6052/ME 6056)	2.2 mm Nominal Thickness

CONSTRUCTIONAL DETAILS



Typical construction Diagram - Not to Scale

OPTICAL FIBER CABLE PERFORMANCE

MECHANICAL				ENVIRONMENTAL	
Max. Tensile strength	2500 N	**Crush Resistance**	2000 N / 100x100 mm	**Temp. Performance**	
Minimum Bend Radius	20 D	**Impact strength**	25 Nm.	**Installation**	-20°C to +80°C
Repeated Bending Test	20 D,30Cycle	**Torsion**	±180°	**Service**	-20°C to +80°C
				Storage	-20°C to +80°C
Water Penetration	1m head, 3m samples, 24 Hr			**Drip Test**	30 cm, 70°C, 24 hr

Tests shall be carried out as per IEC 60793 & IEC 60794-1-2/GR 20 Standards. Change in attenuations shall be ≤ 0.05 dB.

COLOR DETAILS

Optical Fibre Colour	Blue, Orange, Green, Brown, Slate, White, Red, Black, Yellow, Violet, Pink, Aqua.
Loose Tube Colour	For G657A1 : Blue, Orange, Green & For OM2 : Brown.
Outer Sheath Colour	Black

PHYSICAL PARAMETERS

Cable Diameter (mm)	11.75 ± 0.25	**Cable Wt. (Kg/Km)**	114 ± 10%	**Cable Length:**	2 Km ± 5%

PRINTING DETAILS

Cable Printing details (White - Hot Foil Emb.)	48F TELEPHONE SYMBOL LASER SYMBOL MONTH & YEAR OF MANUFACTURE LENGTH CODE METER MARKING

The accuracy of marking shall be ± 0.5%. Occasional loss of printing & remarking shall be as per Bell core GR 20 and this supercedes the earlier markings.

BSES

BSES RAJDHANI POWER LIMITED

Technical Specification for

11 kV Segregated Phase Bus Duct

For 66/11 kV G-4 Grid Substation

Specification No. GN101-03-SP-54-00

Prepared by:	Sign:	Approved by:	Sign:	Rev	Date
Hemanshi Kaul		Kiran Alla		R0	July 14, 2015

Kiran Kumar Alla
HoD - Central Engg Services
Emp. No. 41015970
BSES Rajdhani Power Ltd.

Contents

1. **Intent of Specification:**

This specification covers the design, manufacturing, testing at manufacturer's work, packing and delivery at site/stores of purchaser including installation and successful commissioning of 11 kV Segregated Phase Bus Duct at site.

2. **Scope:**

a. Design, manufacture, testing at manufacturer works before dispatch, packing, and delivery of Bus Duct as per this specification and supply of commissioning spares.

b. Supply and installation of Bus Duct including all accessories.

c. Submission of drawing documentation of Bus Duct.

d. Supervision of testing & commissioning of Bus Duct at site.

3. **Relevant standard:**

S. No.	Standard No.	Standard Details
1	IS 8084	Specification for interconnecting Bus bar for AC voltage above 1Kv up to and including 36Kv.
2	IS 2544	Porcelain post insulators for systems with nominal voltage greater than 1000 Volts (first revision)
3	IS 5350 Part - 1	Dimensions of indoor and outdoor porcelain post insulator and post insulator units for system with nominal voltage greater than 1000 V: Part 1 Indoor post insulators
4	IS 9431:1979	Indoor post insulators of organic material for systems with nominal voltages greater than 1 000 V up to and including 300 kV
5	IS 4759	Hot Dip Zinc coating on structural steel and allied product
6	IS 2629	Recommended Practice for Hot Dip Galvanizing of Iron and steel
7	IS 2062-1999	Hot Rolled Low, medium and high tensile Structural Steel
8	IS 2099	Bushing for alternating voltage above 1000V
9	IS 1893	Criteria for earthquake resistant design of structure
10	IEEE No. 298	Temperature rise calculations
11	IEEE Std. C37.023	Metal enclosed Bus Duct
12	IEC 62271-200	AC Metal enclosed switchgear and Control gear for Rated Voltages above 1 kV and up to and including 52 kV
13	IEC 62271-1	High Voltage switchgear and Control gear – Part 1: Common specifications
14	IEC 60694	Common Specification for high voltage switchgear and Control gear standards
15	IEC 60060	High-voltage test techniques. Part 1: General definitions and test requirements
16	IS 875	Code of practice of design loads (other than earthquake) for buildings and structures
17	IS 800	General Construction in Steel - Code of Practice
18	CBIP Manual	CBIP manual on busduct 2007 - Publication number 303
19		Any other relevant standard

4. Major Design Criteria:

MAJOR DESIGN CRITERIA FOR SEGREGATED PHASE BUS DUCT		
4.1	**Enclosure**	
4.1.1	General	The three phases shall be enclosed in a weather-proof, dust-tight, phase segregated type with non-magnetic metal
4.1.2	Shape	Preferably rectangular in shape.
4.1.3	Dimensions	As per design, maintaining necessary clearance as per relevant IS
4.1.4	Material and Thickness	Aluminum alloy of min 3mm thickness
4.1.5	Slope	Bus duct shall be with plain top
4.1.6	Phase Barriers	i. Phase barriers shall be provided in the bus duct for phase segregation. Ii. The barrier shall be welded to the enclosure.
4.1.7	Identification	For identification of each part of bus duct or accessories for installation at site, appropriate match mark or part number shall be done
4.1.8	Gasket	i. Flange gasket of neoprene shall be provided for the dust tight joints between adjacent enclosure sections ii. Gasket shall be preferably of the joint less type
4.1.9	Expansion Bellows	i. Rubber below shall be provided with pressure plate to withstand vibration, expansion or contraction at equipment terminations. ii. Shall be provided at suitable intervals in any straight run of bus duct where the expansion and contraction would otherwise result in stress of the supporting structures. iii. Shall be weather-proof, non - deteriorating type without any adverse impact with exposure to sunrays, rain etc.
4.1.10	Inspection Opening	i. Shall be provided (on top surface) to allow easy access to support insulator, bus joints, switchgear terminals, etc., for maintenance, checking and replacement. ii. All inspection openings shall have reliable sealing arrangement with neoprene gasket.
4.1.11	Seal off bushings	Epoxy resin cast seal-off bushings complete with wall frame and support plates shall be provided at all wall crossings to avoid propagation of fire and free exchange of air.
4.1.12	Wall frame assembly	During detailed Engineering
4.1.13	Drain plugs	i. To be provided at the lowest points and at such locations where accumulation of condensate can be expected. ii. Drain plug shall be located at suitable place convenient to

		operate.
4.1.14	Silica Gel Breathers with dust filter	Shall be provided and designed for easy maintenance
4.1.15	Hardware	Hardware for flange joints shall be of electro galvanized MS. (bolt+1N+1SW+2PW-HTS Zn Plated).
4.2	**Bus Conductor**	
4.2.1	Design	i. The bus conductor shall be of electrolytic grade tinned copper supported on wet processed insulators designed to withstand dynamic stress due to the specified short circuit current and other forces. ii. The bus conductor shall be designed for bolted connections throughout the run (high grade stainless steel nuts bolts plain and belle-ville washers). iii. Copper Flexible connections shall be provided minimum at 10mtrs interval between bus sections to allow for expansion and contraction of the conductor. Flexible connections shall be provided at all equipment terminations. iv) All contact surfaces shall be silver plated to ensure an efficient and trouble - free connection. All connection hardware shall be non-magnetic and shall have high corrosion resistance. v) Bus bar calculations shall be submitted to the purchaser along with the drawings and documentation for approval. All de-rating factors applicable shall be taken into consideration. Bimetallic connectors of approved make shall be used for connections where bus conductor material is different. vi) Necessary space and arrangement for transposing of phase conductor to match the phase sequence of end panels' Bus bar.
4.2.2	Marking and identification	All bus bars shall be color coded as Red, Yellow and Blue at regular intervals for easy identification of phases
4.3	**Insulators**	
4.3.1	Type	Bus support insulators shall be interchangeable, high creep and high strength, wet process, suitable for heavily polluted atmosphere. Creepage distance of 31mm/kV
4.3.2	Stress Concentration	The insulator shall avoid stress concentration due to direct engagement with the metal fittings
4.3.3	Inspection / Removal / Replacement	The insulator shall be designed and mounted in such a manner so as to facilitate easy inspection, removal and replacement without disturbing the conductor.
4.3.4	Insulator Mounting Plate	Shall be designed for cantilever loading to withstand the short circuit forces.

4.3.5	Conductor mounting on insulator	The conductor shall be fastened on the insulator through fixed and slip joints so as to allow conductor expansion or contraction without straining the insulator
4.3.6	Insulating support at bends	Additional support insulators shall be provided at bends for withstanding all possible forces
4.4	**Terminations at equipment ends**	
4.4.1	Accessories	All matching flanges, flexible connections, phase changeover boxes / adaptor boxes, gaskets, fittings, hardware and support required for termination of the bus duct at switchgear ends shall be provided.
4.4.2	Termination Adaptor	i. Supply the required adaptor of suitable dimension to match with terminating equipment
		For terminating the bus conductors at the switchgear terminals suitable flexible connections shall be provided.
		Flexible connection at equipment termination shall be able to take care of misalignment up to 25mm in all directions.
4.5	**Conductor Joints / Flexible Links**	
4.5.1	Contact surface	All joints in the bus conductor shall be plain
4.5.2	Flexible links type and material	i. Braids or multiple laminations ii. Shall be copper with silver plating on both contact surfaces for termination. iii. Shall be Copper for switchgear termination. iv. Shall be Copper for expansion joints in the bus conductor. v. The palms of Copper flexible shall be of welded construction only.
4.5.3	Hardware	Bolts and nuts for main bus bar joints shall be of high grade stainless steel, with plain / spring steel belle-ville washers (Bolt+1N+1SW+2PW-HTS Zn Plated)
4.5.4	Bi-metallic connectors	Shall be provided wherever the material of bus conductor and equipment terminals are different
4.6	**Earthing**	
4.6.1	Earthing conductor	i. Continuous earth conductor shall be provided along the entire run of each bus duct on the outside mandatorily. Ii. Shall carry the rated short -circuit withstand current for rated duration of short-circuit and shall be at least 50X6mm copper strip iii. All parts of the bus enclosure and supporting structure shall be bonded to the above ear thing bus. iv. Drilled holes on the enclosure for the purpose of mounting of the earthing conductor will not be permitted, to prevent ingress

		of water.
4.6.2	Terminal pads	i. Earthing pads with hardware shall be provided on both ends of the earthing conductor to connect the riser from station earthing grid. Ii. Shall have drilled holes for bolting.
4.7	**Supporting arrangement**	
4.7.1	Scope	All supporting structures required for hanging and/or supporting the complete bus duct shall be furnished. These include all members, indoor posts, bolts, shims, base plates, beams, hangers, brackets, bracings and hardware.
4.7.2	Material	Shall be of high strength steel with weather resistant finish as per IS 2062-99
4.7.3	Design Considerations	i. Design shall be done conforming to IS 800 ii. The bus duct shall be adequately supported and braced to successfully withstand normal operation, vibration, thermal expansion, short circuit forces, seismic forces and all specified design load all along its route. iii. All supporting members and hardware shall be designed to limit the transmission of bus duct and supporting member weight forces to equipment. iv. Safety factor of 2.0 shall be used.
4.7.4	Supporting arrangement	Indoor portion of the bus ducts shall be hanging and supported from roof beams or steel inserts in roof / wall
4.7.5	Tolerance	Supports shall be designed to provide tolerance of +/- 12mm (1/2") in the horizontal and vertical directions.
4.7.6	Galvanization	i. All steel members shall be hot -dip galvanized as per IS 4759 and IS 2629. ii. Minimum thickness of zinc coating shall not be less than 610g/sq.m or 86 micron
4.8	**Space heater**	
4.8.1	Provision	The bus duct shall be provide with adequate number of space heaters mounted on insulated feet to maintain internal temperature above the dew point
4.8.2	Temperature control	By an adjustable thermostat, factory set to close at 30 Deg C(ON) and open at 65Deg C (OFF)

4.8.3	Internal Wiring	i. Space heater and thermostat shall be wired up to terminals in terminal boxes mounted on the bus duct, for external cable connections. Ii. The wiring inside the bus duct shall be done with 1100V grade high temperature resistance cable suitable for the bus duct maximum temperature. iii. The minimum size of stranded copper conductor shall be 2.5sqmm iv. All wires inside the bus duct shall be laid in the GI Conduit. v. Terminal boxes shall be provided with removable gland plated for cable entry.
4.8.4	Marshalling Box	Marshalling box suitable for wall mounting shall be supplied. It shall house the ON/OFF switch, Contactor and other controls / wiring as required.
4.8.5	External Cabling	Cable from terminal boxes to marshalling box shall be in purchasers scope
4.8.6	Power supply	240V single phase 50Hz shall be cabled by the purchaser to the marshalling box
4.8.7	Control Terminal blocks	i. Box-clamp type suitable for 2x2.5 Sq.mm. copper conductor with marking strips. ii. Not more than two wires shall be connected to one terminal
4.8.8	Spare terminals	20% of active terminals shall be provided in the terminal box
4.9	**Painting**	
		i. All surfaces shall be thoroughly cleaned and cleared of all blemishes. De-rusting, degreasing, etc shall be done before painting or galvanizing. Paints shall be carefully selected to withstand heat. The paints shall not scale off or crinkle or get removed by abrasion due to normal handling. ii. Except for support steel structures (which shall be galvanized), all equipment shall be finished with an undercoat of high quality primer followed by two coats of synthetic enamel paints unless otherwise epoxy paints as specifically required. iii. The interior surface finish shall be as per manufacturer's standard. The shade of exterior surface finish for indoor shade shall be informed during detail engineering. iv. Sufficient quantities of all paints and preservatives required for touching up at sites shall be furnished.
4.10	**Nameplate**	
4.10.1	Material for nameplate	Aluminium / stainless steel, 1mm thick, using black letters

		i. Subject to approval during detailed engineering ii. Details on the nameplate shall be as per IS:8084
4.11	**Special Tools & Tackles**	
		i. A set of special tools & tackles which are necessary or convenient for erection, commissioning, maintenance and overhauling of the equipment shall be supplied. ii.The tools shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended.
4.12	**Spares**	The Bidder shall submit a list of recommended spare parts for five (5) years for satisfactory and trouble free operation, indicating the itemized price of each item of the spares.

5. Drawing, data & manuals:

a. General Arrangement Drawing – Plan and Sections.
b. Typical details of bus-insulator assembly, conductor/enclosure connections rigid & flexible, seal-off bushings, connection with transformer & switchgear terminals, etc.
c. Bill of Materials.
d. Technical leaflets/Write-ups on various pieces of equipment offered.
e. Calculation for temperature rise for bus and enclosure as per IEEE No. 298.
f. Calculation for short circuit forces justifying the proposed arrangement.
g. Type test reports on similar equipment.

6. Approved Makes:

Sl. No.	Description of Item	Approved 'Makes'
1	Electrolytic grade tinned copper	
2	Bus support insulator	
3	Seal off bushing	
4	Flexible bellow	
5	Flexible conductor	
6	Gaskets	

7. Quality Assurance:

Bidder shall submit the Quality Assurance Plan along with the Guaranteed Technical Particulars.

8. Enclosure:

a. Annexure A – General Technical Particulars
b. Annexure B – Service Conditions
c. Annexure C – General Technical Particulars (Data by Bidder)
d. Annexure D – Site Layout and Suggestive Sectional View

Annexure A – General Technical Particulars

RATINGS & REQUIREMENTS		
1	**GENERAL (Applicable to all equipment)**	**11000 V SYSTEM**
1.1	System nominal voltage	11000 V
1.2	System maximum voltage	12000 V
1.3	Number of phases	3
1.4	Frequency	50 Hz
1.5	Neutral Grounding	Neutral solidly grounded
1.6	Insulation level	
	a. 1-min. power frequency withstand	28 kV rms
	b. Impulse withstand	75 kV peak
1.7	Creepage distance	31mm/kV
1.8	Short Circuit Level	26.3 kA for 3 Sec.
1.9	Ambient Temperature	50°C
1.10	Humidity	100%
2	**BUS DUCT**	
2.1	Type	Phase segregated self-cooled
2.2	Service	Indoor
2.3	Rated hottest-spot temperature rise (Over 50°C ambient)	a. Bus conductor i. Plain joint 35°C ii. Silver plated joints 55°C b. Bus enclosure & Structure 20°C
3	**Material**	
3.1	Bus conductor	Electrolytic grade tinned copper
3.2	Rated Continuous Current in Amp	2000A
3.3	Short circuit rating of Bus Bar	26.3kA for 3 sec
3.4	Bus enclosure	Aluminum Alloy grade 19501, 60% IACS (min 3 mm thick)
3.5	Inter-phase barrier	Aluminum alloy (min 3 mm thick)
3.6	Enclosure Protection Class	IP-52 for Indoor Installation (Min)
4	**Clearances**	As per relevant IS

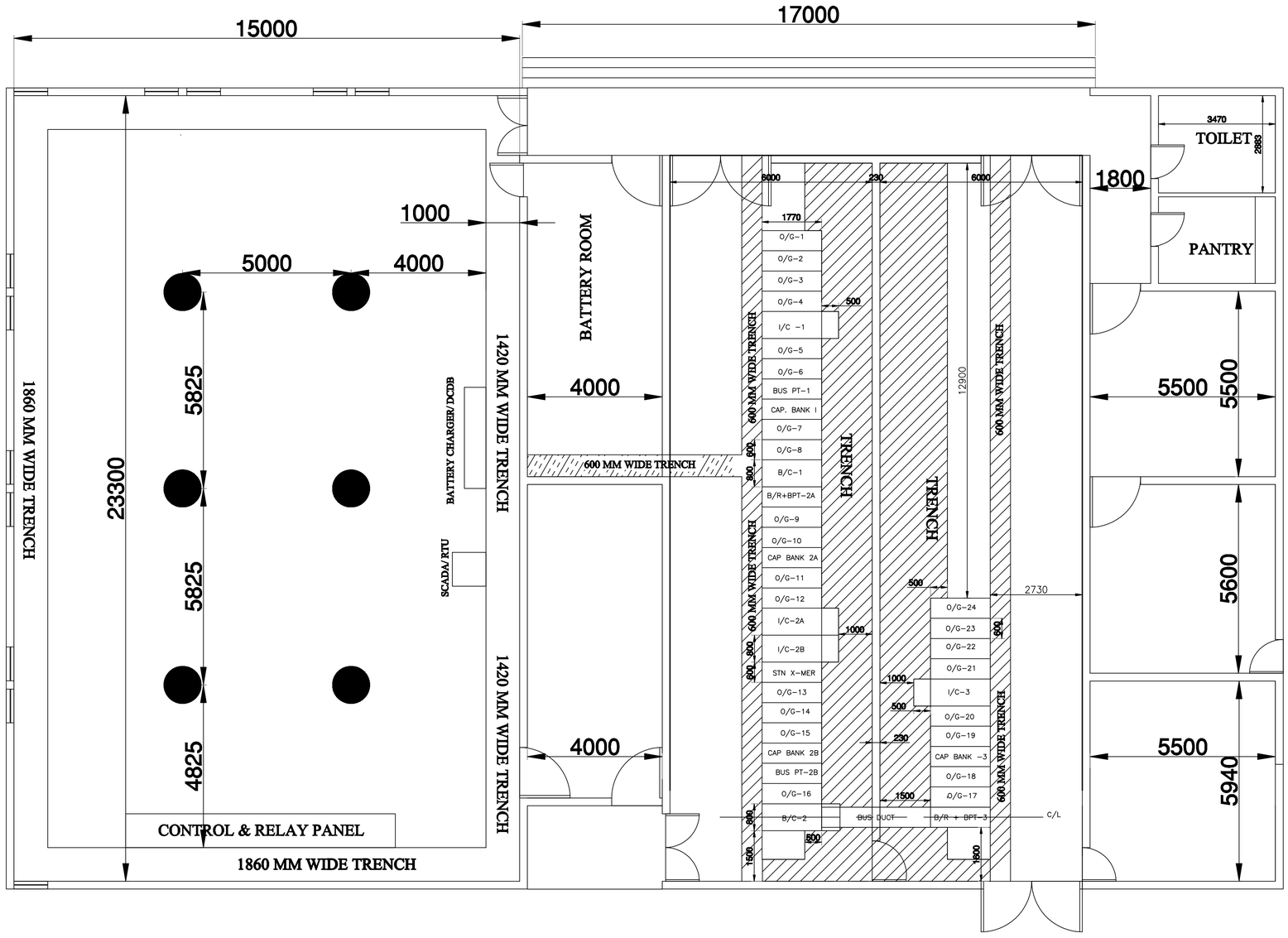
Annexure B – Service Condition

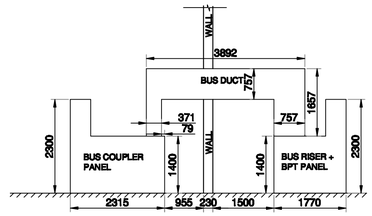
S. No.	Particulars	Data
1	Average grade atmosphere pollution level	Heavy polluted , dry
2	Maximum altitude above Sea level	1000 M
3	Ambient Air temperature	Highest 50 deg C, Average 40 deg C
4	Relative Humidity	100 % Max
5	Seismic Zone	IV as per IS 1893
6	Rainfall	750 mm concentrated in four months
7	Wind Pressure	195 Kg/m2 up to 30 M elevation as per IS 875-1975

Annexure C: Guaranteed Technical Particular (Data to be filled by bidder)

S. No.	**Particulars**	**Data by Purchaser**	**Data by Bidder**
1	**General**		
1.1	System nominal voltage	11000 V	
1.2	System maximum voltage	12000 V	
1.3	Number of phases	3	
1.4	Frequency	50 Hz	
1.5	Neutral Grounding	Neutral solidly grounded	
1.6	Insulation level		
	a. 1-min. power frequency withstand	28 kV rms	
	b. Impulse withstand	75 kV peak	
1.7	Creepage distance	31mm/kV	
1.8	Short Circuit Level	26.3 kA for 3 Sec.	
1.9	Ambient Temperature	50°C	
1.10	Humidity	100%	
2	**BUS DUCT**		
2.1	Type	Phase segregated self-cooled	
2.2	Service	Indoor	
2.3	Rated hottest-spot temperature rise (Over 50°C ambient)	c. Bus conductor i. Plain joint 35°C ii. Silver plated joints 55°C d. Bus enclosure & Structure 20°C	
2.4	Overall dimensions (LxBxH)		
3	**Material**		
3.1	Bus conductor Material	Electrolytic grade tinned copper	
3.2	Rated Continuous Current in Amp	2000A	
3.3	Short circuit rating of Bus	26.3kA for 3 sec	

	Bar		
3.4	Bus enclosure	Aluminium Alloy grade 19501, 60% IACS (min 3 mm thick)	
3.5	Inter-phase barrier	Aluminium alloy (min 3 mm thick)	
3.6	Enclosure Protection Class	IP-52 for Indoor Installation (Min)	
3.7	Bus Bar Size (LxBxT)(mm)		
4	**Clearances**	As per relevant IS	





BUS DUCT DETAILS ELEVATION

NOTE:
1. FLENGE DETAILS FOR BUS DUCT SHALL BE AS PER PANEL MANUFACTURER DRAWING.
2. NECESSARY ARRANGEMENT FOR PHASE CROSS OVER IN THE BUS DUCT NEED TO BE PROVIDED.
3. CLEAR HEIGHT BENEATH THE BUS DUCT IS TO BE MAINTAINED AS PER DRAWING.
4. DIMENSIONS OF BUS DUCT SHALL BE DECIDED AS PER DESIGN, CONSIDERING SECTIONAL CLEARANCES.

NOTE:
1. CONTROL PANEL DIMESIONS & OTHER DETAILS SHALL BE AS PER MANUFACTURER DRAWING.
2. BATTERY CHARGER, DCDB AND ACDB DIMENSIONS SHALL BE AS PER MANUFACTURER DRAWING.
3. SECTIONAL DETAILS OF ALL THE TRENCH HAS ALREADY BEEN RELEASED VIDE DRAWING NO.BRPL/ CES / G-4 DWARKA/ C /POWER CABLE TRENCH SECTION/ 001; DATED 04-08-2014.
4. WIDTH OF CONTROL CABLE TRENCH IN FRONT OF 11 kV PANELS HAS BEEN REVISED TO 600 MM.
5. WIDTH OF 11 kV PANELS:
   ALL INCOMMERS, BUS COUPLERS - 800 MM
   ALL OUTGOINGS, STATION TRANSFORMERS, CAPACITOR BANKS, BUS RISERS AND BUS PT - 600 MM
   (REFER MANUFACTURER'S DRAWING)

TITLE:
GENERAL ARRANGEMENT OF 11 kV PANELS

PROJECT:
66/11 kV SUBSTATION AT G-4, SECTOR - 18 DWARKA

BSES RAJDHANI POWER LIMITED
CENTRAL ENGINEERING SERVICES
BUILDING NO. 20, 5th FLOOR,
NEHRU PLACE, NEW DELHI -110019

					DRAWN:	REVIEWED: / SHEET: A1
					CHECKED:	APPROVED: / SCALE: NTS
					REF.NO.:	DATE:
		AS PER APPROVED PANEL DRAWING	01	17-06-2015	DRAWING NO: BRPL/ CES / G-4 DWARKA/ E /11 kV PANEL ARRANGEMENT/ 001;	REV.NO.: 00 / DATE: 14-10-2014
APPROVED	CHECKED	REASON	REV. No.	DATE		