

Transmission Service Agreement

9. REQUIREMENT OF 245 KV CVT

S. No.	DETAILS	PARTICULARS		
1.	Transformation ratio on all windings	220,000 / 110 $\sqrt{3}$ $\sqrt{3}$ (No. of secondary windings 3)		
2.	Supply frequency	50 Hz.		
3.	Type	Capacitor voltage type.		
4.	Rated voltage factor	1.2 continuous 1.5 for 30 seconds.		
5.	Application	Winding I Protection	Winding II Protection	Winding III Metering/Sync hro.
6.	Accuracy	3P	3P	0.2
7.	Phase angle error	----- As per IS -----		
8.	Output burden	150 VA	150 VA	50 VA
9.	Rated capacitance	4400 + 10% - 5%		
10.	Rated total thermal burden	750 VA		
11.	Standard reference range of frequency for which the accuracies are valid.	97% to 103% for protection & 99% to 101% for measurement.		
12. a)	One minute power frequency test on secondary winding.	3 KV (r.m.s.)		
b)	Withstand voltage between low voltage terminal and earth terminal	4 KV (r.m.s.)		


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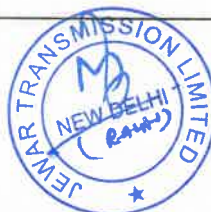

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S. No.	DETAILS	PARTICULARS
(Note : This test voltage shall be 10 KV (r.m.s.) in the low voltage terminal exposed to weather).		
c)	Radio. interference voltage of 266 KV (r.m.s.)	Not exceeding 500 microvolts.
13.	Corona extinction voltage.	320 KV (r.m.s.)
15.	Partial discharge level at rated voltage for capacitor divider.	Less than 10 pico coulombs


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10. TECHNICAL SPECIFICATION OF 145 KV POTENTIAL TRANSFORMERS**STANDARDS :**

Unless otherwise specified elsewhere in this specification, the rating as well as performance and testing of the 145 KV Potential Transformers along with associated accessories shall conform but not limited to the latest issues/ amendments of standards available at the time of placement of order of all the relevant standards as listed hereunder.

Standard No.	Title
IS:3156:1992) Transformers	Specification for Voltage (Part I to III) & IEC 186: 1987
IS:2099	Specification for High Voltage porcelain bushing
IS:335	Specification for Insulating oil for T/F & Switchgear
IS:3202	Code of practice: climate proofing of Electrical equipment
IS:4146: 1983	Application Guide for Voltage Transformers.
IS: 2629	Recommended practice for hot dip galvanizing of iron & steel.

PRINCIPAL TECHNICAL PARAMETERS

The Potential Transformers shall conform to the following specific parameters:

Parameters	Specification 145 kV
Type of installation	Single phase, Oil immersed, self cooled, Hermetically sealed, Outdoor type.
Type of mounting	Mounting on steel structures
Suitable for system frequency	50 Hz $\pm$ 5%
Highest system voltage	145 kV
Transformation ratio on all windings	132,000 / 110 $\sqrt{3}$ / $\sqrt{3}$


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Parameters	Specification 145 kV
Method of earthing	Solidly Grounded
1.2/50 micro second lightning impulse withstand voltage kV (peak)	650
1 minute dry power frequency withstand voltage kV (rms)	275
One minute power frequency withstand voltage on secondary	3 kV
Min. Creepage Distance mm.	3625
Voltage ratios and other requirements of the Voltage Transformers shall comply with the requirement indicated in Annexure-I (B) for 145kV PTs respectively.	
Maximum permissible temperature rise of windings of voltage transformers shall be 45 °C over an ambient of 50°C.	

REQUIREMENT OF 145 KV PT

S. No.	DETAILS	PARTICULARS		
1.	Transformation ratio on all windings	132,000 / 110 $\sqrt{3}$ $\sqrt{3}$ (No. of secondary windings 3)		
2.	Supply frequency	50 Hz.		
3.	Type	Single phase, Oil immersed, self cooled, Hermetically sealed, Outdoor type.		
4.	Rated voltage factor	1.2 continuous and 1.5 for 30 seconds.		
5.	Application	Winding I Protection	Winding II Protection	Winding III Metering
6.	Accuracy	3P	3P	0.2 Note : Acc. of 0.2 to be


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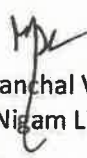


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S. No.	DETAILS	PARTICULARS		
				maintained up to and including a total simultaneous burden of 100 VA on all the windings.
7.	Phase angle error	As per relevant IS		
8.	Output burden	50 VA	50 VA	50 VA
9.	Creepage distance of bushing	3625 mm (minimum).		
10.	Total simultaneous burden	100 VA		
11.	One minute power frequency withstand voltage on secondary.	3 KV (r.m.s.)		
12.	Rated Power Factor	0.8		
13.	Class of insulation in windings	A		


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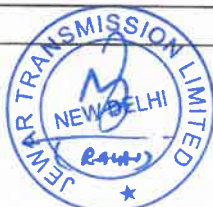

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11. TECHNICAL SPECIFICATION OF 36KV POTENTIAL TRANSFORMERS**SCOPE :**

This Specification covers the design, manufacture, assembling, testing at manufacturers' works, supply and delivery of single phase Potential Transformers with terminal connectors and junction boxes for service in 33 KV, three phase system.

Type & Rating :

The potential transformers shall be outdoor type, single phase, oil immersed, self cooled, suitable for operation on three phase, 50 c/s, 33 KV Solidly Grounded system where the short circuit level of the system is of the order of 1000 MVA under the tropical climate conditions specified under General Requirement of Specification.

The potential transformers should have the following ratings:-

1. Rated Voltage	33 KV
2. Nominal System Voltage	33 KV
3. Highest System Voltage	36 KV
4. Type of Supply	3- Phase A.C.
5. Frequency	50 Cycles/sec.
6. Earthing	Solidly Grounded
7. No. of Secondary Windings	Two
8. Transformation Ratio:	Winding – I & II 33 KV/ $\sqrt{3}$ / 110 Volt/ $\sqrt{3}$
9. Rated Burden:	
	Winding – I 50 VA each
	Winding – II 50 VA each
10. Accuracy Class:	
	Winding – I 0.2 for metering
	Winding – II 3P for protection
11. Basic Insulation Level (Impulse)	170 KV (Peak)
12. Creepage distance	900 mm (minimum)


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13. Rated Voltage Factor:	
	(a) Continuous 1.1
	(b) 30 seconds 1.5
14. Service Conditions	Outdoor, direct in Sun service.
STANDARDS:	
The potential transformers should confirm in all respects to latest edition of ISS: 3156/1965 except wherein specified otherwise.	
1. Rated Voltage	33 KV
2. Nominal System Voltage	33 KV
3. Highest System Voltage	36 KV
4. Type of Supply	3- Phase A.C.
5. Frequency	50 Cycles/sec.
6. Earthing	Solidly Grounded
7. No. of Secondary Windings	Two
8. Transformation Ratio:	Winding – I & II 33 KV/ $\sqrt{3}$ / 110 Volt/ $\sqrt{3}$

REQUIREMENT OF 36 KV PT

S. No.	DETAILS	PARTICULARS	
1.	Transformation ratio on all windings	33,000 / 110 $\sqrt{3}$ $\sqrt{3}$ (No. of secondary windings 2)	
2.	Supply frequency	50 Hz.	
3.	Type	Single Phase wound electromagnetic type PT	
4.	Rated voltage factor	1.1 continuous 1.5 for 30 seconds.	
5.	Application	Winding I Metering	Winding II Protection
6.	Accuracy	0.20 Note : Acc of 0.2 to be maintained up to and including a total simultaneous burden of 75 VA on all the three	3P


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		windings.	
7.	Phase angle error	As per relevant IS	
8.	Output burden	50 VA	50 VA
9.	Total simultaneous burden	75 VA	
10.	One minute power frequency withstand voltage on secondary.	3 KV (r.m.s.)	
11.	Rated Power Factor	0.8	
12.	Class of insulation in windings	A	
13.	Method connection which will be adopted		
	-Primary winding	Star/earthed	
	-Secondary winding I	Star/earthed	
	-Secondary winding II	Open delta	


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12. TECHNICAL SPECIFICATION FOR 245 AND 145 KV MOTOR OPERATED ISOLATORS**STANDARDS**

The Isolators shall conform to the latest revisions with amendments available of relevant standards, rules and codes, some of which are listed herein for ready reference.

Sl. No.	Standard	Title
1.	IEC-168	Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 100
2.	IEC-129	Alternating Current disconnectors and earthing switches.
3.	IS-1818	Specification for alternating current isolators (disconnectors) and earthing switches.
4.	IS-9921	Specification for outdoor air break isolators and earthing switches for voltages up to 220 kV.
5.	IS-5561	Electrical power connectors
6.	IS-325	Specification for three phase induction motors.
7.	IS-3202	Code of practice for climate proofing of electrical equipment
8.	IS-2544	Specification for porcelain post insulators (3.3 kV and above)

TECHNICAL SPECIFICATIONS FOR 36 kV ISOLATORS

1.0	TYPE OF ISOLATORS
	a) Three phase, 1250 A, 36 kV manually operated, Standard isolators without earth switch.
	b) Three phase, 1250 A, 36 kV manually operated, Standard isolators with one earth switch.
2.0	PRINCIPAL PARAMETERS

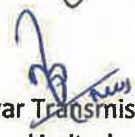

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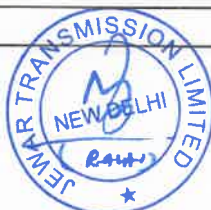

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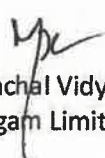


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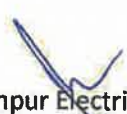
Sl. No.	DETAILS	<u>36 kV Isolator</u>
1	Rated Voltage	36 kV
2	System frequency	50 Hz
3	System Earthing	Effectively earthed
4	Type of Isolator	Outdoor, Horizontal air break suitable for upright mounting
5	Continuous current rating	1250 A
6	Operating mechanism	Manual
7	Phase to phase spacing	1500 mm
8	Rated short time withstand current	25 kA (rms)
9	Rated peak short circuit current	62.5 kA (peak)
10	Temperature rise	As per IEC-129 derated for an ambient of 50°C
11	Seismic co-efficient	0.3 g.
12.	1.2/50 microsecond full wave positive and negative impulse withstand voltage to earth	70 kV (peak)
13.	One minute power frequency withstand voltage dry & wet to earth	70 kV (rms)
14.	Auxiliary Contacts	4 normally open and 4 normally closed.
15	Insulation level of insulators	
	i) Impulse voltage withstand test (1.2/50 micro second full wave)	170 kV (peak)
	ii) Power frequency withstand	70 kV (rms)


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	voltage to earth (dry & wet)	
16	Creepage distance of insulators :	
	i) Total	900 mm
	ii) Protected	450 mm
17	Minimum strength :	Suitable to withstand wind, short circuit and operating forces
	i) Torsional	
	ii) Cantilever	
18	Interlocks with circuit breaker	1 set of electrical and castel type interlocks.
19	Type of contacts	Hard drawn electrolytic copper with silver plating
20	Conductor take off	Horizontal/vertical according to actual requirement.
21.	Phase-to phase clearance	1500 mm


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13. TECHNICAL SPECIFICATION FOR 245/145/36KV SOLID CORE POST INSULATORS**STANDARDS**

Insulators should conform to the latest publications of IS 2544 & IEC in all respects except BIL which should be 1050Kvp for 245 kV, and 650 kVp for 145 kV withstand. Equipment meeting any other authoritative standards which ensures equal or better quality than the IS mentioned above, is also acceptable.

REQUIREMENT FOR INSULATORS

FOR 245 AND 145 KV POST INSULATORS			
Nominal voltage		245 KV	145 kV
Highest system voltage		245 KV	145 kV
Sytem frequency		50Hz.	50 Hz.
Number of phases		3 (Three)	3 (Three)
Neutral		Effectively earthed	Effectively earthed
Short circuit current		40.0 KA	31.5 KA
Phase to phase spacing		4.5 meters	3.0 meters
Height of the insulator support structure.	:	2750 mm.	2750 mm
PCD of Top Flange	:	127 mm.	127 mm
PCD of Bottom Flange	:	184 + .2 mm.	184+ .2 mm
BIL	:	1050 KV	650 mm
Height of insulator	:	2300.00mm	1500 mm
FOR 36 KV POST INSULATORS			
Nominal voltage	:	36 KV	
Highest system voltage	:	36 KV	
Sytem frequency	:	50Hz.	


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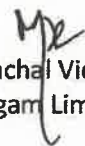
Number of phases	:	3 (Three)
Neutral	:	Effectively earthed.
Short circuit current	:	25.0 KA
Phase to phase spacing	:	1.5 meters
Height of the insulator support structure.	:	2750 mm.
PCD of Top Flange	:	127 mm.
BIL	:	250 KV
Height of insulator	:	508.00 mm



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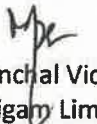
14. TECHNICAL SPECIFICATIONS OF 198 KV/120 KV/30 KV 10KA METAL OXIDE GAPLESS SURGE ARRESTERS**STANDARDS**

The Lightning Arrester shall conform to the latest revision with amendments available of the relevant standards, rules and codes some of which are listed herein for ready reference:

<u>Sl. No.</u>	<u>Standard</u>	<u>Title</u>
1.	IEC 99 – 4	Specification Part – 4 for Lightning Arrester without gap for AC system
2.	IS: 3070	Specification for lightning Arrester for alternating current system Part
3.	IS: 2629	Recommended Practice for hot dip galvanizing of iron and steel
4.	IS: 2633	Method for testing uniformity of coating on Zinc coated articles
5.	IS: 5621	Specification for large hollow porcelain for use in electrical installation
6.	IS: 2174	Degree of protection provided by enclosure for low voltage switch-gear and control
7.	IEC: 71	Electrical Clearances
8.	IS: 12063	Classification of degree of protection provided by enclosure of electrical equipment.
<u>PRINCIPAL PARAMETERS</u>		
•	Rated system voltage	245 KV 145 KV 36 KV
•	System neutral earthing	Effectively earthed
•	Installation	Outdoor
•	Rated arrester voltage	198 KV 120 KV 30 KV
•	Max. continuous operating voltage (MCOV) at 500C	168 KV 102 KV 24 KV


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Sl. No.	Standard	Title		
•	Nominal discharge current	10 KA (8/20 microwave)		
•	Rated frequency	50 Hz		
•	Minimum line discharge capacity	2 KJ / KV		
•	Power frequency reference voltage	Not less than MCOV		
•	Max. Residual voltage at nominal discharge current of 10 KA and 8/20 Micro Sec.	550 KVP	400 KVP	100 KVP
•	Peak & value of high current (4/10 Microwave)	100 KA		
•	Creepage distance	25 mm/KV		
•	Partial discharge test on 1.05 MCOV	Net more than 50 Pico coulombs		
•	One minute power frequency voltage of arrester housing	460 KV	275 KV	70 KV
•	Impulse withstand voltage of arrester housing with 1.2/50 micro second wave.	1050 KVP	650 KVP	170 KVP
•	Minimum prospective fault current.	40 KA		
•	Radio interference voltage	Not more than 500 micro volts.		
•	Pressure relief class	Class-A		
•	Current for pressure relief.	40 KA		
•	Seismic acceleration	0.3 g.		
•	Long duration discharge class	Class 3 (as per IEC)		
The details of the equipments to be protected by these surge arresters are as under :-				
Equipment		Basic Insulation level		
		220 KV	132 KV	33 KV
Transformer 220 KV side		950 KVP	550 KVP	170 KVP
Switchgears, CTs and CVTs		1050 KVP	650 KVP	170 KVP

RELAYS:


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All relays shall conform to the requirements of IS: 3231 or other applicable approved standards. Relays shall be suitable for flush or semi-flush mounting on the front with connections from the rear. Relays shall be rectangular in shape and shall have dust tight, dull black or egg shell black enamel painted cases with transparent cover removable from the front.

TRANSMISSION LINE PROTECTION:

The Line Protection Relays are required to protect the line and clear the faults on line within shortest possible time with reliability, selectivity and full sensitivity to all type of faults on lines. The general concept is to have primary & back up protection having equal performance requirement specially in respect of time as provided by Main protection called Main and Backup Protection.

APPLICABLE STANDARDS

IS 14697: 1999	Specification for A.C Static Transformer operated Watt Hour & VAR – Hour meters, class 0.2S & 0.5S
CBIP Technical Report No. 88 (Revised July 1996 and Amendments & Errata issued in April - 1999 and September'99)	Specification for A.C. Static Electrical Energy Meters.
IEC – 687	Alternating current static watt-hour meters for measurement of active energy, class 0.2
IS- 3202	Climatic proofing of electrical equipment.

STANDARDS:

The design, manufacture and performance of all the equipment and material provided under this specification shall generally conform to the latest issues of the following:-

Indian Standard	Title	International & Internationally Recognized standards
IS: 3231	Electrical Relays for Power system	IEC-255


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Indian Standard	Title	International & Internationally Recognized standards
	Protection	Part 1 to 3, BS:142
IS: 1248 & IS: 419	Indicating Instruments	BS: 89
IS: 6236	Recorders	BS: 90
IS: 722 (Part-I to IX)	Energy Meters	BS: 37/IEC-521
IS: 6875	Control Switches (LV switching devices for Control and Auxiliary circuits)	IEC: 337 & 337-1
IS: 1885 (Part-I & II)	Electro-Technical Vocabulary, Electrical Relays & Electrical Power System Protection	
IS: 2705	Current Transformers	IEC: 185
IS: 3156	Voltage Transformers	IEC-186
IS: 375	Marking & Arrangements for Switchgear, Busbar, Main connection and Auxiliary wiring	
IS: 5	Colours for ready mixed paints and channels stability tests	BS: 142
IS: 1554 (Part)	PVC insulated cables upto and including 1000 Volts.	
IS: 3842 (Part-I to VIII)	Application guide for Protective Relays	
IS: 4483 (Part-I & II)	Preferred Panel Controls and Dimensions	
IS: 9224 (Part-II)	HRC Cartridge fuse links	
IS: 2147	Degrees of Protection provided by	


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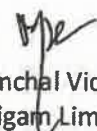


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Indian Standard	Title	International & Internationally Recognized standards
	enclosures for LV switchgear and control gear	
IS: 6005	Code of Practice for Phosphating Iron and Steel	
IS: 8686	Specification for static protective relays & tests	IEC-255 Part-V & VI, IEC-801-4
IS: 4237	General requirement of switchgear and control gear for voltages not excluding 1.1 kV	
IS: 5578	Guide for marking of insulated conductors	
IS: 11353	Guide for uniform system of marking and identification of conductor & apparatus terminals	
IS: 13010	Energy Meters	
CBIP Pub No.274	Manual on Protection of Generators, Generator Transformers and 220kV & 400kV network	
CBIP Pub No: 296	Manual on Reliable fault clearance and Back up protection of EHV & UHV Transmission Networks	
IEC 60870	Communication Protocol	IEC 60870
IEC 61850	Substation Automation Protocol	IEC 61850


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PLCC

Power line carrier communication (PLCC) equipment complete for speech transmission line, tele-protection commands and data channels shall be provided on each 220 kV and 132 kV transmission lines. The protection for transmission line and the line compensated equipment shall have 100% backup communication channels. The PLCC equipments shall in brief include the following :-

Coupling Device, line traps, carrier terminals, protection couplers, HF cables, PABX and maintains and testing instruments.

A telephone exchange (PABX) of 24 lines shall be provided at new substation as means of effective communication among various buildings of the substation, remote end substation and with controls centres (RLDC/SLDC) etc.

Coupling Devices shall be suitable for 220 kV and 132 kV. Phase to Phase coupling for 220 kV and 132 kV single circuit line shall be provide. For Double circuit line inter circuit coupling can be provided. The pass band of coupling devices shall have sufficient margin for adding communication channel in future if required. Necessary protection devices for safety of personal and low voltage part against power frequency voltages and transient voltage shall also be provided.

The line traps shall be broad band turned suitable for blocking the complete range of carrier frequencies. Line trap shall have the necessary protective devices such as lightning arresters for the protection of tuning device and shall be equipped with corona rings. Decoupling network consisting of line traps and coupling capacitors may also be required at certain substation in case of extreme frequency congestion.

Wherever Fiber Optic/OPGW based telecommunication terminal equipment (i.e. SDH/MUX) are being provided, the same shall be utilized for Data, Voice and line protection applications.

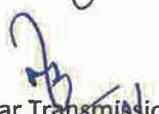

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For protection purposes, both end Digital Protection Couplers (DPCs) shall be included at both ends. However, for line protection application, back up communication channel/link may be considered as per requirement so as to take care of OPGW/ telecommunication equipment outage.

Addition/Modification/Shifting/Re-commissioning etc. as required of PLCC due to LILO of transmission lines shall be covered under the scope according to element wise detailed given below:-

S. No.	Details of element (line)	Coverage under the scope
1	LILO of one ckt. of 220 kV Sarnath (400) – Gajokhar DC line at Cantt. (Chaukaghat) Varanasi. Construction of 41.5 Km (37 Km overhead line (Zebra Conductor) on Lattice Tower and construction of 4.5 Km 630 mm ² line with copper XLPE cable	Addition/Modification/Shifting/Re- commissioning of PLCC shall be covered under the scope
2	LILO of one ckt. of 220 kV Muradnagar (400) – Sahibabad (220) SC line at 220 kV substation Vasundhara (Ghaziabad) (Multi Ckt./Monopole Tower) (Zebra conductor)	Addition/Modification/Shifting/Re- commissioning of PLCC shall be covered under the scope

PLCC equipment for the transmission lines at serial 01 & 02 covered under the package (Consisting of one set of analog PLCC channel along with circuit protection coupler and one set of Digital Protection Coupler for both ends of one line segment due to LILO of existing line) shall be provided by the bidder. All other associated equipment for ends cabling, coupling device and HF cable shall be provided by the bidder. 48 kV DC Power supply for PLCC panels shall be provided by the respective substation bay owner. The wave traps, CVTs required for communications from PLCC shall be provided by respective substation owner.

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Fire Fighting System

Fire Fighting System is general conforms to fire insurance regulations of India. The fire fighting system is proposed with both AC motor & diesel engine driven pumps housed in a fire fighting pump house building along with water storage tank of adequate capacity. Automatic heat actuated multisifying system us proposed for transformers & reactors. In addition for alarm system based on heat/smoke detectors are proposed to be installed at sensitive points in a substation e.g. Cable Vault, Control Room building and other building etc. further, adequate water hydrants and portable fire extinguishers shall be provided in the substations. At existing substations the fire fighting system if already available, would be extended for meeting the additional requirements.

Illumination

Adequate normal & emergency AC & DC illumination shall be provided in the control room, GIS hall & other building of the substation. The switchyard shall also be provided with adequate illumination. The entire control room building, fire fighting pump house lighting shall be done by LED based low power consumption luminaries.

Control Room

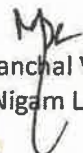
Substation control room would be provided to house substation work station for station level control along with its peripheral and recording equipment, AC & DC distribution boards, DC batteries & associated battery chargers, Fire Protection panels, Telecommunication panels & other panels as per requirements. Air conditioning will be provided in the building as functional requirements.



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SPECIFIC TECHNICAL REQUIREMENT FOR COMMUNICATION FOR 220 KV AND 132 KV LINES

In order to meet the requirement for grid management and operation of substations, Transmission Service Provider (TSP) shall conform to the following requirements.

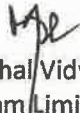
On 220 kV and 132 kV D/C lines one OPGW containing 24 fibers is to be installed in place of conventional earth wire for grid management and substation operation purpose by STU/CTU and 48 fibers to be installed on LILO lines.

220 kV, 132 kV, 66 kV, 33 kV & 11 kV System

SL No	Description of parameters	220 kV System	132 kV System	66 kV System	33 kV System	11kV System
1.	System operating voltage	220 kV	132 kV	66 kV	33 kV	11 kV
2.	Maximum operating voltage of the system (rms)	245 kV	145 kV	72.5 kV	36 kV	12 kV
3.	Rated frequency	50	50 Hz	50 Hz	50 Hz	50 Hz
4.	No. of phase	3	3	3	3	3
5.	Rated Insulation levels					
	i. Full wave impulse withstand voltage (1.2/50 micro sec.)	1050 kVp	650 kVp	325 kVp	170 kVp	75 kVp
	ii. One minute power frequency dry wet withstand voltage (rms)	-	275 kV	140 kV	70 kV	28 kV
6.	Corona extinction voltage	156 kV	105 kV	-	-	-


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SL No	Description of parameters	220 kV System	132 kV System	66 kV System	33 kV System	11kV System
7.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz at 92 kV rms for 132 kV system	1000 micro-volts	500 micro-volts	-	-	-
8.	Minimum creepage distance (25mm/kV)	6125mm	3625mm	1813mm	900mm	300mm
9.	Min. Clearances					
	i. Phase to phase	2100mm	1300mm	750m m	320m m	280mm
	ii. Phase to earth	2100mm	1300mm	630m m	320m m	140mm
	iii. Sectional clearances	5000mm	4000mm	3000mm	3000mm	3000mm
10.	Rated short circuit current for 1 sec. Duration	40kA/50kA (as applicable)	31.5 kA	31.5 kA	25 kA	25 kA
11.	System neutral earthing	Effectively earthed	Effectively earthed	Effectively earthed	Effectively earthed	Effectively earthed


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**TECHNICAL SPECIFICATION OF 220/33 kV SUBSTATION CANTT (CHAUKAGHAT),
VARANASI & VASUNDHARA (GHAZIABAD)**

SYSTEM PARTICULARS

- | | |
|--------------------------|-----------------------------------|
| (i) Rated System voltage | 245kV, 36kV |
| (ii) System frequency | 50 Hz, This may vary by $\pm 5\%$ |
| (iii) Number of phases | Three |
| (iv) Neutral | Effectively Earthed |

(v) Auxiliary power supply:-

Auxiliary electrical equipment shall be suitable for operation on the following supply system:

- | | |
|--------------------------------------|--|
| (a) Power device (Like drive motors) | 400V, 3Phase, 4Wire 50Hz
Effectively earthed AC system. |
|--------------------------------------|--|

(b) Lighting fixtures, space heaters,

fractional Horse Power motors and control devices. 250V, 2wire, 50Hz, AC supply with one point grounded.

- | | |
|---|---------------------|
| (c) DC alarm, Control and Protective supplies | 2wire ungrounded DC |
|---|---------------------|

Devices from sub station batteries
as under

- | | |
|----------------------|---------|
| (i) 220/132kV S/S : | 110V DC |
| (ii) Communication : | 48 V DC |

equipment

The above supply voltage is subject to variation as follows:

All devices must be suitable for a continuous operation over the entire range of voltage variations :


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(i) AC Voltage may vary by $\pm 10\%$.

Frequency by $\pm 5\%$

Combined Voltage & frequency by $\pm 10\%$.

(ii) DC

a) 220 V may vary between 187 & 242 V

b) 110 V may vary between 93 & 121 V

c) 48 V may vary between 41 & 53 V

SYSTEM PARAMETERS

The following system parameters shall prevail:

Sl. No.	Description of Parameters	220 kV System	33 kV System
1	Nominal system voltage	220kV	33kV
2	Maximum operating voltage of the system(rms)	245kV	36kV
3	Rated frequency	50Hz	50Hz
4	No. of phase	3	3
5	Rated short time current	40 kA for 3 Sec	25 kA for 3 sec
6	Dry and wet one minute power frequency withstand voltage	460 kV	95kV
7	Dry and wet impulse withstand voltage positive and negative	1050 kVp	250 kVp
8	Corona extinction voltage	156 kV	-
9	Max. Radio interference voltage for frequency between 0.5 MHz and 2 MHz at 508 kV rms for 765kV, 320kV rms for 400kV system and 156kV rms for 220kV system & 92kV rms for 132kV system	1000 microvolt	-
10	Minimum total creepage	25mm /kV (6125 mm)	25mm/kV (1300 mm)


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11	Min. clearances i. Phase to phase ii. Phase to earth iii) Sectional clearances	2100 mm 2100 mm 5000 mm	320 mm 320 mm 3000 mm
12	System neutral earthing	Effectively Earthed	Effectively Earthed

Major technical parameters of bushings/ hollow column/ support insulators are given below:

Sl. No.	Description of Parameters	220 kV System	33 kV System
1	Max. System voltage Um (kV)	245kV	36kV
2	Impulse withstand voltage (dry & wet) (kVp)	± 1050	± 170
3	Switching surge withstand voltage (dry & wet) (kVp)	-	-
4	Power frequency withstand voltage (dry and wet) (kV rms)	460	75
5	Total creepage distance(min) (mm)	6125	900

Insulator shall also meet requirement of IEC- 815 for 245kV, 145kV and 36kV systems, as applicable having alternate long and short sheds.

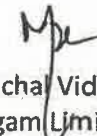
CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENT

All types of boxes, cabinets etc. shall generally conform to in accordance with IS-5039/ IS-8623, IEC-60439, as applicable.

All doors, removable covers and plates shall be provided gasket all around with suitably profiled EPDM/Neoprene gaskets. The gasket shall be tested in accordance with approved quality plan, IS:11149 and IS:3400. The quality of gasket shall be such that it does not get damaged/cracked during ten years of operation of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth straight and reinforced if necessary to


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minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters, the screen shall be fine wire mesh made of brass.

BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS

Bushings shall be manufactured and tested in accordance with IS: 2099 & IEC- 60137 while hollow column insulators shall be manufactured and tested in accordance with IEC- 62155/IS:5621. The support insulators shall be manufactured and tested as per IS:2544/IEC- 60168 and IEC-60273. The insulators shall also conform to IEC-60815 as applicable.

TECHNICAL SPECIFICATION FOR SF6 GAS INSULATED METAL ENCLOSED SWITCHGEARS (GIS)

The GIS shall be double bus bar arrangement and each module shall be complete with SF6 breaker, disconnectors, current and voltage transformers, earthing swithes and all necessary components as detailed in this specification. All parts of the switchgear should be single phase/ three phases (segregated) enclosed for 220 kV GIS and single phase/ three phases encapsulated for 33 kV GIS.

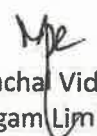
REFERENCE STANDARDS

The metal-enclosed gas-insulated switchgear, including the operating devices, accessories and auxiliary equipment forming integral part thereof, shall be in accordance with the following International Electro-technical Commission (IEC) Publications including their parts and supplements as amended or revised to date:

IEC 62271-203	Gas Insulated metal-enclosed switchgear for rated voltages above 52kV
IEC 60376	New sulphur hexafluoride
IEC 62271- 100	High voltage alternating current Circuit breakers
IEC 60694	Common clauses for high voltage Switchgear and control-gear standards
IEC 62271-102	Alternating current disconnectors(isolate) and earthing switches
IEC 61128	Alternating current disconnectors. Bus-transfer current switching by disconnectors.


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IEC 61129	Alternating current earthing switches. Induced current switching
IEC 66044-1	Current transformers
IEC 66044-2	Voltage transformers
IEC 60137	Bushings for alternating voltages above 1000 V
IEC 60859	Cable connections for gas-insulated switchgear
IEC 60480	Guide to checking of sulphur hexafluoride taken from electrical equipment
IEC 60099 -1/4	Non-linear resistor type arresters for AC systems
IEC 60439	Factory-built assemblies of low-voltage switchgear and control Gear.
IEC 60427	Report on synthetic testing of high-voltage alternating-current breaker.
IEEE 80 (2000)	IEEE Guide for Safety in AC Substation grounding.
CIGRE-44	Earthing of GIS- an application guide. (Electra no.151,Dec'93).
IEC 61639	Direct connection between Power Transformers and gas insulated metal enclosed switchgear for rated voltage 72.5 kV and above.

The components and devices which are not covered by the above standards shall conform to, and comply with, the latest applicable standards, rules, codes and regulations of the internationally recognized standardizing bodies.

PRINCIPAL PARAMETERS

The SF6 gas insulated metal enclosed switchgear shall be totally safe against inadvertent touch of any of its live constituent parts. It should be designed for indoor/outdoor (as specified) application with meteorological conditions at site.

The metal-enclosed gas insulated switchgear, including the operating devices, accessories and auxiliary equipment forming integral part thereof, shall be in accordance with the IEC-62271-203 with latest amendments publications including their parts and supplements as amended or revised to date.

The required overall parameters of GIS are as follows:-


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Sl. No.	Technical particulars	220 kV System	132 kV System	33 kV System
I	GIS			
1.	Type of GIS	Single Phase /Three Phase	Single Phase /Three Phase	Single/ Phase Three
	encapsulation	encapsulated	Phase encapsulated	Phase encapsulated
2.	Location	Indoor	Indoor	Indoor
3.	Rated voltage	245kV rms	145kV rms	36 kV (rms)
4.	Rated frequency	50 HZ	50 HZ	50 HZ
5.	Number of Phases	3	3	3
6.	Grounding	Effectively Earthed	Effectively Earthed	Effectively Earthed
7.	Rated continuous current rating at design ambient temperature i.e. 50 °C			
	i) Busbar and Bus coupler Bay	2000 Amp.	1600 Amp.	2500 Amp.
	ii) Feeder and Transformer Bay	1600 Amp.	800 Amp.	1250/2500 Amp. (Feeder)/Transf
8.	Rated burn through time of enclosure due to internal arc to short circuit Current Rated lightning impulse (1.2/50 micro sec.) withstand	According to IEC	According to IEC	According to IEC
9.	voltage	± 1050 kV peak	± 650 kV peak	±170 kVp
10.	One minute power frequency withstand voltage	460 kV rms	275 kV rms	70 kV rms
11.	Rated short time	40 kA rms	40 kA rms	31.5 kA rms


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	withstand current (3 sec)	(As applicable)	(As applicable)	
12.	Rated peak withstand current	125/100 kA peak (As applicable)	125/100 kA peak (As applicable)	80 kA peak
13.	Material of enclosure	Aluminium alloy	Aluminium alloy	Aluminium alloy
14.	Minimum thickness of enclosure (mm)	As per IEC/CENELEC Standard	As per IEC/CENELEC Standard	As per IEC/CENELEC Standard
15.	Material of busbar conductor	Aluminium and/or Copper Less than 0.5% as	Aluminium and/or Copper	Aluminium and/or Copper
16.	Guaranteed maximum gas losses for complete installation as well as for all individual sections in %.	per IEC-62271-203	Less than 0.5% as per IEC-62271-203	Less than 0.5% as per IEC- 62271- 200
17.	Seismic level	Zone- IV, as per IS-1893, Year- 2002	Zone- IV, as per IS-1893, Year- 2002	Zone- IV, as per IS- 1893, Year- 2002

II Circuit Breaker (CB)

1.	Rated voltage	245kV rms	145kV rms	36 kV rms
2.	Rated frequency	50 HZ	50 HZ	50 HZ
3.	Type of Circuit Breaker	SF6 insulated	SF6 insulated	SF6 insulated
4.	System neutral Earthing	Effectively earthed	Effectively earthed	Effectively earthed
5.	Rated continuous current rating at design ambient temperature i.e.			


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	50 °C			
	-Feeder Bay	1600 Amp.	800 Amp.	1250 Amp.
	-Transformer Bay	1600 Amp.	800 Amp.	2500 Amp.
	-Bus coupler Bay	2000 Amp.	1600 Amp.	2500 Amp.
6.	No. of poles	3	3	3
7.	Type of operation	Single Phase Operation Hydro-Mechanical	Three Phase Gang Operation	Three Phase Gang Operation
8.	Operating Mechanism	spring drive/Hydraulic/Sp ring drive	Hydro-Mechanical spring drive/Hydraulic/ Spring drive	Hydro-Mechanical spring drive/Hydraulic/ Spring drive
	Auto re-closing duty	Three Phase/ Single Phase	Three Phase	
	Rated operating duty cycle	O-0.3 sec-CO-3 min- CO	O-0.3 sec-CO-3 min-CO	O-0.3sec-CO- 3 min-CO
	First pole to clear Factor	1.3	1.3	1.5
	Maximum closing time	Not more than 120 ms	Not more than 120 ms	Not more than 120 ms
	Maximum breaking time at rated breaking capacity	65 ms	65 ms	80 ms
	Rated lighting impulse withstand voltage			


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-between line terminals and ground	±1050 kV peak	± 650 kV peak	±170 kV peak
-between terminals with circuit breaker open	±1050 kV peak	± 650 kV peak	±195 kV peak

One minute power frequency phase to earth voltage (kv rms)

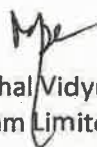
- between line terminals and ground	460 kV rms	275 kV rms	As per IEC
- between terminals with circuit breaker open	530 kV rms	315 kV rms	As per IEC

Rated breaking current capacity

i) Rated short circuit current withstand capacity (3 sec)	40 kA (As applicable)	40 kA (As applicable)	31.5 kA
ii) Line charging current	50 A rms/ As per IEC	50 A rms/ As per IEC	As per IEC
iii) Cable charging current	120 A rms	120 A rms	
iv) Small inductive breaking current	10 A rms	10 A rms	


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	Rated short time	125/100 kA peak	125/100 kA peak	80 kA peak
	making current capacity	(As applicable)	(As applicable)	
	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz at 156kV	1000 Micro volts	500 Micro volts	—
19.	Max. difference in the instants of closing/opening of contacts (ms) between poles	As per IEC	As per IEC	As per IEC
20.	Trip coil and closing coil voltage	110 V DC with variation as specified in GTR Each circuit	110 V DC with variation as specified in GTR	110 V DC with variation as specified in GTR
21.	Auxiliary Contacts	breaker pole shall be provided with an auxiliary switch with 20% of spare – NO and 20% spare NC contact for use in future.	Each circuit breaker pole shall be provided with an auxiliary switch with 20% of spare – NO and 20% spare NC contact for use in future.	Each circuit breaker pole shall be provided with an auxiliary switch with 20% of spare – NO and 20% spare NC contact for
	Auxiliary switch shall also comply with requirements as given, independent single pole reversible contacts (from NO to NC & vice versa)			
	Rating of auxiliary contacts	10A at 110V DC	10A at 110V DC	10A at 110V DC
	Breaking capacity	2A DC with the	2A DC with the	2A DC with the


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	of Aux. Contacts	circuit time constant of not less than 20 ms	circuit time constant of not less than 20 ms	circuit time constant of not less than 20 ms
	less than 20 ms			
III	Disconnectors (DS)			
1.	Rated voltage	245kV rms	145kV rms	36 kV rms
2.	Rated frequency	50 HZ	50 HZ	50 HZ
3.	Type	SF6 insulated	SF6 insulated	SF6 insulated
4.	System Earthing	Effectively Earthed	Effectively Earthed	Effectively Earthed
5.	Rated short time withstand current (3 sec)	40 kA rms (As applicable)	40 kA rms (As applicable)	31.5 kA rms
6.	Rated short time making current capacity	125/100 kA peak (As applicable)	125/100 kA peak (As applicable)	80 kA peak
7.	No. of poles	3	3	3
8.	Rated continuous current rating at design ambient temperature i.e. 50 °C			
	Feeder Bay	1600 Amp.	800 Amp.	1250 Amp.
	Transformer Bay	1600 Amp.	800 Amp.	2500 Amp.
	Bus coupler Bay	2000 Amp.	1600 Amp.	2500 Amp.
9.	Operating Mechanism	Motor	Motor	Motor
10.	Operating time	Less than 12 sec.	Less than 12 sec.	Less than 12 sec.
11.	Rated lightning impulse withstand voltage			
	- Phase to earth	±1050 kV peak	±650 kV peak	±170 kV peak
	- Across the open	±1200 kV peak	±750 kV peak	±195 kV peak


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	contacts			
12.	One minute power frequency withstand voltage			
	- Phase to earth	460 kV rms	275 kV rms	As per IEC
	- Across the open contacts	530 kV rms	315 kV rms	As per IEC
13.	Rated mechanical terminal load	As per IEC	As per IEC	As per IEC
14.	Rating of auxiliary contacts	10A at 110V DC	10A at 110V DC	10A at 110V DC
15.	Breaking capacity of auxiliary contacts	2 A	2 A	2 A
16.	No. of auxiliary contacts on each isolator	6 NO and 6 NC	6 NO and 6 NC	6 NO and 6 NC
17.	No. of auxiliary contacts on each earthing switch	6 NO and 6 NC	6 NO and 6 NC	6 NO and 6 NC
IV Earthing Switches (ES)				
1.	Rated voltage	245kV rms	145kV rms	36kV rms
2.	Rated frequency	50 HZ	50 HZ	50 HZ
3.	Rated short time withstand current (3 sec)	40 kA rms (As applicable)	40 kA rms (As applicable)	31.5 kA rms
4.	Rated short time making current capacity -For high speed earthing switch	125/100 kA peak (As applicable)	125/100 kA peak (As applicable)	80 kA peak
5.	Rated lightning impulse withstand	±1050 kV peak	±650 kV peak	±170 kV peak


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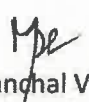


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	voltage			
6.	One minute power frequency withstand voltage	460 kV rms	275 kV rms	70 kV rms
	Operating Mechanism			
	- For maintenance earthing switch	Motor	Motor	Motor
	-For high speed earthing switch	Motor	Motor	Motor
8.	Operating time			
	-For maintenance earthing switch	Less than 12 sec.	Less than 12 sec.	Less than 12 sec.
	-For high speed earthing switch	Less than 300 m sec	Less than 300 m sec	Less than 300 m sec
V	Current Transformer (CT)			
1.	Rated voltage	245kV rms	145kV rms	36kV rms
2.	Rated frequency	50 HZ	50 HZ	50 HZ
3.	System neutral earthing	Effectively earthed	Effectively earthed	Effectively earthed
4.	Maximum temperature rise over an ambient temperature of 50°C	As per IEC 60044-1	As per IEC 60044-1	As per IEC 60044-1
5.	Radio interference voltage at 1.1 Un/V3 and frequency range	≤ 1000 micro-volts	≤ 500 micro-volts	-


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	0.5 to 2 MHz One minute			
6.	power frequency withstand voltage between sec. Terminal & earth	5 kV (rms)	5 kV (rms)	5 kV (rms)
7.	Partial discharge level	≤ 10 pico coulombs	≤ 10 pico coulombs	-
8.	Rated insulation level i) 1.2/50 micro second impulse voltage ii) 1 Minute power frequency withstand voltage	±1050 kVp	± 650 kVp	± 170 kVp
9.	Current Ratio For Feeders	1000-800-500- 300/1A	800-400-200/1A	400-200/1A
	For Transformer	1000-800-500- 300/1A	160MVA (800- 400/1A), 100MVA (500/1A),	2000-1250/1A
	For bus coupler	1000-800-500- 300/1A	800-400-200/1A	2000-1250/1A
10.	Ratio taps	On secondary side	On secondary side	On secondary side
11.	Accuracy Class -For protection	PS	PS	PS
	-For metering	0.2	0.2	0.2


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	Burden			
	-For protection	20 VA	20 VA	20 VA
	-For metering	20 VA	20 VA	10 VA
13.	Rated short time withstand current	40 kA rms (As applicable) for 3 Second.	40 kA rms (As applicable) for 3Second.	31.5 kA rms for 3 Second.
14.	Rated dynamic withstand current	125/100 kA peak (As applicable)) for 1 Second.	125/100 kA peak (As applicable) for 1 Second.	80 kA peak for 1 Second.
15.	Safety factor for metering	< 5	< 5	< 5
16.	Parameters/ Approval Finalization	Burden, Knee Point Voltage Rct, Excitation Current and other parameters shall be got approved by purchaser as per protection co-ordination/ scheme requirements during detailed engineering based on details/ calculations to be submitted by successful bidder	Burden, Knee Point Voltage Rct, Excitation Current and other parameters shall be got approved by purchaser as per protection co-ordination/ scheme requirements during detailed engineering based on details/ calculations to be submitted by	Burden, Knee Point Voltage Rct, Excitation Current and other parameters shall be got approved by purchaser as per protection co-ordination/ scheme requirements during detailed engineering based on details/ calculations to be


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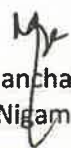
successful bidder

submitted by
successful bidder**VI Voltage
Transformers**

1.	Rated System voltage	245kV rms	145kV rms	36kV rms
2.	Rated frequency	50 HZ	50 HZ	50 HZ
3.	Type	Electromagnetic	Electromagnetic	Electromagnetic
4.	System neutral earthing	Effectively earthed	Effectively earthed	Effectively earthed
5.	System fault level	40 kAp. (As applicable) for 3 Second.	40 kAp. (As applicable) for 3 Second.	31.5 kAp for 3 Second.
6.	Rated lightning impulse withstand voltage	± 1050 kV peak	± 650 kV peak	± 170 kV peak
7.	One minute power frequency withstand voltage	460 kV rms	275 kV rms	70 kV rms
8.	One minute power frequency withstand voltage for secondary winding	3 kV rms	3 kV rms	3 kV rms
9.	Radio interference voltage at 1.1 Un/ $\sqrt{3}$ and frequency range 0.5 to 2 MHz Rated total thermal burden	≤ 1000 micro volts	≤ 500 micro volts	-
10.	thermal burden	400 VA	100 VA	75 VA

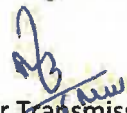

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11.	Partial discharge level	≤ 10 pico coulombs	≤ 10 pico coulombs	-
12.	Voltage Ratio	$245/\sqrt{3} : 110 \text{ V}/\sqrt{3}$	$145/\sqrt{3} : 110 \text{ V}/\sqrt{3}$	$36/\sqrt{3} : 110 \text{ V}/\sqrt{3}$
13.	Number of secondary winding	3	3	2 or 3
14.	Rated voltage factor	1.5 for 30 seconds	1.5	for 30 seconds
		continuous	continuous	continuous
15.	Phase angle error	± 10 min	± 10 min	± 20 min
		(for metering core)	(for metering core)	(for metering core)

Sec-

16.	Rated voltage	Sec-I	II	Sec-III	Sec-I	Sec- II	Sec-III	Sec-I
-----	---------------	-------	----	---------	-------	---------	---------	-------

110/
 $\sqrt{3}$ 110/
 $\sqrt{3}$ 110/
 $\sqrt{3}$ 110/
 $\sqrt{3}$ 110/
 $\sqrt{3}$ 110/
 $\sqrt{3}$

	Prot.	Prot.	Meteri ng	Prot.	Prot.	Meteri ng	Metering
Accuracy	3P	3P	0.2	3P	3P	0.2	0.2


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	Output Burden (Min.) VA	50	50	50	50	50	50	10
VII	Lightning Arresters (LA)							
1.	Highest system voltage	245 kV rms			145 kV rms			36 kV rms
2.	Rated arrester voltage	198 kV rms			120 kV rms			30 kV rms
3.	Continuous operating voltage at 50 °C	168 kV			102 kV			25 kV
4.	Type (Tank Type)	Gapless type/ Metal Zinc Oxide type Class			Gapless type/ Metal Zinc Oxide type			Gapless type/ Metal Zinc Oxide type
5.	Long duration Discharge Class	3			Class 3			Class 3
6.	Nominal discharge current corresponding to 8/20 microsec wave shape	10 kA rms			10 kA rms			10 kA rms
7.	Rated frequency Minimum	50 HZ			50 HZ			50 HZ
8.	discharge capability voltage corresponding to minimum	5 kJ/kV (referred to rated arrester)			5 kJ/kV (referred to rated arrester)			5 kJ/kV (referred to rated arrester)


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	discharge characteristic			
9.	System neutral earthing	Effectively earthed	Effectively earthed	Effectively earthed
10.	Max. switching surge residual voltage(1 kA)	500 kVp	280 kVp	-
11.	Max. residual voltage at			
	i) 5 kA	560 kVp	310 kVp	-
	ii) 10 kA nominal discharge current	600 kVp	330 kVp	100 kVp
	iii) 20 kA nominal discharge current	-	-	-
12.	High current short duration test value (4/10 micro second wave)	100 kVp	100 kVp	100 kVp
13.	Current for pressure relief test	40 kA rms	40 kA rms	40 kA rms
14.	Prospective symmetrical fault current Pressure relief	40 kA rms for 0.2 Sec	40 kA rms for 0.2 Sec	40 kA rms
15.	class	A	A	A
16.	RIV at 1.1 Un/V3 kV rms	Less than 500 (micro volts)	Less than 500 (micro volts)	-
17.	Partial discharge at 1.05 COV	Not more than 50 pc	Not more than 50 pc	Not more than 50 pc
18.	Low current long duration test value	As per IEC	As per IEC	As per IEC


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	(2000 micro sec.)			
19.	Discharge counter and leakage current meter to be provided	Yes	Yes	Yes
VIII Busbar				
1.	Rated voltage	245kV rms	145kV rms	36kV rms
2.	Rated frequency	50 HZ	50 HZ	50 HZ
3.	Rated current	2000 A rms	1600 A rms	2500 A rms
4.	Rated short time withstand current	40.0 kA rms/3sec	40.0 kA rms/3sec	31.5 kA rms
5.	Temperature rise			
	-For enclosure	According to IEC	According to IEC	According to IEC
	-For conductor	According to IEC	According to IEC	According to IEC
6.	Rated lightning impulse withstand voltage	±1050 kV peak	±650 kV peak	±170 kVp
7.	One minute power frequency withstand voltage	460 kV (rms)	275 kV (rms)	70 kV (rms)
IX Bus Coupler				
1.	Rated voltage	245kV rms	145kV rms	36kV rms
2.	Rated frequency	50 HZ	50 HZ	50 HZ
3.	Rated current	2000 A rms	1600 A rms	2500 A rms
4.	Rated short time withstand current	40.0 kA rms/3sec	40.0 kA rms/3sec	31.5 kA rms
5.	Temperature rise			
	-For enclosure	According to IEC	According to IEC	According to IEC
	-For conductor	According to IEC	According to IEC	According to IEC
6.	Rated lightning impulse withstand voltage	±1050 kV peak	±650 kV peak	±170 kV peak


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7. One minute power frequency withstand voltage 460 kV (rms) 275 kV (rms) 70 kV (rms)

X Cable Head (CHD)

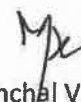
- | | | | |
|---|------------------|------------------|------------------|
| 1. Rated voltage | 245kV rms | 145kV rms | 36kV rms |
| 2. Rated frequency | 50 HZ | 50 HZ | 50 HZ |
| 3. Rated current | 2000 A rms | 1600 A rms | 2500 A rms |
| 4. Rated short time withstand current | 40.0 kA rms | 40.0 kA rms | 31.5 kA rms |
| 5. Rated lightning impulse withstand voltage | ±1050 kV peak | ±650 kV peak | ±170 kV peak |
| 6. One minute power frequency withstand voltage | 460 kV (rms) | 275 kV (rms) | 70 kV (rms) |
| 7. Interface with power cable sealing end | According to IEC | According to IEC | According to IEC |

XI SF6 Bus Interconnection Duct Termination Head

- | | | | |
|---|---------------|--------------|--------------|
| 1. Rated voltage | 245kV rms | 145kV rms | 36kV rms |
| 2. Rated frequency | 50 HZ | 50 HZ | 50 HZ |
| 3. Rated current | 2000 A rms | 1600 A rms | 2500 A rms |
| 4. Rated short time withstand current | 40.0 kA rms | 40.0 kA rms | 31.5 kA rms |
| 5. Rated lightning impulse withstand voltage | ±1050 kV peak | ±650 kV peak | ±170 kV peak |
| 6. One minute power frequency withstand voltage | 460 kV (rms) | 275 kV (rms) | 70 kV (rms) |


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	frequency			
	withstand voltage			
7.	Interface with SF6 Duct end	According to IEC	According to IEC	According to IEC
XII	Bus Sectionalizers			
1.	Rated voltage	-	-	36kV rms
2.	Rated frequency	-	-	50
3.	Rated current	-	-	2500 A rms
4.	Rated short time withstand current	-	-	31.5 kA rms
	Temperature rise	-	-	According to IEC
	-For enclosure			
	-For conductor			
	Rated lightning impulse withstand voltage	-	-	±170 kV peak
	One minute power frequency withstand voltage	-	-	70 kV (rms)


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CIRCUIT BREAKERS**GENERAL**

The circuit breakers and accessories shall conform to IEC: 62271-100, IEC: 62271-01 and other relevant IEC standards.

245/145/36 kV circuit breakers offered would be of sulphur hexafluoride (SF6) type only and of class C2-M2 as per IEC.

The support structure of circuit breaker as well as that of control cabinet shall be hot dip galvanised. All other parts shall be painted as per shade 697 of IS-5.

DISCONNECTORS (ISOLATORS)**General**

Disconnectors shall be of the single-pole, group operated type, installed in the switchgear to provide electrical isolation of the circuit breakers, the transformers, double bus and transmission lines. The disconnectors shall conform to IEC-62271-102.

INSTRUMENT TRANSFORMERS**Current Transformers**

The current transformers and accessories shall conform to IEC : 60044-1 and other relevant standards.

Voltage Transformers

The voltage transformers shall conform to IEC- 60044-2 and other relevant standards.

SURGE ARRESTERS

The surge arresters shall confirm in general to latest IEC –60099-4.

- a) The surge arresters are being provided to protect the followings whose insulation levels are indicated in the table given below:-


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Equipment to be protected	Lightning impulse (kVp) for 245 kV system	Lightning impulse (kVp) for 145 kV system	Lightning impulse (kVp) for 36 kV system
Power Transformer	± 950	± 550	± 170
Instrument Transformer	± 1050	± 650	± 170
CB/Isolator Phase to ground	± 1050	± 650	± 170
Across open contacts	± 1200	± 750	± 195

220/132/33KV GIS BUILDING

The buildings shall house 220kV, 132kV and 33kV Gas Insulated Switchgear (GIS) separately and other associated equipments inside in each of the GIS building. The building shall have arrangement to maintain pressurised air in order to prevent the ingress of dust in the GIS Hall.

The GIS hall shall have an independent ventilation system. Each ventilation system shall consist of two 100% capacity systems, one operating and one stand-by.

To ensure that the air being supplied to the GIS hall is free from dust particles, a minimum two stage dust filtration process shall be supplied. This shall consist of at least the following:

3.3.2 Pre Filters: To remove dust particles down to 10 micron in size with at least 95% efficiency.

3.3.3 Fine Filters: To remove dust particles down to 5 microns in size with at least 99% efficiency.

QUALITY OF SF6 GAS

- a) The SF6 gas insulated metal-clad switchgear shall be designed for use with SF6 gas complying with the recommendations of IEC 376, 376A & 376B, at the time of the first charging with gas. All SF6 gas supplied as part of the contract shall comply with the requirements of IEC as above


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as a minimum & should be suitable in all respects for use in the switchgear under all operating conditions.

- b) The high pressure cylinders in which SF₆ gas is supplied & stored at site shall comply with the requirements of following standards & regulations:

IS:

4379 Identification of the contents of industrial gas cylinders.

IS:

7311 Seamless high carbon steel cylinders for permanent & high pressure liquefiable gases. The cylinders shall also meet Indian Boilers Regulations. (Mandatory)

CIRCUIT BREAKERS

The circuit breakers and accessories shall conform to IEC: 62271-100, IEC: 62271-01 and other relevant IEC standards.

SULPHUR HEXAFLUORIDE GAS (SF₆ GAS)

- a) The SF₆ gas shall comply with IEC 60376, 60376A and 60376B and shall be suitable in all respects for use in the switchgear under the operating conditions.
- b) The high pressure cylinders in which the SF₆ gas is shipped and stored at site shall comply with requirements of the relevant standards and regulations.

INSULATORS

All hollow insulators shall conform to IEC-62155.

INTERPOLE CABLING

All cables to be used shall be armoured and shall be as per IS – 1554/ IEC-502 (1100 Volts Grade).

TECHNICAL PARAMETERS**I. 245 kV CIRCUIT BREAKER**


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- | | | |
|----|---|--|
| 1. | Rated continuous current(A)
at design ambient
temperature. | 1600
(as applicable)
-2000 for bus coupler
bay. |
| 2. | Rated short circuit

current breaking capacity
at rated voltage | 40 kA (as applicable)
with percentage DC
component
as per IEC: 62271-100
corresponding to minimum
opening time under operating
conditions specified. |
| 3. | Symmetrical interrupting
capability (kArms) | 40 (as applicable) |
| 4. | Rated short circuit
making current (kAp) | 125/ 100 (as applicable) |
| 5. | Short time current
carrying capability
for 3 second (kArms) | 40 (as applicable) |
| 6. | Rated operating duty | O-0.3sec-CO-3min-CO cycle |
| 7. | Reclosing | Single phase & three phase
autoreclosing |
| 8. | First pole to clear
factor | 1.3 |
| 9. | Rated line/cable charging
interrupting current at 90
deg. leading power | As per IEC |

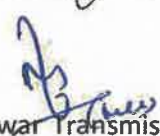

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factor angle (A. rms)

(The breaker shall be able to interrupt the rated line/cable charging current with test voltage immediately before opening equal to the product of $U/\sqrt{3}$ & 1.4 as per IEC: 62271-100)

- | | | |
|-----|--|--|
| 10. | Temperature rise over the design ambient temperature | As per IEC: 62271-100 |
| 11. | i) Total break time as per Cl.3.0 of this specification (ms) | 65 |
| | ii) Rated break time as per IEC (ms) | 60 |
| 12. | Total closing time (ms) | Not more than 120 |
| 13. | Operating mechanism | spring/hydraulic or a combination of these |
| 14. | Max. difference in the instants of closing/ opening of contacts (ms) | |
| | i) Between poles (opening) | 3.3 |
| | ii) Between poles (closing) | 5.0 |
| | The above shall be at rated control voltage and rated operating and quenching media pressures. | |
| 15. | Trip coil and closing coil voltage | 110V DC with variation as specified |


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- | | | |
|-----|---|--|
| 16. | Noise level at base and upto 50 m (distance from base of breaker) | 140 dB (Max.) |
| 17. | Rated terminal load | As per IEC or as per the value calculated by GTR, whichever is higher. |
| 18. | Auxiliary contacts | Besides requirement of specification, the bidder shall wire up 5 NO+5 NC contacts for future use of Purchaser. |
| 19. | No of Terminals in common control cabinet | All Contacts & control circuits to be wired out upto common control cabinet plus 24 terminals exclusively for Purchaser's use. |
| 20. | Maximum allowable switching IEC overvoltage under any switching condition | As per (Auxiliary switch shall also comply with requirements stipulated under GTR). |


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DISCONNECTORS (ISOLATORS)

Disconnectors shall be of the single-pole, group operated type, installed in the switchgear to provide electrical isolation of the circuit breakers, the transformers, double bus and transmission lines/cables. The disconnectors shall conform to IEC: 62271-102 (or IS: 9921).

SAFETY GROUNDING SWITCHES

Three-pole, group operated, safety grounding switches shall be operated by electric motor for use on 110V DC ungrounded system and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over-current and short circuit.

The safety grounding switches shall conform to the requirements of IEC- 62271-102

HIGH SPEED MAKE PROOF GROUNDING SWITCHES

Grounding switches located at the beginning of the feeder bay modules shall be of the high speed, make proof type and will be used to discharge the respective charging currents, in addition to their safety grounding function. These grounding switches shall be capable of interrupting the inductive currents and to withstand the associated TRV.

Single phase switches shall be provided with operating mechanism suitable for operation from a 110V.DC.

The short circuit making current rating of each ground switch shall be at least equal to its peak withstand current rating. The switches shall have inductive/capacitive current switching capacity as per IEC-62271-102.

The high speed make proof grounding switches shall conform to the requirements of IEC-62271- 102.

INSULATOR

The insulator shall conform to IS: 2544 and/or IEC-60168.

TECHNICAL PARAMETERS


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2. 245 kV ISOLATORS

- | | | |
|----|--|---|
| 1. | Type | SF6 insulated |
| 2. | Rated current at 50°C ambient temperature | 1600/2000 (As applicable).
-1600 for line and Transformer bays.
- 2000 bus coupler bay. |
| 1. | Rated short time withstand current of isolator and earth switch (for 3 Sec.) | 40 kA / 50 kA (as applicable) |
| 2 | Rated dynamic short circuit withstand current of isolator and earth switch | IEC-694. |
| | 100 kAp / 125 kAp (as applicable) | IEC-62271-102 |
| 3 | Temperature rise over design ambient temperature | A.C. Motor operated |
| 4 | Rated mechanical terminal load | |
| | | 12 sec. or less |
| 5 | Operating mechanism of isolator/earth switch | |
| 6 | Operating time | |


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INSTRUMENT TRANSFORMERS

The instrument transformers and accessories shall conform to the latest version of the standards specified below:-

Current transformers IEC: 60044-1 (or IS: 2705) Inductive Voltage Transformers IEC: 60044-

Insulating Oil

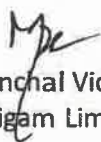
- a) Insulating oil to be used for instrument transformers shall be of EHV grade and shall conform to IS-335/ IEC-60296 (required for first filling).
- b) The SF6 gas shall comply with IEC-60376, 60376A and 60376B and shall be suitable in all respects for use in the switchgear under operating conditions. Suitable valve shall be provided for SF6 gas filling in the instrument transformers in live condition. A suitable Rupture Disc shall be provided on the SF6 filled instrument transformers to prevent any chance of explosion.

TECHNICAL PARAMETERS

A.	245 kV CURRENT TRANSFORMERS	
1.	Rated Primary current	
2.	Rated short time thermal current	1000A (as applicable)
3.	Rated dynamic current kA (peak)	40 kA for 3 sec./50 kA for 3 sec. (as applicable)
4.	Maximum temperature rise over design ambient temperature	100 / 125 (as applicable)
5.	One minute power frequency withstand voltage sec. terminal &	As per IEC:60044-1


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	earth	
6.	Number of terminals	All terminals of control circuits are to be wired upto marshaling box plus 20% spare terminals evenly distributed on all TBs.
7.	Type of insulation	Class A
B.	245 KV INDUCTIVE VOLTAGE TRANSFORMERS	
1.	System fault level(for 3 second)	40 kA / 50 kA (as applicable)
2.	Standard reference range of frequencies for which the accuracies are valid	96% to 102% for protection and 99% to 101% for measurement
3.	One minute power frequency withstand voltage :	
	i) For secondary winding	3 kV (rms)
4.	Maximum temperature rise over design ambient temperature	As per IEC:60044-2
5.	Number of terminals	All terminals of are wired upto marshaling box plus 12 terminals exclusively for Purchaser's use.
6.	Rated Total Thermal burden (VA)	300 (100VA/winding)

SURGE ARRESTERS

The Surge Arresters shall conform to IEC: 60099-4.

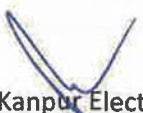
The surge arresters are being provided to protect the following equipment whose insulation levels are indicated in the table given below:-


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<i>Equipment to be protected</i>	<i>Lightning Impulse (kVp) for 245 kV system</i>	<i>Lightning Impulse (kVp) for 145 kV system</i>	<i>Lightning Impulse (kVp) for 36 kV system</i>
<i>Power transformer</i>	± 950	± 550	± 170
<i>Instrument Transformer</i>	± 1050	± 650	± 170
<i>CB/Isolator Phase to ground</i>	± 1050	± 650	± 170
<i>CB/Isolator Across open contacts</i>	± 1050 (for CB) ± 1200 (for Isolator)	± 750	± 195

TECHNICAL PARAMETERS:

A. 245 kV CLASS SURGE ARRESTER

- (a) Rated arrester voltage 198 kV
- (b) Nominal discharge current 10 kA of 8/20 microsecond wave
- (c) Minimum discharge capability 5kJ/kV (referred to rated arrester voltage corresponding to minimum discharge characteristics.
- (d) Continuous operating voltage at 50 deg.C 168 kV rms
- (e) Max. switching surge residual voltage (1kA) 500 kVp
- (f) Max. residual voltage at 5 kA 560 kVp


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	10 kA nominal discharge current	600 kVp
(g)	Max. steep current impulse residual voltage at 10 kA.	650 kVp
(h)	Long duration discharge Class	3
(i)	High current short duration test value (4/10 micro second wave)	100 kAp
(j)	Current for pressure relief test	40 kA rms / 50 kA rms (as applicable)
(k)	Low current long duration test value (2400 micro sec)	As per IEC.
	Pressure relief class	40 kA / 50 kA (as applicable)

B. 36 kV and 11 kV CLASS SURGE ARRESTER

	36 KV	11 kV
Rated arrester voltage	30 kV	9 kV
Nominal discharge	---10 kA of 8/20 microsecond wave ---	
		
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Current

Minimum discharge capability	5kJ/kV (referred to rated arrester voltage corresponding to minimum discharge characteristics.)	
Continuous operating voltage at 50 deg.C	25 kV rms	7.2 kV rms
Max. switching surge residual voltage (1kA)	72 kVp	22.4 kVp
(f) Max. residual voltage at		
i) 5 kA	85 kVp	26 kVp
ii) 10 kA nominal discharge current	90 kVp	28 kVp
Long duration discharge Class	2	2
Pressure relief class	25kA	25 kA

TECHNICAL SPECIFICATION FOR 220 kV XLPE CABLE

STANDARDS


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IEC-60228	Conductor for insulated cable. IEC-60229 Tests on cable over sheaths.
IEC-60230	Impulse tests on cables and their accessories.
IEC-60270	Partial discharge measurements.
IEC-60287-1-1	Calculation of continuous current carrying capacity.
IEC-60502	Power Cables with extruded insulation and their accessories.
IEC-60067	Tests for Power cables with extruded insulation for rated voltage upto 500kV.
BIS: 7098	XLPE Cable specification for working voltages from 66 kV upto and including 220 kV
IEEE:48	Tests procedures and requirements for high voltage cable terminations.

DESIRED TECHNICAL PARTICULARS OF XLPE CABLE

S.NO.	PARTICULARS	TECHNICAL DETAILS
1.	Cable Applicable Standard	Single Core, Copper Conductor XLPE cable. Conforming to IEC 60502 – 2 and IEC 60840: 2004-04 or IS 7098 (Part - 3) amended up to date.
2.	System voltage & frequency	220 ± 10% kV, 50Hz ± 3%
3.	Rated & Highest System Voltage	245 kV
4.	Suitable for earthed system	Yes
5.	CONDUCTOR	
(i)	Material	Annealed Plain Copper wires Conforming to IEC 60228/ IS 8130 with latest amendments


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S.NO.	PARTICULARS	TECHNICAL DETAILS
(ii)	Nominal cross-sectional area	800 Sq. mm
(iii)	Construction of conductor / flexibility class	Class -2, IEC 228/ IS: 8130 with latest amendments
(iv)	Shape and formation	Circular, stranded & very well compacted
(v)	Approx. overall diameter of conductor	To be indicated
6.	CONDUCTOR SCREENING	
(i)	Material & Type	Extruded, semi conducting compound layer
(ii)	Grade	As per IEC/ IS
(iii)	Thickness	1.0 mm
7.	INSULATION	
(i)	Material	Cross linked polyethylene (XLPE)
(ii)	Special Super clean grade Normal thickness of insulation	As per IEC 6207/ IS 7098 (Part-3) with latest amendments
8.	INSULATION SCREENING	
A.	Non-metallic part (extruded)	
(i)	Material	Extruded semi conducting compound layer
(ii)	Grade	As per IEC/ IS 7098 (Part-3) with latest amendments
(iii)	Min. Thickness	0.8 mm
B	Non-metallic part (taped) longitudinal water barrier over insulation screen	
(i)	Material	Synthetic Non-woven semi conducting Water swell-able tape


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S.NO.	PARTICULARS	TECHNICAL DETAILS
(ii)	Min thickness	As per standard
C	METALLIC SHEATH	
(i)	Material	Corrugated Aluminium/ Lead alloy "E" sheath IS 692 with latest amendments
(ii)	Min. Thickness(mm)	Conforming to IEC 60502-2/ IS 7098
(iii)	Short Circuit Current Withstand (Metallic sheath, together with copper screen (if required))	40 kA for three second
(D)	Bedding over lead sheath	Semi conducting tape(s)
(E)	CONCENTRIC COPPER WIRE SCREEN (IF REQUIRED)	
(i)	Material and type	Annealed plain copper wires applied helically with gap followed by open helix of copper tape binder.
(ii)	Min. area (sq. mm.)	This and lead alloy E sheath shall meet earth fault current of 40 kA for a duration of 3 second
9.	OUTER SHEATH	
(i)	Material	Extruded Layer of Black PE or PVC type ST-2 as per IEC 62067/ IS 7098 (Part-3)
(ii)	Min. thickness of outer sheath	As per standard
10.	Conducting layer over outer sheath	Graphite coating
11.	Approx. weight overall diameter of cable (mm)	To be indicated
12.	Approx. weight per meter of cable	To be indicated

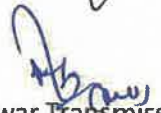

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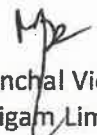


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S.NO.	PARTICULARS	TECHNICAL DETAILS
	(kg/m)	
13.	Recommended minimum installation radius.	To be indicated
14.	Maximum D.C. Resistance of conductor at 90°C in ohm/km	As per standard
15.	Minimum continuous current rating for each circuit when laid in ground in trefoil formation and other condition given in specification.	1100 / 843 Amps. As applicable after all de-rated factors.
16.	Maximum allowable temperature for cable and accessories.	
(i)	At rated full load and at site conditions.	90° C
(ii)	The conductor temperature after a short circuit for one second shall not exceed (with conductor temperature at start of short circuit as 90°C).	250°C
17.	Basic impulse insulation level (1.2 / 50 micro second wave)	650 kV
18.	Power frequency withstand	As per standard


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S.NO.	PARTICULARS	TECHNICAL DETAILS
	voltage	
19.	Symmetrical Short circuit rating for one second duration for lead sheath and copper screened combined	40 kA for 3 sec.
20.	Drum Length	500-600 mtr. / As per requirement.
21.	Expected cable life.	35 years.

TECHNICAL SPECIFICATION FOR 245kV CABLE TERMINATION AND JOINTINGKITS FOR 1 x 800 SQ. MM& 1x1000SQ.MM. XLPE CABLE

STANDARDS

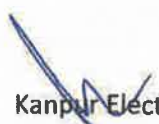
IEC: 62067	Tests for power cables with extruded insulation for rated voltage above 150kV upto 500kV.
IEC: TS 60859	Cable connection for Gas insulated metal enclosed switchgear for rated voltages of 72.5 kV and above.
IEC: 62271-203	Gas-insulated metal enclosed switchgear for rated voltages of 72.5 kV and above.
IEC: 60228	Conductor for insulated cable
IEC: 60229	Tests on cable over sheaths
IEC: 60230	Impulse tests on cables and their accessories
IEC: 60270	Partial discharge measurements
IEC: 60287	Calculation of continuous current carrying capacity
IEC: 60502	Power Cables with extruded insulation and their accessories.
BIS: 7098 (Part-3)	XLPE cable specification for working voltages from 66 kV up to and including 220 kV.
IEEE 48- 1990	IEEE Standard Test, Procedure & requirement for high voltage alternating current cable terminations.


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SYSTEM CONFIGURATION

The 220kV systems will be solidly grounded. Cables will be protected from over voltages caused by lightning strikes or switching surges by means of station type lightning arrestors located at terminal point/ substations. The terminal substation yard equipment and all overhead 220kV transmission lines will be shielded against direct lightning strokes by overhead ground wires.

EARTHING

Earthing of sheath/ screen at both of termination ends of 245kV cable using insulation sheath bonding (earthing) cable of required size through Link box with/ without surge limiter at terminations.

Earthing shall be as per relevant standards.

The sheath/ screen shall bound in the earth station through disconnecting type link boxes.

DESIRED TECHNICAL PARTICULARS OF XLPE CABLES KITS AND ACCESSORIES

	OUTDOOR CABLE END TERMINATION	
1.	Nominal System Voltage	220 kV (rms)
2.	Rated/ Highest System Voltage Um	245 kV (rms)
3.	Rated frequency & No. of phase	50 Hz $\pm$ 3%, Three (3)
4.	Installation	Outdoor
5.	Name and address of manufacturer of end termination	
6.	Nomenclature of kit	To be indicated


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	OUTDOOR CABLE END TERMINATION	
7.	Type of kit	Pre-molded
8.	Suitable for Single Core Copper Conductor XLPE cable Conforming to IEC 62067/ IS 7098 (pert-3) amended upto date and as per specification.	Yes
9.	Maximum conductor size	To be indicated
10.	Rated continuous current	Maximum current of the cable
11.	Applicable standard for testing	IEC 62067
12.	Maximum allowable Pd-level	As per IEC
13.	Type of Insulator	Silicone/ Composite
14.	Creepage distance	25 mm/KV
15.	Colour	Brown
16.	Maximum allowable temperature for cable and accessories i) At rated full load and at site condition The conductor temperature after a short ii) circuit for one second shall not exceed (with conductor temperature at start of short circuits as 90°C).	90°C 250°C
17.	Basic impulse insulation level (1.2/50 micro second wave)	1050 kV
18.	Power frequency withstand voltage	As per standard
19.	Symmetrical Short circuit rating	40 kA for 3 sec.
20.	Power frequency withstand voltage (a) Dry (kV rms.) (b) Wet (kV rms.)	To be indicated
21.	Flashover voltage:	To be indicated


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OUTDOOR CABLE END TERMINATION		
	(a) Dry (kV rms.) (b) Wet (kV rms.)	
22.	Stress relief cone made of	Silicone rubber
23.	Net dimensions of kit (Length x Breadth x Width and Weight)	To be indicated
24.	Craft sensitivity and reliability	To be indicated
25.	Time required for energisation after completing the joint (curing period)	To be indicated
26.	Special storage condition. If any, upto an ambient temperature of 50 degree C and period.	To be indicated
27.	Whether provision made for: a) Stress relief b) Track resistance c) Sealing	Yes
28.	Whether any additional support is required for kit?	If so, give details
29.	Make, Type and Material of lugs provided with kits.	Details to be given by bidder.
30.	Class of Kits.	Details to be given by bidder
31.	Sectional Drawing Showing constructional details along with each item material, description enclosed.	Yes.
32.	Expected life of cable joint and cable.	35 years
33.	(a) Shelf life of the kit (years) (b) Design life of the kit (years)	To be indicated To be indicated
34.	Guarantee of kit.	Five (5) years from date of commissioning
35.	Details of terminal connector	


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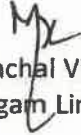


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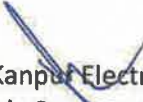
	OUTDOOR CABLE END TERMINATION	
B.	SF6 SWITCHGEAR TYPE CABLE END TERMINATION	
1.	Nominal System Voltage U	220 kV (rms.)
2.	Rated/ Highest System Voltage Um	245 kV (rms.)
3.	Rated frequency & No. of phase	50 Hz $\pm 3\%$, Three (3)
4.	Installation	Indoor/ Outdoor
5.	Name and address of manufacturer of end termination	
6.	Nomenclature of kit	To be indicated
7.	Type of kit	Premoulded, Plug in type
8.	Suitable for Single Core Copper Conductor XLPE cable Conforming to IEC 62067/ IS 7098 (Part-3) amended upto date and as per specification.	Yes
9.	Maximum conductor size	To be indicated
10.	Rated continuous current	Maximum current of the cable
11.	Applicable standard for testing	IEC 62067
12.	Maximum allowable Pd-level	As per IEC
13.	Type of Insulator	Silicone/ Composite
14.	Creepage distance	25 mm/KV
15.	Colour	Brown
16.	Maximum allowable temperature for cable and accessories	
	(i) At rated full load and at site condition	90°C
	(ii) The conductor temperature after a short circuit for one second shall not exceed (with conductor temperature at start of short circuits as 90°C).	250°C

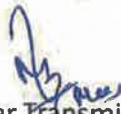

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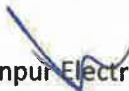
OUTDOOR CABLE END TERMINATION		
17.	Basic impulse insulation level (1.2 / 50 micro second wave)	1050 kV
18.	Power frequency withstand voltage	As per standard
19.	Symmetrical Short circuit rating	40 KA for 3 sec.
	Power frequency withstand voltage (a) Dry (kV rms.) (b) Wet (kV rms.)	To be indicated
21.	Flashover voltage: (a) Dry (kV rms.) (b) Wet (kV rms.)	To be indicated
22.	Stress relief cone made of	Silicon rubber
23.	Details of terminal connector	As applicable
24.	Net dimensions of kit (Length x Breadth x Width and Weight)	To be indicated
25.	Craft sensitivity and reliability	To be indicated
26.	Time required for energisation after completing the joint (curing period)	To be indicated
27.	Special storage condition. If any, upto an ambient temperature of 50°C and period.	To be indicated
28.	Whether provision made for: Stress relief Track resistance Sealing	Yes
29.	Whether any additional support is required for kit?	If so, give details.


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	OUTDOOR CABLE END TERMINATION	
30.	Make, Type and Material of lugs provided with kits.	Details to be given by bidder.
31.	Class of Kits.	Details to be given by bidder.
32.	Sectional Drawing Showing constructional details along with each item material, description enclosed.	Yes
33.	Expected life of Cable joint and cable.	30 years
34.	(a) Shelf life of the kit (years) (b) Design life of the kit (years)	To be indicated To be indicated
35.	Details of terminal connector	
36.	Guarantee of kit	Five (5) years from date of commissioning.
C.	LINK BOX FOR EARTHING CABLE WITH PVC INSULATION	
1.	Make	
2.	Type	
3.	Detailed dimension and internal arrangement of Single/ Three phase Link boxes with direct grounding	To be submitted
4.	Detailed dimension and internal arrangement of Three Phase Link boxes for cross bonding with SVL	To be submitted
5.	Earthing of sheath/ screen at cross bonding points and termination ends	Yes
6.	PVC insulated single core/ concentric/ coaxial cable to be used for sheath bonding (earthing) suitable for	Size, Type to be indicated


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OUTDOOR CABLE END TERMINATION		
	40 kA for 3 second	
7.	Insulation of above a earthing cable	To be indicated (3 kV / 6 kV)
8.	Voltage rise of the insulation sheath controlled within voltage	65 Volts.
9.	Surge voltage limiter	Required (3 kV / 6 kV)
D. SUPPORTING STRUCTURE & ANGLE BRACKET SUPPORTS FOR CABLE		
1.	Detail drawing enclosed	Yes
2.	Overall height of structure	Shall be as per approved drawing.

33KV XLPE CABLE & ACCESSORIES**33 KV XLPE Cable**

33KV XLPE cable shall be in accordance with the Internationally accepted standard and also conform to the requirement of IEC Publication 502.

TECHNICAL SPECIFICATION FOR 60 MVA 220/33 KV 3 PHASE POWER TRANSFORMER**STANDARDS**

The transformer should conform in all respect to latest addition of IS:2026 & CBIP.

PRINCIPAL PARAMETERS

The transformers shall be of core type constructions, three phase, oil immersed for outdoor service as both step up and step down transformers, with types of cooling mentioned below. The rating and electrical characteristics of transformers shall be as below :-

(i)	Maximum continuous capacity	60MVA
(ii)	Frequency	50 Hz


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(iii) No. of Phase	Three
(iv) Rated Voltage of HV winding	220KV
(v) Rated Voltage of LV winding	33KV
(vi) Rated Voltage of Tertiary winding	11KV
(vii) Percentage impedance	
(viii) HV to LV at Normal tap No. 13 at 100% rating	12.5%
(ix) HV to Tertiary at Normal tap	12.5% (min.)
(x) LV to Tertiary at Normal tap	12.5% (min.)
(xi) a. No load loss at rated voltage and frequency at Principal Tap (KW)	25 (max)
No load loss at voltage corresponding to the highest tap (KW)	35 (max)
Tolerance if any on the above value	No tolerance
(xii) a. Load loss at rated output, rated frequency and corrected for 75 Deg C winding temperature at -Principal Tap (KW) - Highest Tap (KW) -Lower Tap (KW)	150 KW (max) at 220/33 KV 126 KW (approx.) at 220/37.95 KV 161 KW (approx.) at 220/31.35 KV
Tolerance, if any, on the above value	No tolerance
(xiii) a. Auxiliary losses at rated output, normal, rated voltage, rated frequency and ambient temperature (KW)	3.0 KW (max)
b. Tolerance, if any, on the above value	NIL
(xix) Total Loss at normal ratio inclusive of auxiliary component losses (KW)	178 KW (Max.) at 220/33 KV@60MVA Base


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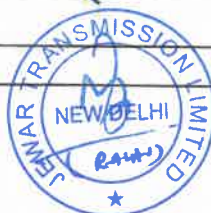

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NOTE : No reactor either inside or outside the tank shall be used to achieve above percentage impedance value.

(xx) Connections for :-	
a) HV Winding /LV Winding	Star / Star
b) Tertiary winding	Delta
(xxi) Reference Voltage group and terminal markings	HV/LV/Tertiary -YNynOd11
(xxii) On load tap on HV side neutral	- 5% to +15% in equal steps. of 1.25 % each for IV variations.
(xxiii) Type of cooling	ONAN/ONAF/OFAF.
(xxiv) Rating corresponding to cooling system :-	
a) ONAN Cooling	30 MVA
b) ONAF Cooling	42 MVA
c) OFAF Cooling	60 MVA
(xxv) Rated capacity of tertiary winding	18 MVA
(xxvi) D.C. Voltage for relays etc.	110V
(xxvii) Maximum Noise Level	75 dB

INSULATION

The di-electric strength of winding insulation and of the bushing shall conform to the value given in IS:2026-1977.

For rated system, Voltage of 245 KV, 36 KV and 11 KV following test voltage shall be provided.

SYSTEM	IMPULSE TEST	ONE MINUTE POWER
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VOLTAGE	VOLTAGE	FREQUENCY TESTS
245 KV	950 KV	395 KV
36 KV	170 KV	70 KV
11 KV	95 KV	38 KV

The HV and LV windings of transformers shall have graded insulation. The insulation class of the neutral of the winding shall be graded to 95 KV impulse and 38 KV Power frequency withstand.

FREQUENCY

The normal frequency of the system is 50 Hz. It may vary $\pm 5\%$. The transformers shall be suitable for continuous operation at rated capacity without exceeding the specified temperature rise within this frequency range.

PARALLEL OPERATION

The transformer shall operate satisfactorily in parallel with similar units of different make having following parallel operation details:-

Sl. No.	Variable	Details
1	HV to IV %impedance of tap No.1(ëxtreme) of 100% rating	12.5%
2	HV to IV %impedance of tap No.13(Normal) of 100% rating	12.5%
3	HV to IV %impedance of tap No.17(2nd ëxtreme) of 100% rating	12.5%
4	Location of Tap Changer	HV side neutral
5	Voltage variation	-5% to + 15%
6	Step Voltage	1.25%
7	Vector group	YNyn0d11

CONSTRUCTION DETAILS


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The features and construction details of power transformers shall be in accordance with the requirements stated hereunder:-

TANK AND TANK ACCESSORIES**TANK :-**

Tank shall be of welded construction and fabricated from tested quality low carbon steel of adequate thickness.

All seams and those joints not required to be opened at site shall be factory welded and wherever possible, they shall be double welded. After completion of tank construction and before painting, dye penetration test shall be carried out on welded parts of jacking bosses, lifting lugs and all load bearing members.

Tank stiffeners shall be provided for general rigidity and these shall be designed to prevent retention of water.

The tanks shall be designed to withstand :

- i) Mechanical shocks during transportation.
- ii) Vacuum filling of oil.
- iii) Continuous internal pressured of 35 kN/m² over normal hydrostatic pressured of oil.
- iv) Short circuit forces.

Wherever possible, the transformer tank and its accessories shall be designed without pockets, wherein, gas may collect. Where pockets can not be avoided, pipes shall be provided to vent the gas in to the main expansion pipes.

Adequate space shall be provided at the bottom of the tank for collection of sediments.

Lifting lug & eye bolts shall be so located that a safe clearance is obtained between slings and transformer bushings without use of spreader.


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When transformers are provided with separately mounted radiators, flexible joints shall be provided on the main oil pipes connecting the transformer tank to the radiator banks to reduce vibration and facilitate erection and dismantling.

Transformer tank shall be of bell shape construction with an oil tight bolted flange joint near the base, such that during inspection or maintenance, it is possible to lift the upper portion of the tank to provide access to the core and coils.

The transformer tank shall be equipped with the following valves :-

One drain and lower filter valve located on low voltage side of transformer and placed to completely drain the tank.

One valve at the top and one at the bottom of the tank mounted diagonally opposite to each other for filtration purpose.

One relief valve to operate at the pressure below the test pressure for the tank.

One oil filling valve (inlet).

One oil sampling valve with plug.

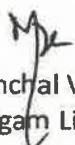
Two nos. stop valves for each pump.

TANK COVER :-

- The tank cover shall be sloped to prevent retention of rain water and shall not distort when lifted.
- At least two adequately sized inspection openings, one at each end of the tank shall be provided for easy access to bushings and earth connections. The inspection covers shall not weigh more than 25 Kg. The inspection covers shall be provided with two handles.
- The tank covers shall be fitted with pockets at the position of maximum oil temperature of MCR (Maximum Continuous Rating) for bulbs of oil and


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winding temperature indicators. It shall be possible to remove these bulbs without lowering the oil in the tank.

- Bushings, turrets, covers of inspection openings, thermometer, pockets, etc. shall be designed to prevent ingress of water into or leakages of oil from the tank.
- All bolted connections shall be fitted with weather proof, hot oil resistant gasket in between, for complete oil tightness. If gasket is compressible, metallic stops shall be provided to prevent over compression.

AXELS AND WHEELS

- Transformer shall be provided with flanged bi-directional wheels for moving the transformer on rail tracks in directions parallel (X-X) and perpendicular (Y-Y) to the axis of HV bushings. Rail gauge for movement along the axis of HV bushing (i.e., X-X) shall be 1676.4 mm. The movement in direction perpendicular to transformer HV bushing (i.e., Y-Y axis) direction of rail gauge is 3048 mm.
- The transformer shall be rigidly mounted on wheels resting on rails in concrete foundations. The complete transformers shall be rigidly anchored through wheel assemblies to the foundation using anti-earthquake clamping and locking devices. Rails would be mounted flush with top surface of the foundations.
- Ladders with suitable locking arrangement shall be provided on the side of each transformer for purpose of maintenance.

ANTI EARTQUAKE CLAMPING DEVICE

- To prevent transformer movement during earthquake, clamping device shall be provided for fixing transformer to the foundation. The Supplier shall supply necessary bolts for embedding in the concrete foundation. The arrangements shall be such that the transformer can be fixed to or unfastened from these bolts as desired. The fixing of the transformers to the foundations shall be designed to withstand seismic events to the extent that a static co-efficient of 0.3 g., applied in the direction of least


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resistance to that loading will not cause the transformer or clamping devices as well as bolts to be over stressed.

- The details of the device used and its adequacy shall be brought out in the additional information schedule.

CONSERVATOR TANK

- The conservator tank shall have adequate capacity between highest and lowest visible level to meet the requirement of expansion of the total cold oil volume in the transformer and cooling equipment from minimum ambient temperature to 90 deg.C.
 - a) The conservator tank shall be bolted into position, so that it can be removed for cleaning purposes.
 - b) The conservator shall be fitted with magnetic oil level gauge with low level electrically alarm contact..
 - c) Conservator shall be provided in such a position as not to obstruct the electrical connections of the transformer.
 - d) Separate conservator shall be provided for OLTC.

PRESSURE RELIEF DEVICE

02Nos. of pressure relief devices may be provided at suitable locations, which shall be of sufficient size for rapid release of any pressure that may be generated in the tank and which may result in damage to the equipment. The device shall operate at a static pressure of less than the hydraulic test pressure of transformer tank, it shall be mounted direct on the tank. One set of electrically insulated contact shall be provided for alarm / tripping. Separate contact for N2 fire prevention system shall also be provided.

BUCHHOLZ RELAY

A double float type Buchholz relay shall be provided. All the gases evolved in the transformer shall collect in this relay. The relay shall be provided with a test cock suitable for flexible pipe connection for checking its operation and taking gas sample. A copper or stainless steel tube, shall be connected from the gas collector to a valve located about 1200 mm above ground level to facilitate



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sampling, with the transformer in service. The device shall be provided with two electrically independent ungrounded contacts, one for alarm on gas accumulation and the other for tripping on sudden rise of pressure. Separate contact for N2 fire prevention system shall also be provided.

TEMPERATURE INDICATOR**a) Oil Temperature Indicator (OTI)**

Transformer shall be provided with a 150mm dial type thermometer for top oil temperature indication. The thermometer shall have adjustable, electrically independent ungrounded alarm and trip contacts, maximum reading pointer and resetting device mounted in the cooler control cabinet. A temperature sensing element suitably located in a pocket on top oil shall be furnished. This shall be connected to the OTI by means of capillary tubing. Accuracy class of OTI shall be plus or minus 1.0% or better.

b) Winding Temperature Indicator (WTI)

A device for measuring the hot spot temperature of each of the windings shall be provided (HV, IV, Tertiary). It shall comprise of the following :-

- i) Temperature sensing element.
- ii) Image Coil.
- iii) Auxiliary CTs, if required to match the image coil, shall be furnished and mounted in the cooler control cabinet.
- iv) 150 mm dia local indicating instrument with maximum reading pointer mounted in cooler control cabinet and with two adjustable electrically independent ungrounded contacts (besides that required for control of cooling equipment), one for high winding temperature alarm and one for trip.
- v) Calibration device.


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- vi) In addition to the above, the following indication equipment shall be provided for each winding.
- Signal transmitter.
 - Remote winding temperature indicator, it shall be suitable for flush mounting on RTCC panel (this shall not be repeater dial of local WTI and shall operate by signal transmitter). The difference between local and remote WTI indication at any given time shall not exceed 1 deg. C. One RWTI with four point selector.
 - Switch shall be provided for all the three windings (HV, IV and Tertiary).
- vii) Auxiliary supply, if required, in RTCC panel, for RWTI, shall be 110V DC only.
- viii) Accuracy class of WTI shall be plus or minus 1.0% or better.
- ix) Any special cables required for shielding purpose for connection between cooler control cabinet and remote winding temperature indicator control circuit shall be in supplier's scope of work.
- x) Provide current transducer with OTI & WTI to monitor these parameters on SCADA.

EARTHING TERMINALS

Two(2) earthing pads (each complete with two(2) Nos. tapped holes, M 10 bolts, plain and spring washers) suitable, for connection to 75 x 10 galvanized steel flat shall be provided each at position close to the two(2) diagonally bottom corners of tank. Earthing strip upto the ground level shall be provided by the Bidder.

CORE

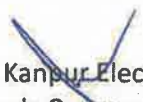
- Core shall be constructed from high grade, non-ageing cold-rolled low loss and high Permeability grain oriented silicon steel laminations.
- Each lamination shall be insulated with a material that will not deteriorate due to pressure and the action of hot oil.
- Every care shall be exercised in the selection, treatment and handling core steel to ensure that as far as practicable the lamination are flat and the finally assembled core is free from distortion.


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- Oil ducts shall be provided where necessary to ensure adequate cooling. The winding structure and major insulation shall not obstruct the free flow of oil through such ducts. Where the magnetic path is divided into packets by cooling ducts parallel to the plane of lamination or by insulating material above 0.254 mm thick, tinned copper strip bridging pieces shall be inserted to maintain electrical continuity between packets.
- All parts of the core shall be of robust design capable of withstanding any shocks to which they may be subjected to during lifting, transport. Installation and service. The bolts used in assembly of the core shall be suitably insulated and clamping structure shall be so constructed that the eddy currents are minimum.
- The core shall be provided with lugs suitable for lifting the complete core, coil, assembly of the transformers.
- Adequate provision shall be made to prevent movement of the transformer relative to the tank during transport and installation or while in service.
- The supporting frame work of the cores shall be so designed as to avoid the presence of pocket, which would prevent complete emptying of the tank through drain valve or trapping of air during filling.
- The maximum flux density in any part of the core and yoke at normal voltage and frequency and ratio must not exceed 1.53 Tesla.

WINDING

- The winding shall be so designed that all coil assemblies of identical voltage rating shall be inter-changeable and field repairs to the winding can be made readily without special equipment and also to reduce to a minimum the out of balances forces in transformer at all voltage ratios. The coils shall be supported between adjacent section by insulating spacers and the barriers, bracing and insulation used in the assembly of the windings shall be arranged to ensure a free circulation of oil and to reduced hot spots in the windings.
- Insulation of the coils shall be treated with a suitable insulating varnish or equivalent compound to develop the full electrical strength of the winding. All material used in the insulations and assembly of winding shall be


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insoluble, non-catalytic and chemically inactive in the hot transformer oil and shall be free from insulating composition liable to soften, doze out, shrink or collapse during service.

- All threaded connections shall be provided with locking facilities.
- All leads from the windings to the terminal Board and bushings shall be rigidly supported to prevent injury from vibration. Guide tubes shall be used where practicable.
- The windings shall be clamped securely in place, so that they will not be displaced or deformed during transit or short circuits. The assembled core & winding shall be vacuum dried and suitably impregnated before removal from treating tank. The copper conductor used in the coil structure should be best suited to the requirements and all permanent current carrying joints in the windings and the leads shall be as per best manufacturing practice to give trouble free service.
- Any metal pieces in contact with laminated rings shall be so designed that they do not weaken the electrical or mechanical properties of the rings.
- Gasket joints shall be provided with mechanical steps to prevent crashing.
- It is desirable that the impulse voltage distribution is measured after the coils are wound (with the help of a surge oscilloscope) and compared with the design values and suitable modifications be done, if deviation found, so as to get stress relieved construction.
- To avoid damage to tertiary winding due to high stress at the time of severe short circuit, it is desirable that some special constructional features like encasing the tertiary winding in some epoxy compound etc., is done as per bidder practices. Suppliers shall elucidate the constructional features adopted by them for the same. Special constructional and design features adopted for avoiding displacement of coils / clamping structures during dynamic short circuit condition be given.

INSULATING OIL

- a) The quality of the oil supplied with transformer shall conform to the oil parameters specified below. No inhibitors shall be used in the oil. The oil


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used shall be non- PCB (Poly Chlorinated Biphenyl) type. The oil samples will be drawn as follows :-

- i) Prior to filling.
- ii) Before and after heat run test.
- iii) Before energizing.

All tests as per IS: 335 shall be conducted on all samples.

NEUTRAL BUSHING CTs

CT	RATIO	PROTECTION	BUR - DEN	ACCURACY CLASS	MIN. KNEE POINT VOLTAGE	MAX. EXCITING CURRENT	MAX. SEC. RESISTANCE IN OHMS
1	2	3	4	5	6	7	8
220 KV	500 / 1 A	REF (Restricted earth fault).	-	PS	300 V	40mA at $V_k/2$	5.0
33 KV	2000 / 1 A	Earth Fault Protection	-	PS	300 V	40mA at $V_k/4$	5.0

- 1 All 60 MVA transformers are to be provided with bushing CT's of following ratio and Particulars :
2. The metering core of all CT's shall be of 30 VA burden, class of accuracy (as per BSS).
3. Over voltage protection devices shall be provided for all the cores of each CT to protect them against heavy current in CT primary, open circuiting or heavy burden of secondary.
4. All CTs shall have bar primaries.
5. Only molded epoxy terminations shall be provided on all the CTs secondary terminals with suitable terminal and cable glands.


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SPECIFICATIONS**250 KVA 33/0.415 KV Station Transformers****STANDARDS**

The transformers shall conform in all respects to IS:1180 (Part-1):-2014 subject to latest amendment and modifications. In case the provisions of ISS are not clear the provisions of IEC shall apply.

TECHNICAL SPECIFICATION FOR 245/145/36KV SOLID CORE POST INSULATORS**1.0 STANDARDS**

Insulators should conform to the latest publications of IS 2544 & IEC in all respects except BIL which should be 1050Kvpfor 245 kV, and 650 kVp for 145 kV withstand. Equipment meeting any other authoritative standards which ensures equal or better quality than the IS mentioned above, is also acceptable.

2.0 REQUIREMENT FOR INSULATORS**2.1 FOR 245 AND 145 KV POST INSULATORS**

(1)	Nominal voltage	245 KV	145 kV
(2)	Highest system voltage	245 KV	145 kV
(3)	Sytem frequency	50Hz.	50 Hz.
(4)	Number of phases	3 (Three)	3 (Three)
(5)	Neutral	Effectively earthed	Effectively earthed
(6)	Short circuit current	40.0 KA	31.5 KA
(7)	Phase to phase spacing	4.5 meters	3.0 meters
(8)	Height of the insulator support structure.	2750 mm.	2750 mm
(9)	PCD of Top Flange	127 mm.	127 mm
(10)	PCD of Bottom Flange	184 + .2	184+ .2


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		mm.	mm
(11)	BIL	1050 KV	650 mm
(12)	Height of insulator	2300.00mm	1500 mm
2.2	FOR 36 KV POSTINSULATORS		
(1)	Nominal voltage	36 KV	
(2)	Highest system voltage	36 KV	
(3)	Sytem frequency	50Hz.	
(4)	Number of phases	3 (Three)	
(5)	Neutral	Effectively earthed.	
(6)	Short circuit current	25.0 KA	
(7)	Phase to phase spacing	1.5 meters	
(8)	Height of the insulator support structure.	2750 mm.	
(9)	PCD of Top Flange	127 mm.	
(10)	BIL	250 KV	
(11)	Height of insulator	508.00 mm	

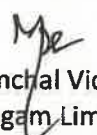
TECHNICAL SPECIFICATIONS OF 198 KV/120 KV/30 KV 10KA METAL OXIDE GAPLESS SURGE ARRESTERS

PRINCIPAL PARAMETERS

•	Rated system voltage	245 KV	145 KV	36 KV
•	System neutral earthing	Effectively earthed		
•	Installation	Outdoor		
•	Rated arrester voltage	198 KV	120 KV	30 KV


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•	Max. continuous operating voltage (MCOV) at 500C	168 KV	102 KV	24 KV
•	Nominal discharge current	10 KA (8/20 microwave)		
•	Rated frequency	50 Hz		
•	Minimum line discharge capacity	2 KJ / KV		
•	Power frequency reference voltage	Not less than MCOV		
•	Max. Residual voltage at nominal discharge current of 10 KA and 8/20 Micro Sec.	550 KVP	400 KVP	100 KVP
•	Peak & value of high current (4/10 Microwave)	100 KA		
•	Creepage distance	25 mm/KV		
•	Partial discharge test on 1.05 MCOV	Net more than 50 Pico coulombs		
•	One minute power frequency voltage of arrester housing	460 KV	275 KV	70 KV
•	Impulse withstand voltage of arrester housing with 1.2/50 micro second wave.	1050 KVP	650 KVP	170 KVP
•	Minimum prospective fault current.	40 KA		
•	Radio interference voltage	Not more than 500 micro volts.		
•	Pressure relief class	Class-A		
•	Current for pressure relief.	40 KA		
•	Seismic acceleration	0.3 g.		
•	Long duration discharge class	Class 3 (as per IEC)		

The details of the equipments to be protected by these surge arresters are as under :-

Equipment Basic Insulation level

		220 KV	132 KV	33 KV
i)	Transformer 220 KV side	950 KVP	550 KVP	170 KVP
ii)	Switchgears, CTs and CVTs	1050 KVP	650 KVP	170 KVP


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TECHNICAL SPECIFICATION OF 198 KV, 10 KA POLYMER HOUSED, METAL OXIDE GAPLESS SURGE ARRESTERS:

CONTROL AND RELAY PANELS

Control and Relay Panels shall consist of separate vertical stationary front panels with equipment mounted thereon and having wiring access from the rear. Each cubicle assembly shall be provided with doors on the rear having handles with built in locking facility. It shall have double leaf doors with lift off hinges at the back for panels of width more than 800 mm.

These panels shall be of the following approximate dimensions: -

Height: 2250mm + 15mm ant vibration pad + 50 mm (base)

Depth: 800mm to 1000mm

Width: 800 mm to 1000 mm

Metering Instruments:**APPLICABLE STANDARDS**

The CT PT operated HT energy meter shall be of accuracy Class 0.2s and conform to following standards-

- IS 14697: 1999 Specification for A.C Static Transformer operated Watt Hour & VAR – Hour meters, class 0.2S & 0.5S
- CBIP Technical Report No. 88 (Revised July 1996 and Amendments & Errata issued in April - 1999 and September'99) Specification for A.C. Static Electrical Energy Meters.
- IEC – 687 - Alternating current static watt-hour meters for measurement of active energy, class 0.2.
- IS- 3202 Climatic proofing of electrical equipment.
- CBIP technical report – 111 where ever applicable.

PRINCIPAL PARAMETERS


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The energy meters shall be indoor/ out door type connected with the secondary side of out door current and voltage transformers.

Sl. No.	Item	Specification
i.	Type of Installation	Indoor(non AC) /Outdoor
ii.	CT secondary	1 A
iii.	VT secondary	110 V/ $\sqrt{3}$ Volts
iv.	Auxiliary AC Supply	230 V+ 10 % to -15%
v.	Auxiliary DC Supply	110 V/220V/ + 10%
vi.	System frequency	50HZ + 5%
vii.	Earthing System	Solidly Grounded

GENERAL TECHNICAL REQUIREMENT

- i) Application: 3 phase 4 wire, -/01A
- ii) Rated Secondary Voltage: -/110V AC, 63.5 Volts (Phase to Neutral)
- iii) Rated secondary Current (I Basic): 1 Amp balanced & unbalanced load
- iv) Maximum Current : 2 Amps.
- v) Rated Frequency: 50 Hz.
- vi) Accuracy class: 0.2s
- vii) Power Factor: Unity to Zero (all power factor lag to lead).
- viii) Power Consumption: Not more than 1.5Watt per phase(Active)
10 VA (Apparent) Apparent power consumption in each current circuit at basic current and reference frequency shall not exceed 1.0 VA
- ix) Phase Sequence Immunity: Shall be unaffected to phase sequence.


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- x) Data Transfer Speed from meter to MRI and from MRI to BCS: at least 19200 kbps.
- xi) Communication Port: Optical port for MRI and communication port for remote data transfer.
- xii) Degree of protection of encapsulation : shall be at IP 51/IP 54 or better.
- xiii) Minimum Starting Current – 0.1% of I basic.

RELAYS:

All relays shall conform to the requirements of IS: 3231 or other applicable approved standards. Relays shall be suitable for flush or semi-flush mounting on the front with connections from the rear. Relays shall be rectangular in shape and shall have dust tight, dull black or egg shell black enamel painted cases with transparent cover removable from the front.

TECHNICAL SPECIFICATIONS FOR 110/30A BATTERY CHARGERS AND 110V/30A DC DISTRIBUTION BOARDS**REQUIREMENT OF BATTERY CHARGER****TYPE & RATING**

Each battery charger shall be of 3 phase type which must be able to meet the above requirement plus 20 Amps station load current on both float and boost charging modes with a voltage variation from 350 V to 470 V A.C. 50 Hz $\pm$ 5% separately or simultaneously.

The charger shall be stand-alone, floor mounted indoor type. The panels shall consist of fabricated sheet steel enclosures on the sides, front, rear and top. The rear door of panel shall be in the form of lockable, hinged tight fitting flap door which should close and open without keys. The front and rear sheets shall be folded construction for providing rigidity and strength (without using any frame works or screwed & bolted sheet steel sections) of not less than 14 SWG. All the switches, knob should be such mounted that only their operating handles protrude out of the panel. Suitable support channels shall be provided inside the cubicle. The charger unit will be completely vermin proof and neoprene gaskets will be provided around the edges of the door.

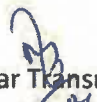

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Important identifications/ markings shall be made on anodized plate with etching process (not with screening process) which shall be riveted.

All screws, nuts and bolts shall be rust proof and spring washers shall be provided wherever required.

Terminal blocks should be easily accessible and transparent flexible top covers (easily removable) shall be provided to cover the live parts.


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TECHNICAL SPECIFICATIONS OF D.C. DISTRIBUTION BOARDS

The D.C. distribution board shall be similar in construction to the charger having preferably the same height using 14SWG sheet steel. The DCDB shall have single aluminum bus bar arrangement and arrangement for connecting the out put of charger. Automatic switching of D.C.emergency light circuit in the event of A.C. failure shall also be provided.

TECHNICAL SPECIFICATION OF DISC INSULATORS AND CONDUCTORS ETC**STANDARDS**

The supply of accessory items covered by this specification shall comply with the latest editions of the Indian standards / IEC and codes of practice. Some of the applicable standards are given below :-

I.S.S No.	Particulars	Remarks
IS.731	Disc insulators	Or any other equivalent International standard
IS. 2544	Porcelain Insulators	- do -
IS. 6005	Code of practice for phosphating Iron & Steel	- do -
IS. 398	ACSR Conductor	- do -
IS. 226	M. S. Bars	- do -

REQUIREMENT OF ANTI-FOG TYPE DISC INSULATORS**A) 220 kV SWITCHYARD**

- (i) Single suspension string shall be complete with 14 nos. anti-fog type disc insulators and without suspension clamps & fittings.
- (ii) Single strain string shall be complete with 16 nos. anti-fog type disc insulators and without strain clamps & fittings.

B) 132 kV SWITCHYARD (For 220 kV & 132 kV Substations)


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- (i) Single suspension string shall be complete with 9 nos. anti-fog type disc insulators and without suspension clamps & fittings.
- (ii) Single strain string shall be complete with 10 nos. anti-fog type disc insulators & without strain clamps & fittings.

PARAMETERS OF DISC INSULATORS

These are required for 220 kV, 132 kV and 33 kV tension and suspension strings. The minimum guaranteed requirements of one unit of each type of insulators shall be as follows :

Anti-fog type insulators shall be of ball and socket type.

For 220 kV & 132 kV Busbar Strings

i)	Types of insulator	Anti-fog type
ii)	Electromechanical strength (kN)	70
iii)	Size of Insulator (mm)	280 x 146
iv)	Creepage distance	
	a) Total mm	430
	b) protected mm	290
v)	Power Frequency Flashover Voltage	
	a) Dry kV	100
	b) Wet kV	60
vii)	Power frequency with stand Test voltage	
	a) Dry kV.	85
	b) Wet kV.	50
vii)	50% Impulse 1.2/50 micro sec. Flashover voltage (dry)	


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a) Positive polarity / kV.	175
b) Negative polarity/ kV.	170
viii) Impulse 1.2 / 50 micro sec. withstand test voltage.	155
ix) Power Frequency Puncture Voltage kV.	140
x) Size of in ball shank in mm	16
xi) Minimum corona extinction voltage kV. R.M.S.	18
xii) Max. RIV at 10 kV. RMS.	50 micro Volt

BUS BAR CONDUCTORS

Aluminum strands for ACSR and all aluminum conductors shall be hard drawn from 99.5% pure electrolytic aluminum rods with 61% conductivity.

The steel wire for ACSR conductor shall be manufactured from high tensile steel of 134 to 143 kg. / Sq. mm. quality produced either by the acid or basic open hearth process or by electric process. It shall not contain sulphur or phosphorous exceeding 0.05 percent and total of sulphur or phosphorous shall not exceed 0.085 percent. No wires drawn from Bessemer process steel shall be used.

The surface of the conductor shall be clear and dry . The surface strands shall be smooth and free from burrs and other projections which may cause in creasing corona losses above those occurring on perfectly smooth conductor when used on extra high voltage lines.


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TECHNICAL SPECIFICATIONS FOR 63KVA DIESEL GENERATOR

ELECTRICAL SUPPLY SPECIFICATIONS

Nominal voltage : 415V $\pm 10\%$

No. of Phases : 3 + Neutral

Frequency : 50Hz $\pm 5\%$

Neutral earthing : Solidly Grounded

Control supply : 12 / 24V, 2-wire DC

PRINCIPAL TECHNICAL PARAMETERS

The Voltage Transformers shall conform to the following specific parameters:

Sl. No	Parameters	Specification
1	2	3
1.	Type of installation	Single Phase, Oil filled hermetically sealed and outdoor types
2.	Type of mounting	Pedestal type
3.	Suitable for system frequency	50 Hz $\pm 5\%$
4.	Highest system Voltage	245 Kv
5.	Transformation ratio on all windings	220,000 / 110 $\sqrt{3}$ $\sqrt{3}$
6.	Method of earthing	Effectively earthed
7.	1.2/50 micro second lightning impulse withstand voltage kV (peak)	1050
8.	1 minute dry power frequency withstand voltage kV (rms)	460
9.	Min. Creepage Distance mm.	6125
10.	Radio interference Voltage at 266 kV	Not exceeding 500 micro volts


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REQUIREMENT OF 245 KV CVT

S. No.	DETAILS	PARTICULARS		
1.	Transformation ratio on all windings	220,000 / 110 $\sqrt{3}$ $\sqrt{3}$ (No. of secondary windings 3)		
2.	Supply frequency	50 Hz.		
3.	Type	Capacitor voltage type.		
4.	Rated voltage factor	1.2 continuous 1.5 for 30 seconds.		
5.	Application	Winding I Protection	Winding II Protection	Winding III Metering/Synchro.
6.	Accuracy	3P	3P	0.2
7.	Phase angle error	----- As per IS -----		
8.	Output burden	150 VA	150 VA	50 VA
9.	Rated capacitance	4400 + 10% - 5%		
10.	Rated total thermal burden	750 VA		
11.	Standard reference range of frequency for which the accuracies are valid.	97% to 103% for protection & 99% to 101% for measurement.		
12. a)	One minute power frequency test on secondary winding.	3 KV (r.m.s.)		
b)	Withstand voltage between low voltage terminal and earth terminal	4 KV (r.m.s.)		
(Note : This test voltage shall be 10 KV (r.m.s.) in the low voltage terminal exposed to weather).				
c)	Radio interference voltage of 266 KV (r.m.s.)	Not exceeding 500 microvolts.		
13.	Corona extinction voltage.	320 KV (r.m.s.)		


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15.	Partial discharge level at rated voltage for capacitor divider.	Less than 10 pico coulombs
-----	---	----------------------------

TECHNICAL SPECIFICATION FOR 160 MVA, 220/132/11KV, AUTOTRANSFORMERS.**STANDARDS**

The transformers shall conform in all respect to latest edition of IS 2026 and CBIP specification.

TYPE RATING AND QUANTITY

The auto transformers shall be of core type constructions, three phase, oil immersed for outdoor service as both step up and step down transformers, with types of cooling mentioned below. The rating and electrical characteristics of transformers shall be as follows :-

i)	Maximum continuous capacity	160 MVA
ii)	Frequency	50 C/s
iii)	No. of phase	3
iv)	Rated Voltage of HV winding	220 KV
v)	Rated Voltage of IV winding	132 KV
vi)	Rated voltage of Auxiliary winding	11 KV
vii)	% age impedance	
	a) HV to IV at normal tap no. 13 at 100% rating.	10%
	b) HV to IV at tap no. 1 at 100% rating.	11%
	c) HV to IV at Tap no. 17 at 100% rating.	11%
	d) HV to tertiary	60% (min.)


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(Offers with lower %

impedance will not be
considered)

e) IV to tertiary

50% (min.)

(Offers with lower %
impedance will not be
considered)

Note: No reactor either inside or outside the tank shall be used to achieve above %age impedance value.

viii) Connections

- | | | | |
|-------|---|---|------------------------|
| a) | Series and common winding | -----Star----- | |
| b) | Auxiliary winding | -----delta----- | |
| ix) | Reference voltage group and terminal markings | ---HV/LV/Tertiary--
-----YNaod11. | |
| x) | On load taps steps of | ---(-5%) to (+15%)
1.25% each for IV | in equal
variation. |
| xi) | Polarity | ----Subtractive---- | |
| xii) | Type of Cooling | ONAN/ONAF/OFAF
80/ 112/ 160 MVA | |
| xiii) | Rated capacity of auxiliary winding | 45 MVA | |
| xiv) | D.C. Voltage for relays etc. | 110 V /220 Volt DC | |

All the transformers shall be oil immersed, weather proof Auto-type for outdoor installation in lightening areas. The windings of 3 phase transformers shall be connected Star/Star to conform to vector symbol YNaod11 group no. in accordance with IS 2026-1977 and any amendment thereof.


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TECHNICAL SPECIFICATIONS FOR 36 kV ISOLATORS

TYPE OF ISOLATORS

- a) Three phase, 1250 A, 36 kV manually operated, Standard isolators without earth switch.
- b) Three phase, 1250 A, 36 kV manually operated, Standard isolators with one earth switch.

PRINCIPAL PARAMETERS

DETAILS	36 kV Isolator
Rated Voltage	36 kV
System frequency	50 Hz
System Earthing	Effectively earthed
Type of Isolator	Outdoor, Horizontal air break suitable for upright mounting
Continuous current rating	1250 A
Operating mechanism	Manual
Phase to phase spacing	1500 mm
Rated short time withstand current	25 kA (rms)
Rated peak short circuit current	62.5 kA (peak)
Temperature rise	As per IEC-129 derated for an ambient of 50°C
Seismic co-efficient	0.3 g.
1.2/50 microsecond full wave positive and negative impulse withstand voltage to earth	70 kV (peak)
One minute power frequency withstand voltage dry & wet to earth	70 kV (rms)


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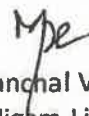
Auxiliary Contacts	4 normally open and 4 normally closed.
Insulation level of insulators	
i) Impulse voltage withstand test (1.2/50 micro second full wave)	170 kV (peak)
ii) Power frequency withstand voltage to earth (dry & wet)	70 kV (rms)
Creepage distance of insulators :	
i) Total	900 mm
ii) Protected	450 mm
Minimum strength :	Suitable to withstand wind, short circuit and operating forces
i) Torsional	
ii) Cantilever	
Interlocks with circuit breaker	1 set of electrical and casteltype interlocks.
Type of contacts	Hard drawn electrolytic copper with silver plating
Conductor take off	Horizontal/vertical according to actual requirement.
Phase-to phase clearance	1500 mm

TECHNICAL SPECIFICATIONS FOR 10 MVAR,33KV CAPACITOR BANK**CAPACITOR BANKS**

Capacitor banks detailed above shall be complete with the Capacitor unit controlling breaker, manually operated OFF load isolators without earthing switch at bus bar side and with earthing switch at capacitor side, CT, NCT, VT, switching reactors, control & relay panel, necessary mounting racks, insulators, interconnecting materials, bi-metallic terminal connectors, junction boxes and any


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other material required for satisfactory operation and installation. As per system condition, switching reactor for harmonic suppression are not required.

General arrangements

The capacitor banks shall be out door type suitable for operation in the climatic conditions as detailed on page S-2 Mounting steel racks to be supplied by the tenderer shall be suitable for mounting on plinth. The Tenderers should offer compact design to occupy minimum ground area with least possible height. The bank shall suitable for mounting under the bus bars drawn on ganturies having height as mentioned in clause 3.1.6 of technical specification with due consideration for required clearances. The tender shall be complete with drawing showings the arrangements.

Each capacitor bank shall be in two double star groups of 5MVAR each with separate one number manually operated, OFF load type isolator with earthing switch for each group. Each group of 5MVAR shall be connected in double star formation with their neutral point ungrounded and protected through separate one number NCT. Each star formation shall be of 2.5 MVAR rating at 33KV.

Each capacitor bank shall be complete with all auxiliaries accessories and the following associated equipments:-

Sl. No.	Name of associated equipment	Qty. required for Bank
1	36KV, 3-ph, Circuit Breaker	1 No
2	36KV, 3-ph Isolator without earthing switch	1 No
3	36KV, 3-ph. Isolator with earthing switch	2 No
4	36KV, 1-ph. Current Transformer	3 No
5	36KV, 1-ph Neutral Current Transformer	2 No
6	3-ph. Switching reactor	4 Nos.
7	Control & Relay panel with relays	1 No
8	36KV, 3-ph/ 1-ph voltage Transformers	1/3 Nos.

The number of parallel units in each series group shall be such that failure of one unit shall not preferable creating.

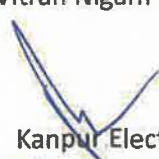
- i) More than 5% voltage rise with internal fuse on other units in the bank.


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INDIVIDUAL CAPACITOR UNIT

Individual Capacitor Units of 5.485 KV, 276.25 KVAR, rating of Bank shall be self contained, outdoor types, having two bushing to give the required total Bank Capacity at 50Hz. And the Bank compact to occupy minimum ground area with least possible height. The bushing should be of metal coated porcelain and shall be joined to the case by solder sealing method. The Creepage distance of bushing shall not be less than 25mm/KV of voltage stress appearing between the terminal and the case. The bushing shall be suitable for heavily polluted. Atmospheric condition.

The impregnant used shall be non-PCB and the impregnation shall be carried out under high degree of vacuum and the unit shall be of totally sealed type.

Each capacitor unit shall be provided with internal discharge resistors designed to drain out the residual charge up- to 50 volts within less than 10 minutes after disconnection from supply.

Each capacitor unit shall be individually protected by fuse suitably rated for load current. Capacitor to be provided with additional external fuse should have arrangement for visual indication for detection of faulty units.

Each unit shall satisfactorily operate at 130% rated KVAR including the factor of over voltage (referred to rated voltage), harmonic currents and manufacturing tolerance.

Terminal and mounting arrangement may be in accordance with manufacturer's standard practice, but should be amply proportioned with adequate safety margins.

The Containers of capacitor units shall be of sufficiently thick sheet painted with suitable anti- rust synthetic enamel primer paint and the finishing coats of paint as per the standard practice.

The Capacitor banks shall conform to latest edition of IS: 13925(Part-I: 1998/ IEC-70).

ISOLATORS (WITH AND WITHOUT EARTH SWITCH)

The isolators (with and without earthing switch both) shall be outdoor, manually gang operated, double break, OFF load type, 36kV, 800 amps, 1000MVA, 3 phase, 50 Hz triple pole complying in all respects with the requirements of the latest edition of IS: 9921-1981 and complete with insulators, mechanical and electrical inter locks, bi-metallic terminal connectors suitable for ACSR panther conductor all auxiliaries and accessories.


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Current Transformers

The current transformers shall be of the outdoor dead tank type single phase, 50Hz, oil immersed self cooled.

The current transformers shall have following ratings:-

a	Nominal system voltage	33 KV
b	Highest system voltage	36 KV
c	No. of cores	Two
d	system earthing	Effective
e	Transformation ratio	400-200/1/1/A
f	Basic insulation level	170 KV (peak)
g	Short time current rating	25 KA
h	Fault level	1000 MVA
i	Rated output of each core	15 VA
j	Class of accuracy	5-P for protection, 1for metering
k	Max. resistance of secondary winding	5 ohms
l	Accuracy limit factor (protection core)	10
m	Instrument security factor (metering core)	5
n	Cree page distance	
	a) Total	900 mm (Min)
	b) Protected	450 mm (min)

The core shall be of high grade, non- ageing electrical silicon laminated steel of low hysteresis loss and high permeability to ensure high accuracy at both normal and over current.

Voltage Transformers

The voltage transformer shall be of outdoor type, three phase / single phase, 50 Hz, oil immersed, self cooled.


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The voltage transformer shall have the following ratings:-

a	Nominal system voltage	33 KV
b	Highest system voltage	36 KV
c	Frequency	50 Hz
d	System earthing	Effective
e	No. of secondary windings per phase	One
f	Ratio	33000/110 volts $\sqrt{3} / \sqrt{3}$
g	Basic insulation level	170KV (peak)
h	Rated burden	100 VA
i	Rated voltage factor (continuous)	1.1.
j	Rated voltage factor (30sec.)	1.5
k	Class of accuracy	3.p
l	Creepage distance	
	a) Total	900 mm (min)
	b) Protected	450 mm (min)

The VTs shall conform to the latest edition of IS: 3156. The bushing shall comply with the latest edition of IS: 2099 and IS: 5347.

Neutral Current Transformer

Two NCT shall be required for one set of capacitor bank.

The neutral current transformer shall be as per specifications of CT except that it shall have single core, transformer ratio 5/1 and accuracy class for the protection core shall 5 P 10.

Required number of suitable and matching bimetallic terminal connectors along- with required number of cable glands shall be supplied along- with the NCTs. And accordingly the prices may be quoted.

Control & Relay Panel (SAS Based)

The control and relay panels shall conform in all respects to relevant Indian standards.


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Equipment meeting any other authoritative standard which ensures an equal or better standard than mentioned above may also be considered.

The control and relay panel shall be of floor mounted, indoor free, standing cubicle type. The panels shall consist of fabricated sheet enclosures on the sides, front, rear and top.

The rear of the panels shall be in the form of lockable hinged flap door. The front and rear sheets shall be of folded construction for providing rigidity and strength without using any frame work or screwed or bolted sheet steel sections. The front of the panels which accommodates most of the mountings shall be fabricated with sheet steel of thickness not less than 10 SWG. For the rest of the panel which carries no weight of the mountings, sheet steel of thickness not less than 14 SWG should be used.

FIBRE OPTIC EQUIPMENTS**Network Configuration and Equipment Characteristics****Introduction**

This section describes the Fibre Optic Communication network configuration and the equipment characteristics for communication system to be installed under the project. The sub-systems addressed within this section are:

- (1) Fibre Optic Transmission System (FOTS)
- (2) Termination equipment Subsystems
- (3) Network Management System (NMS)
- (4) MDF, DDF and Cabling

Digital Tele-Protection Coupler (Stand (Stand-Alone type)

Protection coupler shall be of modular type having independent Command interfaces.

- o Each coupler shall have redundant power supply source.



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- Protection command signals shall be suitable for 110/220V DC (site programmable) directly from station battery without involving any intermediate converter. **Opto-coupler Interface shall be provided suitable for 110Volt & 220Volt DC.**
- Power supply source 110V DC with additional provision for operation on 48V DC.

BUS SCHEME FOR SUBSTATIONS			
400/220kV Jewar	220/33kV Cantt (Chaukaghat)	220/33kV Vasundhara	220/132/33kV Khaga
400- Double Main Bus Scheme 220- Double Main Bus Scheme	220- Double Main Bus Scheme 33- Single Main & Transfer Bus Scheme	220- Double main Bus scheme 33- Single Main & Transfer Bus Scheme	220- Double main Bus & Transfer Scheme 132- Double main Bus & Transfer Scheme 33- Single Main & Transfer Bus Scheme.


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SPECIFIC TECHNICAL REQUIREMENT FOR COMMUNICATION IN 220 kV, 132 kV and 33 kV SUBSTATION

In order to meet the requirement for grid management and operation of substations, Transmission Service Provider (TSP) shall conform to the following requirements.

On 220 kV and 132 kV D/C lines one OPGW containing 24 fibers is to be installed in place of conventional earth wire for grid management and substation operation purpose by STU/CTU and 48 fibers to be installed on LILO lines.

220 kV, 132 kV, 66 kV, 33 kV & 11 kV System

SL No	Description of parameters	220 kV System	132 kV System	66 kV System	33 kV System	11kV System
1.	System operating voltage	220 kV	132 kV	66 kV	33 kV	11 kV
2.	Maximum operating voltage of the system (rms)	245 kV	145 kV	72.5 kV	36 kV	12 kV
3.	Rated frequency	50	50 Hz	50 Hz	50 Hz	50 Hz
4.	No. of phase	3	3	3	3	3
5.	Rated Insulation levels					
	i. Fullwave impulse withstand voltage (1.2/50 micro sec.)	1050 kVp	650 kVp	325 kVp	170 kVp	75 kVp
	ii. One minute power frequency dry and wet withstand voltage (rms)	-	275 kV	140 kV	70 kV	28 kV
6.	Corona extinction voltage	156 kV	105 kV	-	-	-


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SL No	Description of parameters	220 kV System	132 kV System	66 kV System	33 kV System	11kV System
7.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz at 92 kV rms for 132 kV system	1000 micro- volts	500 micro- volts	-	-	-
8.	Minimum creepage distance (25mm/kV)	6125mm	3625mm	1813mm	900mm	300mm
9.	Min. Clearances					
	i. Phase to phase	2100mm	1300mm	750mm	320mm	280mm
	ii. Phase to earth	2100mm	1300mm	630mm	320mm	140mm
	iii. Sectional clearances	5000mm	4000mm	3000m m	3000m m	3000mm
10.	Rated short circuit current for 1 sec. Duration	40kA/50kA (as applicable)	31.5 kA	31.5 kA	25 kA	25 kA
11.	System neutral earthing	Effectively earthed	Effectively earthed	Effectively earthed	Effectively earthed	Effectively earthed


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APPENDIX

FOR
TRANSMISSION LINES
&
400/220 KV GIS SUBSTATION
&
COMMUNICATION SYSTEM

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SPECIFIC TECHNICAL REQUIREMENTS FOR 400 KV TRANSMISSION LINES

- 1.0** The Tower shall be fully galvanized using mild steel or/and high tensile steel sections. Bolts and nuts with spring washer are to be used for connection.
- 2.0** IS Steel section of tested quality in conformity with IS 2062:2011, grade E 250 (Designated Yield Strength 250 Mpa) and/or grade E 350 (Designated Yield Strength 350 MPa) are to be used in towers, extensions, gantry structures and stub setting templates. However, use of steel grade having designated yield strength more than 350 MPa is not permitted. The steel used for fabrication of towers shall be manufactured by primary steel producers only.
- 3.0** Towers shall be designed as per IS-802:1995 considering wind zone 4. However, drag coefficient of the tower shall be as follows:-

Solidity Ratio	Drag Coefficient
Upto 0.05	3.6
0.1	3.4
0.2	2.9
0.3	2.5
0.4	2.2
0.5 and above	2.0

As per Clause 12.1.2.1 b) 2) of IS 802:1995, Under security condition for tension and dead end towers, the transverse loads due to line deviation shall be the component of 100 percent mechanical tension of conductor and ground wire/OPGW corresponding to 100% of design wind pressure at everyday temperature or 36% design wind pressure at minimum temperature after accounting for drag coefficient and gust response factor.

As per CEA's technical standards for construction of lines Regulation 2010, Transmission Service Provider (TSP) may adopt any additional loading/ design criteria for ensuring reliability of the line, if so desired and/ or deemed necessary.


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4.0 The conductor configuration shall be as follows:-

4.1 For transmission lines with ACSR conductor:-

Transmission line	ACSR Conductor specified	Sub-conductor Spacing
400kV D/C (Twin Moose) transmission lines	Moose : Stranding 54/3.53mm-Al + 7/3.53 mm-Steel, 597sq mm, Total Sectional Area, 31.77mm diameter	450 mm
400kV D/C (Twin HTLS) transmission lines	HTLS. type- INVAR/ GAP/ Composite Core/ ACSS, 1596A ampacity, 28.62 mm diameter, 0.05552 (Ω /km) resistance	450 mm

Note: The transmission lines shall have to be designed for a maximum operating conductor temperature of 85 deg C for ACSR only.

5.0 The required phase to phase spacing and horizontal spacing for 400 kV D/C line shall be governed by the tower design as well as minimum live metal clearances for 400kV voltage level respectively under different insulator swing angles.

a) For 400 kV transmission lines:

The minimum live metal clearances for 400kV D/C transmission lines may be considered as follows:

(i) Under stationary conditions

From tower body:

For 400 kV D/C: 3.05 m

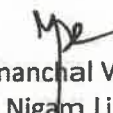
(i) Under swing conditions

Wind pressure Condition	Minimum electrical clearance
a) Nil	3.05 mtrs
b) Swing angle (22°)	3.05 mtrs
c) Swing angle (44°)	1.86 mtrs

However the phase to phase spacing for 400kV D/C line shall not be less than 8.0 m

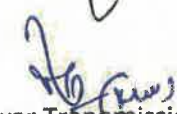

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- 6.0 The minimum ground clearance for 400 kV D/C transmission lines shall be 8.84 m so that maximum electric field does not exceed 10kV/m within the ROW and does not exceed 5kV/m at the edge of the ROW as per international guidelines.
- 7.0 The minimum mid span separation between earth wire and conductor shall be 9.0 m for 400 kV D/C transmission lines. Shielding angle shall not exceed 20 deg for 400 kV D/C line D/C transmission lines.
- 8.0 Transposition is to be done for all transmission lines whose length is greater than 100 km. Transposition should be carried out at 1/3 and 2/3 of the line length tower positions. Transposition of the transmission line after the construction of LILO shall be maintained by the developer. Transposition disturbed from construction of LILO will be set right by the TSP in the resulting Loop in and Loop out Lines as per regulation issued by the competent authority.
- 9.0 The switching impulse withstands voltage (wet) for 400 kV line shall be 1050 kVp. Lightning impulse withstand voltage (dry) for 400kV line shall be 1550 kVp.
- 10.0 The Fault current for design of line shall be 63 kA for 1 sec for 400 kV.
- 11.0 The lines shall be designed for very heavy pollution level (creepage of 31mm/kV as per IEC-60815). Porcelain/ glass/ polymer insulators shall be used in the line as per requirement and site conditions for the transmission lines.
- 12.0 Each tower shall be earthed such that tower footing resistance does not exceed 10 ohms. Pipe type or Counterpoise type earthing shall be provided in accordance with relevant IS. If the value (before stringing) has been recorded higher than 10 ohm, earthing shall be changed to Counterpoise type. Additional earthing shall be provided on every 7 to 8 kms distance at tension tower for direct earthing of both shield wires.
- 13.0 The required grade of concrete and mix design for foundation of transmission line tower shall be as per relevant IS.
- 14.0 **Technical specification for 400kv line on Monopole**

- i) The monopoles are of the following types:

400 kV Double Circuit (PA, PB, PC & PD)

Classification of Monopole/Towers


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The Pole for 400 kV Lines are classified as given below:-

a) For Suspension Pole PA (0-2 deg.)

Normal Span : 200m

Wind Span : 200m

Weight Span : 300m

b) For Tension Pole PB (2-15 deg.)

Normal Span : 200m

Wind Span : 200m

Weight Span : 300m

c) For Tension Pole PC (15-30 deg.)

Normal Span : 200m

Wind Span : 200m

Weight Span : 300m

d) For Tension Pole PD (30-60 deg.)

Normal Span : 200m

Wind Span : 200m

Weight Span : 300m


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ii) Broken wire Conditions:

For Suspension pole (PA)	:	One Earthwire or One Conductor broken at a time, whichever is more stringent for a particular section.
For Tension pole (PB)	:	One Earthwire and any One Conductor broken or any two conductor broken at a time on same side, whichever is more stringent for a particular section.
For Tension pole (PC)	:	One Earthwire and any One Conductor broken or any two conductor broken at a time on same side, whichever is more stringent for a particular section.
For Tension pole (PD)	:	One Earthwire and any Two Conductor broken or any Three conductor broken at a time on same side, whichever is more stringent for a particular section.

Code Reference

Load Calculation : IS 802

Sag & Clearance : IS: 5613 CBIP Manual

Deflection Criteria: 5% of height of pole @ ultimate load conditions and 2% of the height of pole @ everyday condition (safety normal)

iii) Ground Clearance

The minimum ground clearance from the bottom conductor shall not be less than 8840 mm for 400KV lines at the maximum sag conditions i.e. at 85° C and still air.

An allowance of 150mm shall be provided to account for errors in stringing.

Conductor creep shall be compensated by over tensioning the conductor at a temperature of 26°C lower than the stringing temperature for ACSR ,MOOSE conductor.


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iv) Electrical System Data for 400 kV line

1.	Nominal Voltage	kV	400
2.	Maximum system voltage	kV	420
3.	BIL (Impulse)	kV (Peak)	1550
4.	Power frequency withstand voltage (Wet)	kV (rms)	680
5.	Switching surge withstand voltage (Wet)	kV (rms)	1050
6.	Minimum Corona extinction voltage at 50 Hz AC system under dry condition	kV (rms) phase to earth.	320(Min)
7.	Radio interference voltage at one MHz for phase to earth voltage of 305 KV under dry condition.	Micro Volts	1000 (Max)

v) Details of line Material: earthwire & OPGW

Sl. No.	Description	Earthwire	OPGW (tentative)
1.	Type	7/3.66mm GS Earthwire	24 fibre OPGW
2.	Stranding and wire diameter		
	Aluminium	-	
	Steel	7/3.66	
3.	Conductor per phase	NA	NA
4.	Spacing between conductor of same phase(sub conductor spacing)(mm)	NA	NA
5.	Configuration	One continuously to run	One continuously to run on top of the

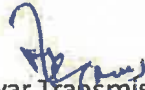

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		horizontally on top of the towers and conductors.	towers and conductors
6.	Overall Diameter (mm)	10.98	≈ 10.98
7.	Unit mass (kg/km)	583	≈ 583
8.	Min. UTS (kN)	68.4	Equivalent to earthwire

- 15.0** For crossings design, installation and maintenance of overhead power lines shall be as per IS:5613 or latest amendments.


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SPECIFIC TECHNICAL REQUIREMENTS FOR 400/220 KV SUBSTATION

The proposed 400/220 kV Jewar (2x500 MVA) substation shall be Gas Insulated Switchgear (GIS) type generally confirming to the requirement of CEA regulation for construction of sub-station.

1.0 Salient features of 400/220kV GIS Substation Equipment and Facilities

The design and specification of substation equipment are to be governed by the following factors:

2.0 Insulation Coordination

400kV System would be designed to limit the Switching overvoltage to 2.5 pu and is expected to decay to 1.5 p.u. in 5 to 6 cycles. Consistent with these values and protective levels provided by lightning arrestors, the following insulation levels are proposed to be adopted for 400 KV & 220kV systems:

Sl. No.	Particulars	<u>400kV</u>	<u>220kV</u>
a.	Impulse withstand voltage for - Transformer and reactors	1300kVp	950kVp
	- for Other Equipment	1425 kVp	1050 kVp
	- for insulator strings	1550kVp	1050 kVp
b.	Switching surge withstand voltage	1050 kVp	-NA-
c.	Minimum creepage distance - for insulator strings	13020mm	7595 mm
	- for other equipment	13020mm	7595 mm
d.	Max. fault current	63 kA	40 kA
e.	Duration of fault	1 Sec	1 Sec
f.	Corona extinction voltage	320kV rms	156kV rms


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3.0 Switching Schemes

It is essential that the system should remain secured even under conditions of major equipment or bus-bar failure. Sub-stations being the main connection points have large influence on the security of the system as a whole. The selection of the bus switching scheme is governed by the various technical and other related factors. One & Half breaker bus scheme has been considered for 400kV side of the substation due to their merits in terms of reliability, security, operational flexibility and ease of maintenance of equipment.

Substation	Bus Scheme
400/220 kV (2×500 MVA) GIS Substation at Jewar	400 kV- Double Main Bus Scheme 220 kV- Double Main Bus Scheme

4.0 Substation Equipment and Facilities

The switchgear shall be designed and specified to withstand operating conditions and duty requirements. All equipments shall be designed considering the transmission line capacity.

Current rating for various feeders & bus bar are as follows

Sl. No	Description of bay	400 kV	220 kV
1	Bus Bar	4000A	3000A
2	Line bays	3150	1600A
3	ICT bays	3150	1600A
4	Bus Reactor bays	3150	NA
5	Bus coupler bays	NA	2500A

4.1 400/220KV GIS Substation equipment

GIS (Gas Insulated Switchgear) shall be indoor type and in accordance to IEC: 62271-203. The switchgear shall be designed and specified to withstand operating conditions and duty requirements. All the switchgear such as Circuit Breaker, isolator, earth switch including CT, PT etc. shall be GIS type. Surge Arrestors used for transformer/Reactor connections will be AIS or GIS type. 400kV scheme shall be designed in such a way that it shall be possible to use line reactors (if provided) as bus reactors, in case of outage of line, to control


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bus voltage. Local control cabinets (LCC) shall be provided as per requirement. The alarm & annunciation of GIS equipment shall be wired to SCADA System.

4.1.1 Circuit Breakers

GIS Circuit breakers shall in general be of C2-M2 class and comply to IEC- 62271-100. The rated break time shall not exceed 40 ms for 420KV breaker and 60 ms for 245kV breaker. 420 kV & 245 kV Circuit breakers shall be provided with single phase and three phase auto reclosing. The Circuit breakers controlling 400kV lines of more than 200km length shall also be provided with pre insertion closing resistor of about 400 ohms maximum with 9 ms minimum insertion time. The short line fault capacity shall be same as the rated capacity and this is proposed to be achieved without use of opening resistors. The short line fault capacity shall be same as the rated capacity and this is proposed to be achieved without use of opening resistors. Control switching device shall be provided in Circuit breaker of switchable line reactor and in Main & Tie circuit breakers of Transformers, line with non-switchable line reactors and Bus reactors. Further, it shall be possible to use line reactors as bus reactors, in case of outage of line.

4.1.2 Isolators

The isolators shall comply to IEC 62271-102 in general. Isolators shall be motor (DC powered) operated. Earth switches are provided at various locations to facilitate maintenance. Main blades and earth blades shall be interlocked and interlock shall be fail safe type. All earth switches shall be motor operated type.

4.1.3 Current Transformers

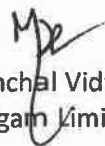
Current Transformers shall comply with IEC 61869 in general. All ratios shall be obtained by secondary taps. Generally, Current Transformers (CT) shall have five cores (four for protection and one for metering) whereas; CT in Tie bays shall have six cores (four for protections & two for metering) suitably distributed on both sides of CB. The burden and knee point voltage shall be in accordance with the requirements of the system including possible feeds for telemetry. Accuracy class for protection core shall be PX and for metering core it shall be 0.2S.

4.1.4 Voltage Transformer

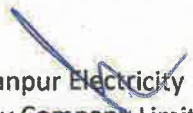
The voltage transformers shall conform to IEC- 61869 Voltage transformers shall be of the electromagnetic type with SF6 gas insulation. The earth end of the high voltage winding and the ends of the secondary winding shall be brought out


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in the terminal box. The voltage transformers shall be located as a separate bay module and will be connected phase to ground and shall be used for protection, metering and synchronization. The voltage transformers shall be of inductive type, nonresistant and shall be contained in their own- SF6 compartment, separated from other parts of installation. The voltage transformers shall be effectively shielded against high frequency electromagnetic transients. The voltage transformers shall have three secondary windings. The voltage transformer should be thermally and dielectrically safe when the secondary terminals are loaded with the guaranteed thermal burdens. The accuracy class for core –I & II for 400 kV shall be 0.5/3P and for 220 kV shall be 3P. The accuracy of 0.2 on secondary III should be maintained throughout the entire burden range up to 50VA on all the three windings without any adjustments during operation.

4.1.5 SF6 to Air Bushing

Outdoor bushings, for the connection of conventional external conductors to the SF6 metal enclosed switchgear, shall be provided. Bushings shall generally be in accordance with the requirements of IEC -60137. The creepage distance over the external surface of outdoor bushings shall not be less than 31 mm/kV considering polluted area. SF6 to air Bushing shall be of Polymer / composite type and shall be robust and designed for adequate cantilever strength to meet the requirement of seismic condition. The electrical and mechanical characteristics of bushings shall be in accordance with IEC: 60137. Polymer / composite insulator shall be seamless sheath of a silicone rubber compound. The housing & weather sheds should have silicon content of minimum 30% by weight. It should protect the bushing against environmental influences, external pollution and humidity. The hollow silicone composite insulators shall comply with the requirements of the IEC publications IEC 61462 and the relevant parts of IEC 62217.

4.1.6 Capacitor Voltage Transformers

Capacitive Voltage transformers shall comply to IEC 61869-1 & 61869-5 in general. These shall have three secondaries out of which two shall be used for protection and one for metering. Accuracy class for protection cores shall be 3P and for metering core shall be 0.2. The capacitive voltage transformers on lines shall be suitable for Carrier Coupling. The Capacitance of CVT for 400kV and 220kV shall be of 4400/8800 pF depending on PLCC requirements.


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4.1.7 Surge Arresters

Station class current limiting, heavy duty gapless type Surge arresters conforming to IEC 60099-4 in general shall be provided.

The rated voltage of Surge arrester and other characteristics are chosen in accordance with system requirements. Surge arresters shall be provided near line entrances, transformers so as to achieve proper insulation coordination. Surge arrester should be providing with porcelain / polymer housing.

4.1.8 Power Transformers**CODES AND STANDARDS**

The latest revisions of the following Codes and Standards shall be applicable for the equipment/material covered in this Specification. In case of conflict, the manufacturer may propose equipment/material conforming to one group of Industry Codes and Standards quoted hereunder without jeopardizing the requirement of this specification:

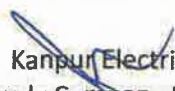
IEC60044	Instruments transformers
IEC60076	Power transformers
IEC60137	Insulating bushing for alternating voltages above 1000 V
IEC60214	On-load tap-changers
IEC60273	Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V
IEC 60282-2	High-voltage fuses
IEC60289	Reactors
IEC60529	Degrees of protection provided by enclosures (IPCode)
IEC60815 conditions	Guide for the selection of insulators in respect of polluted conditions
IEC60947	Low-voltage switchgear and control gear


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Design and Construction Requirements**Core**

1. The core shall be assembled with oriented grain steel, cold rolled sheet, and treated with an insulating layer heat and oil resistant.
2. The core supports shall be designed to counter the effects of marine and overland transport under poor conditions. The air core reactance of the core shall be less than 20%.

Over Fluxing

The transformer shall withstand without injurious heating combined voltage and frequency fluctuations which produce the following overfluxing conditions and give desired performance:

- 105% for 10minutes
- 125% for 1minute
- 140% for 5seconds
- Bidder shall provide the overvoltage withstand time for 150% and 170% over fluxing

- (a) Transformer shall conform to IEC 60076 in general. The transformer and all its accessories including bushing/ built in CTs etc shall be designed to withstand thermal and mechanical stresses caused by symmetrical or asymmetrical faults on any terminals. Mechanical strength of the transformer shall be such that it can withstand 3-phase and 1- phase through fault for transformer rated voltage applied to HV and / or IV terminals of transformer. The short circuit shall alternatively be considered to be applied to each of the HV, IV and tertiary (LV) transformer terminals. Tertiary is not considered to be connected to source.

Core shall be constructed from high grade, non-ageing cold rolled super grain oriented silicon steel laminations (HI-B or better grade). The maximum flux density in any part of the core and yoke at the rated MVA, voltage and frequency shall not exceed 1.9 Tesla at all tap positions during 10% continuous over voltage condition. Transformers shall withstand without damage and over-


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heating due to over fluxing conditions of 110 % for continuous, 125 % for 1 minute and 140 % for 5seconds.

All the windings shall be capable of withstanding the Dielectric, mechanical and thermal stresses which may be caused by switching, dead short circuit on its terminals. Transfer surge at tertiary shall not exceed 250kVp during impulse and switching impulse from HV & IV Terminals. The tertiary windings shall be suitable for connection of reactors or capacitors which would be subjected to frequent switching and shall be suitable for connection to LT Transformer for auxiliary supply. The air core reactance of HV winding of transformer shall not be less than 20% for 400kV class Transformer. External or internal reactors shall not be used to achieve the specified HV/LV and IV/LV impedances.

Transformers shall be fitted with two cooler banks, each capable of dissipating 50 per cent of the loss at continuous maximum rating. Transformer shall be capable of operating at full load for 20 minutes in the event of failure of the oil circulating pump or blowers associated with one cooler bank and for at least ten (10) minutes in the event of total failure of power supply to cooling fans and oil pumps, without winding hot spot temperature exceeding 140 deg C. Transformer shall be designed so that tank hotspot shall not exceed 130 deg C, considering maximum ambient temperature of 50°C.

The transformer shall be complete with all required accessories, Bushing CTs, Neutral CT (outdoor type), cooler control cabinet, individual and common marshalling box, RTCC etc as required for satisfactory operations of transformer. The transformer shall be provided with IEC 61850 compliant digital RTCC relay having automatic voltage regulating features to operate OLTC including parallel operation of transformers. Neutral of the transformer shall be solidly grounded.

HV and IV bushing shall be RIP (Resin Impregnated Paper)/RIS (Resin Impregnated Synthetic) with composite insulator type. LV bushing shall be OIP/RIP/RIS. 36kV Neutral bushing shall be solid porcelain or oil communicating type.

The major technical particulars / parameters of transformer are given below:


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(A) 500MVA, 400/220/33kV, 3-Phase Auto transformer
(applicable standard: IEC-60076)

Sl. No.	Description	Unit	Technical Parameters
1.	Rated Capacity: HV/IV/LV (Tertiary)	MVA	500/500/167 (Active loading of tertiary: 5 MVA)
2.	Voltage ratio (Line to Line)		400/220/33
3.	Frequency	Hz	50
4.	No. of Phase	Nos	3
5.	Vector Group (unless specified differently elsewhere)		YNaoD11
6.	Cooling		ONAN/ONAF/(OFAF or ODAF) OR ONAN/ONAF1/ONAF2
7.	Rating at different cooling above	%	60/80/100
8.	Type of Transformer		Constant Ohmic impedance type
9.	Impedance at 75 Deg C		
a)	HV – IV (with tolerance as per IEC)	%	At Max./ Principal/ Min. Voltage Tap: 10.3/12.5/15.4
b)	HV - LV	%	At Principal tap(minimum) : 60
c)	IV - LV	%	At Principal tap (minimum): 45
10.	Losses		
a)	Maximum No-Load Loss at rated voltage and frequency	kW	90
b)	Maximum Load Loss at rated current and 75°C	kW	500
c)	Maximum I ² R Loss at rated current and frequency and at 75°C for HV and IV windings	kW	375
d)	Maximum Auxiliary Loss at rated voltage and frequency	kW	15


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Sl. No.	Description	Unit	Technical Parameters
11.	Max. Temperature rise over 50 deg C ambient Temp	Deg. C	Top oil: 50 & Winding: 55
12.	Windings		
i)	Insulation Level (LI/SI/PF)		kVp/kVp/kVrms
	HV		1300/1050/570
	IV		950/-/395
	LV		250/-/95
	Neutral		95/-/38
ii)	Tan delta of winding	%	< 0.5
13.	Tap Changer & Tappings		OLTC with range $\pm$ 10% for HV variation in the step of 1.25%, 17 steps, on 220kV side of series winding
14.	Maximum Partial discharge (PD) level at $1.58 \cdot U_r / \sqrt{3}$	pC	100
15.	Noise level at rated voltage and at principal tap at no load and all cooling active	dB	< 80
16.	Bushing		
i)	Rated voltage (HV/IV/LV/Neutral)	kV	420/245/52/36
ii)	Rated current(Min.) HV/IV/LV/Neutral	A	1250/2000/3150/2000
iii)	Insulation Level (LI/SI/PF)		kVp/ kVp/ kVrms
	HV		1425/ 1050/ 630
	IV		1050/ -/ 460
	LV		250/ -/ 95
	Neutral		170/ -/ 75
iv)	Tan delta of bushings HV/IV/LV	%	< 0.4
v)	Max. PD of bushings at level @ 1.5 pu	pC	100
17.	Insulating Oil		virgin high grade inhibited, conforming to IEC-60296


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4.1.9 125 MVAR Bus Reactors

Reactor shall conform to IS:5553 and IEC 60076-6 in general.

The Technical Particulars / Parameters of Shunt Reactor are given below:

REACTOR (3-PHASE)

(i)	Power	125 MVAR Bus Reactor
(ii)	Rated voltage	420 kV(1.0 p.u)
(iii)	System fault level	50 kA
(iv)	Connection	Star with neutral brought out
(v)	Winding Insulation level	
a)	Lightning impulse 1.2/50microseconds withstand voltage	1300 kV (peak)
b)	Switching surge withstand voltage	1050 kV (peak)
)`	One minute power frequency withstand voltage	NA
(vi)	Maximum admissible Temperature Rise over an ambient temp of 50 deg. C and at highest Voltage	
a)	Winding measured by resistance method	45 degree C
b)	Top oil measured by thermometer	40 degree C
(vii)	Cooling system	ONAN
(viii)	Insulation level of Neutral	
a)	Impulse withstand voltage	550 kV (peak)
b)	Power frequency voltage	230 kV (rms)
c)	Whether neutral is to be brought out	Yes (through 145kV class bushing)
(ix)	Ratio of zero sequence reactance to positive reactance (X0/X1)	Between 0.9 and 1.0 (The bidder must clearly specify the exact figure)


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(x)	Range of constant impedance	Upto 1.5 p.u. voltage (The bidder shall furnish complete saturation characteristics of the reactor up-to 2.5 p.u. voltage).		
(xi)	Tolerance on current	0 to +5%		
(xii)	Harmonic content in phase	The crest value of the third harmonic current component in phase current not to exceed 3% of the crest value of fundamental, when reactor is energized at rated voltage with sinusoidal wave form.		
(xiii)	Permissible current unbalance among different phases	$\pm 2\%$		
(xiv)	Minimum clearance in air at rated voltage of 420 kV with terminal connector			
	a) Phase to Phase	4000mm		
	b) Phase to ground	3500mm		
(xv)	Noise level at rated voltage and frequency	80 db.		
(xvi)	Vibration level at rated voltage and frequency	Not more than 200 microns peak. Average vibration shall not exceed 60 microns peak to peak Tank stresses shall not exceed 2.0 kg/mm ² at any point on the tank		
(xvii)	Bushings	Line side	Neutral side	


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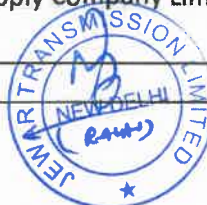

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a) Rated voltage	420 kV	145 kV
b) Creepage distance (total)	10500 mm	3625 mm
c) Mounting	Tank Cover	Tank Cover
d) Lightning impulse withstand voltage (kVp)	1425	650
e) Switching impulse withstand voltage (kVp)	1175	-
f) Power frequency with stand voltage (kV) (rms)	630	275
g) Rated current (Amps)	800	800

4.1.10 Protection and Control

The protective relaying system proposed to be provided for transmission lines, auto-transformers, reactors and bus bars to minimize the damage to the equipments in the events of faults and abnormal conditions, is dealt in this section. All main protective relays shall be numerical type with IEC 61850 communication interface. All numerical relays shall have built in disturbance recording feature.

a) Transmission Line Protection

400 kV, 220 kV and 132 kV lines shall have MAIN-I numerical three zone distance protection scheme with carrier aided inter-tripping feature. 400 kV, 220 kV and


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132 kV lines shall also have MAIN-II numerical distance protection scheme like Main-I but from different make that of MAIN-I. Line Current Differential as Main-I & Main-II may be considered, for short lines (line length below 30 km) having Fibre Optic communication link. In case of loop in loop out of transmission lines, the existing protection scheme shall be studied and suitable up-gradation (if required) shall be carried out.

All 400 kV lines shall also be provided with two stages over voltage protection. Further, all 400 lines shall be provided with single and three phase auto-reclosing facility to allow reclosing of circuit breakers in case of transient faults. These lines shall also be provided with distance to fault locators to identify the location of fault on transmission lines.

- b) These shall have the following protections:
- i) Numerical Differential protection
 - ii) Numerical Restricted earth fault protection
 - iii) Numerical Over-current and earth fault protection on HV & MV side
 - iv) Numerical Over fluxing protection on HV & MV side
 - v) Numerical Overload alarm

Besides these, power transformers shall also be provided with BUCHOLZ relay, protection against high oil and winding temperature and pressure relief device etc.

- c) 420kV Reactor Protection
Reactor shall be provided with the following protections:

- i) Numerical Differential protection
- ii) Numerical Restricted earth fault protection
- iii) Numerical Back-up impedance protection

Besides these, reactors shall also be provided with Bucholz relay, protection against oil and winding temperatures & pressure relief device etc.

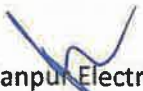
- d) Numerical Bus Bar Protection
The high speed bus bar differential protection, which is essential to minimize the damage and maintain system stability at the time of bus bar faults, shall be provided for 400kV, 220kV and 132kV buses. Duplicated busbar protection is


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envisaged for 400kV bus-bar protection. Bus bar protection scheme shall be such that it operates selectively for each bus and incorporate necessary features required for ensuring security. The scheme shall have the provision for future expansion. For existing substations, the existing bus bar protection shall be augmented wherever required.

e) Numerical Local Breaker Back up Protection

This shall be provided for each 420 kV, 245 kV and 145 kV breakers and will be connected to de-energize the affected stuck breaker from both sides.

f) Substation Automation System

For all the new substations, state of art Substation Automation System (SAS) conforming to IEC-61850 shall be provided. The distributed architecture shall be used for Substation Automation system, where the controls shall be provided through Bay control units. The Bay control unit is to be provided bay wise for voltage level 132kV and above. All bay control units as well as protection units are normally connected through an Optic fibre high speed network. The control and monitoring of circuit breaker, dis-connector, re- setting of relays etc. can be done from Human Machine Interface (HMI) from the control room. SAS shall be equipped with the facility of remote operation and by providing remote HMI and suitable communication link, the substation can be controlled from a remote location. Necessary gateway & modems (as required) shall be provided to send data to RLDC/SLDC.

The functions of control, annunciation, disturbance recording, event logging and measurement of electrical parameters shall be integrated in Substation Automation System. The Automation System shall be provided with the facility of communication and control for remote end operation. In existing Substations where Substation automation is not provided, control functions shall be done through control panels.

g) Time Synchronization Equipment

Time synchronization equipment complete in all respect including antenna, cable, processing equipment required to receive time signal through GPS or from National Physical Laboratory(NPL) through INSAT shall be provided. This equipment shall be used to synchronize SAS & IEDs etc.


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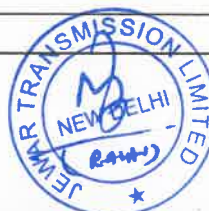

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4.1.11 Control Concept

All the EHV breakers in substation/switching stations shall be controlled and synchronized from the switchyard control room and remote control centre. Each breaker would have two sets of trip circuits which would be connected to separately fused DC supplies for greater reliability. All the isolators shall have control from remote/local whereas the earth switches shall have local control only.

4.1.12 PLCC

Power line carrier communication (PLCC) equipment complete for speech transmission line, tele-protection commands and data channels shall be provided on each 400 kV, 220 kV and 132 kV transmission line. The protections for transmission line and the line compensating equipment shall have hundred percent back up communication channels. The PLCC equipment shall in brief include the following:-

Coupling device, line traps, carrier terminals, protection couplers, HF cables, PABX and maintenance and testing instruments.

A telephone exchange (PABX) of 24 lines shall be provided at new substations as means of effective communication among various buildings of the substation, remote end substations and with control centres (RLDC/SLDC) etc.

Coupling devices shall be suitable for 4400pF 400kV, 220 kV and 132 kV CVT. Phase to phase coupling for 400 kV line, 220 kV and 132 kV single circuit line shall be provided. For D/c line Inter circuit coupling can be provided. The pass band of coupling devices shall have sufficient margin for adding communication channel in future if required. Necessary protection devices for the safety of personnel and low voltage part against power frequency voltages and transient over voltage shall also be provided.

The line traps shall be broad band tuned suitable for blocking the complete range of carrier frequencies. Line Trap shall have the necessary protective devices such as lightning arresters for the protection of tuning device and shall be equipped with corona rings. Decoupling network consisting of line traps and coupling capacitors may also be required at certain substation in case of extreme frequency congestion.

The carrier terminals shall be of single side - band (SSB) amplitude modulation


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(AM) type and shall have 4 kHz band width. PLCC Carrier terminal & Protection coupler shall be considered at both ends of line.

Wherever Fiber Optic/OPGW based telecommunication terminal equipment (i.e. SDH/MUX) are being provided; the same shall be utilized for Data, Voice and line protection applications. For protection purposes, both end Digital Protection Couplers (DPCs) shall be included at both ends. However, for line protection application, back up communication channel/link may be considered as per requirement so as to take care of OPGW/Telecommunication equipment outage.

Addition /Modification /shifting/re-commissioning etc. as required of PLCC due to LILO of transmission lines shall be covered under the scope according to element wise detailed given below:-

Sr. No	Detail of element (line)	Coverage under the scope
1	LILO of one ckt. of 400 kV Gr. Noida (765 kV) – Sector-148 (400) Noida DC line at 400/220 kV GIS substation Jewar (GautamBudh Nagar) (for LILO, twin HTLS conductor and OPGW stringing work on Narrowbase multi circuit towers)	Addition/Modification/ shifting/re-commissioning of PLCC shall be covered under the scope.

PLCC equipment for the transmission lines at serial 01 covered under the package (Consisting of one set of analog PLCC channel along with circuit protection coupler and one set of Digital Protection Coupler for both ends of one line segment due to LILO of existing line) shall be provided by the bidder. All other associated equipment for ends cabling, coupling device and HF cable shall also be provided by the bidder. 48 V DC Power supply for PLCC panels shall be provided by the respective substation bay owner. The wave traps, CVT's required for communications from PLCC shall be provided by respective substation owner.

4.1.13 Substation Support Facilities

Certain facilities required for operation & maintenance of substations as described below shall be provided in new substation. In existing substation, these facilities have already been provided and would be extended/ augmented,


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wherever required.

4.1.14 AC & DC Power Supplies

For catering to the requirements of three phase & single phase AC supply and DC supply for various substation equipment, the following arrangement is envisaged:-

- i) For LT Supply at each new Substation, two (2) nos. 630 kVA LT Transformers shall be provided out of which one shall be connected with SEB supply and other one shall be connected to tertiary of 400/220 kV transformer.
- ii) SEB supply at 33kV level shall be connected to 630kVA LT transformer through 33kV AIS equipments i.e. LA, CT, PT, Isolators and breaker where as tertiary supply of 400/220kV transformer shall be connected to LT transformer through 72.5kV AIS equipments.
- iii) 2 Nos. batteries of 220V for control & protection and 2 Nos. 48V batteries for PLCC/ Communication equipment shall be provided at each new Substation. Each battery bank would have a float-cum-boost charger. Battery shall be of VRLA type.
- iv) Suitable AC & DC distribution boards and associated LT Switchgear would be provided at new Substations. For Substation Extensions, existing facilities shall be augmented as required. For new substations following switch boards with minimum rating as is specified here under shall be considered with duplicate supply
 - a) 415V Main switch board – 1no.
 - b) AC distribution board – 1no.
 - c) Main lighting distribution board –1no.
 - d) Emergency lighting distribution board –1no.
 - e) 220 volt DC distribution board –2nos.
 - f) 48 volt DC distribution board –2nos.
- v) In new Substations, one No. 250 KVA DG set shall be provided for emergency applications Sizing of Auxiliary system (like battery, charger, LT switchgear) may be done considering future bay requirements to avoid replacement in future with higher sizes.


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4.1.15 Fire Fighting System

Fire fighting system in general conforms to fire insurance regulations of India. The fire fighting system is proposed with both AC motor & diesel engine driven pumps housed in a fire fighting pump house building along with water storage tank of adequate capacity. Automatic heat actuated mulsifying system is proposed for transformers & reactors. In addition for alarm system based on heat/smoke detectors are proposed to be installed at sensitive points in a substation e.g. Cable Vault, Control Room building and other buildings etc. Further, adequate water hydrants and portable fire extinguishers shall be provided in the substations. At existing substations the fire fighting systems if already available, would be extended for meeting the additional requirements.

4.1.16 OIL EVACUATING, FILTERING, TESTING & FILLING APPARATUS

To monitor the quality of oil for satisfactory performance of transformers, shunt reactors and for periodical maintenance necessary oil evacuating, filtering, testing and filling apparatus would be provided at new substations. Oil tanks of adequate capacities for storage of transformer oil would be provided.

4.1.17 Illumination

Adequate normal & emergency AC & DC illumination shall be provided in the control room, GIS hall & other buildings of the substation. The switchyard shall also be provided with adequate illumination. The entire control room building, fire fighting pump house lighting shall be done by LED based low power consumption luminaries

4.1.18 Control Room

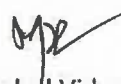
Substation control room would be provided to house substation work station for station level control (SAS) along with its peripheral and recording equipments, AC & DC distribution boards, DC batteries & associated battery chargers, Fire Protection panels, Telecommunication panels & other panels as per requirements. Air conditioning will be provided in the building as functional requirements.

4.1.19 GIS Hall

The Gas Insulated Switchgear (GIS) of each voltage other associated equipment


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shall be housed separately and inside in the GIS buildings. The panels i.e. Bay level units, bay mimic, relay and protection panels, RTCC panels, PLCC panels etc. are to be placed in a separate room in the GIS building. The size of the room shall be such that all the panels for the future bays/ diameters shall be accommodated in the above room. The panel room shall be air-conditioned. Further, the temperature of the room shall be monitored through substation automation system by providing necessary temperature transducers.

One EOT Crane each for GIS hall of suitable capacity shall be provided for erection & maintenance of largest GIS component/assembly and all plant installed in the GIS switchgear room. The crane shall capable of fulfilling all special requirements for erection & maintenance of GIS equipment The capacity of the crane shall be sized to lift the heaviest GIS switchgear component.

SPECIFIC TECHNICAL REQUIREMENT FOR 400 KV and 220 KV COMMUNICATION

In order to meet the requirement for grid management and operation of substations, Transmission Service Provider (TSP) shall conform to the following requirements.

On 400 kV D/C transmission lines one earth wire and one OPGW containing 24 fibers is to be installed by the TSP in place of conventional earth wire during the construction of line for grid management and substation operation purpose by STU/CTU and 48 fibers to be installed on LILO lines. The installation of OPGW shall be done from gantry of one substation up to gantry of another substation and shall be terminated in a joint box by the TSP at both ends.

On 220 kV and 132 kV D/C lines one OPGW containing 24 fibers is to be installed in place of conventional earth wire for grid management and substation operation purpose by STU/CTU and 48 fibers to be installed on LILO lines.

400 kV & 220 kV System Parameters

Sr. No	Description of parameters	400 kV System	220 kV System
1.	System operating voltage	400 kV	220 kV
2.	Maximum operating voltage of the system	420 kV	245 kV


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3.	Rated frequency	50 HZ	50 HZ
4.	No. of phase	3	3
5.	Rated Insulation levels		
	i. Full wave impulse withstand voltage (1.2/50 micro sec.)	1550 kVp	1050 kVp
	ii. Switching impulse withstand voltage (250/2500 micro sec.) dry and wet	1050 kVp	-
	iii. One minute power frequency dry withstand voltage (rms)	630 kV	-
	iv. One minute power frequency dry and wet withstand voltage (rms)	-	460 kV
6.	Corona extinction voltage	320 kV	156 kV
7.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz at 508 kV rms for 765 kV system, 266kV rms for 400kV system and 156kV rms for 220 kV system	1000 micro-volts	1000 micro-volts
8.	Minimum Creepage distage (25mm/kV)	10500 mm	6125 mm
9.	Min. Clearances		
	i. Phase to phase	4000mm	
		(for conductor-conductor configuration) 4200 mm (for rod-conductor configuration)	2100 mm
	ii. Phase to earth	3500 mm	2100mm
	iii. Sectional clearances	6500mm	5000mm
10.	Rated short circuit current for 1 sec. duration	40kA/50kA /63kA(as	40kA/50kA (as


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		applicable)	applicable)
11.	System neutral earthing	Effectively earthed	Effectively earthed
12.	DC Voltage	220V	110V

Note:

1. The above parameters are applicable for installations up to an altitude of 1000m above mean sea level. For altitude exceeding 1000m, necessary altitude correction factor shall be applicable.
2. The insulation and RIV levels of the equipments shall be as per values given in the respective chapter of the equipments.

Schedule: 2

Scheduled COD

[Note: As referred to in the definition of "Element", "Scheduled COD", and in Articles 3.1.3 (c), 4.1 (b) and 4.3 (a) of this Agreement]

S. No.	Name of the Transmission Element	Schedule d COD in months from Effective Date	Percentage of Quoted Transmission Charges recoverable on Scheduled COD of the Element of the Project	Element(s) which are pre-required for declaring the commercial operation (COD) of the respective Element
A.	Construction of 400/220kV, 2×500 MVA GIS substation Jewar with associated lines			
A1	Construction of 400/220 kV, 2×500MVA GIS substation Jewar (GautamBudh Nagar)	18 months	30.85%	Elements at Sr. No. A1 & A2 shall be required simultaneously.


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	(alongwith 125MVAR reactor)			
A2	LILO of one ckt. of 400 kV Gr. Noida (765 kV) – Sector-148 (400) Noida DC line at 400/220 kV GIS			
B.	Construction of 220/33 kV, 2×60 MVA GIS substation Cantt. (Chaukaghat) Varanasi with associated lines			
B1	Construction of 220/33 kV GIS substation Cantt. (Chaukaghat) Varanasi	18 months	26.78%	Elements at Sr. No. B1 & B2 shall be required simultaneously.
B2	LILO of one ckt. of 220 kV Sarnath (400) – Gajokhar DC line at Cantt. (Chaukaghat) Varanasi construction of 41.5 Km (37 Km overhead line (Zebra Conductor) on Lattice Tower and construction of 4.5 Km 630 mm ² line with copper XLPE cable			
C.	Construction of 220/33 kV, 3×60 MVA GIS substation Vasundhara (Ghaziabad) with associated lines			
C1	Construction of 220/33 kV GIS substation Vasundhara	18 months	17.11%	Elements at Sr. No. C1, C2 & C3 shall be required simultaneously.
C2	LILO of one ckt. of 220 kV Muradnagar (400) – Sahibabad (220) SC line at 220 kV substation Vasundhara (Ghaziabad) (			


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	Multi Ckt./Monopole Tower) (Zebra conductor)			
C3	220 kV Indirapuram (400) – Vasundhara SC line (Monopole and Narrowbase multi circuit tower)			
D.	Construction of 220/132/33 kV, 2×160+2×40MVA substationKhaga (Fatehpur) with associated lines			
D1	Construction of 220/132/33 kV substation Khaga (Fatehpur)	18 months	25.26%	Elements at Sr. No. D1, D2, D3, D4, D5 & D6 shall be required simultaneously.
D2	220 kV Fatehpur (765) PG – Khaga DC line (Zebra Conductor)			
D3	132 kV Khaga (220) – Khaga DC line			
D4	132 kV Khaga (220) – Hussainganj SC line			
D5	132 kV Bay at 132 kV substation Khaga- 02 Nos.			
D6	132 kV Hybrid Bay at 132 kV substation Hussainganj- 01 No.			

The payment of Transmission Charges for any Element, irrespective of its successful commissioning on or before its Scheduled COD, shall only be considered after successful commissioning of the Element(s), which are pre-required for declaring the commercial operation of such Element as mentioned in the above table.

Scheduled COD for the Project is: **18 Months from Effective Date.**


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Schedule: 3**Safety Rules and Procedures**

[Note: As referred to in Articles 5.6 of this Agreement]

1: Site Regulations and Safety:

The TSP shall establish Site regulations within sixty (60) days from fulfilment of conditions subsequent, as per Prudent Utility Practices setting out the rules to be observed till expiry of the Agreement at the Site and shall comply therewith.

Such Site regulations shall include, but shall not be limited to, rules in respect of security, safety of the Project, gate control, sanitation, medical care, and fire prevention, public health, environment protection, security of public life, etc.

Copies of such Site regulations shall be provided to the Long Term Transmission Customers and the CEA for the purpose of monitoring of the Project.

2: Emergency Work:

In cases of any emergency, the TSP shall carry out all necessary remedial work as may be necessary.

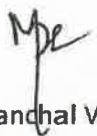
If the work done or caused to be done by any entity, other than the TSP, the TSP shall, reimburse the actual costs incurred, to the other Party carrying out such remedial works.

3: Site Clearance:

In the course of execution of the Agreement, the TSP shall keep the Site reasonably free from all unnecessary obstruction, storage, remove any surplus materials, clear away any wreckage, rubbish and temporary works from the Site, and remove any equipment no longer required for execution of the Agreement. After completion of all Elements of the Project, the TSP shall clear away and remove all wreckage, rubbish and debris of any kind from the Site, and shall leave the Site clean and safe.

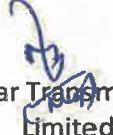

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4: Watching and Lighting:

The TSP shall provide and maintain at its own expense all lighting, fencing, and watching when and where necessary for the proper construction, operation, maintenance / repair of any of the Elements of the Project, or for the safety of the owners and occupiers of adjacent property and for the safety of the public, during such maintenance / repair.


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Schedule: 4**Computation of Transmission Charges****1.1 General**

The Monthly Transmission Charges to be paid to the TSP for providing Transmission Service for any Contract Year during the term of the Agreement shall be computed in accordance with this Schedule and paid as per applicable Regulations.

Illustration regarding payment of Transmission Charges under various scenarios (considering definitions of Contract Year, Expiry Date & Monthly Transmission Charges above) is as below: -

Illustration-1: In case the Project Elements achieve COD as per Schedule

Quoted Transmission Charges: Rs. 140 Million

Completion Schedule:

Element No.	Completion Schedule in Months	Scheduled CoD of the Element	Actual CoD of the Element	% Charges recoverable on Scheduled CoD of the Element
Element 1	28	1-Feb-2018	1-Feb-2018	25%
Element 2	38	1-Dec-2018	1-Dec-2018	75%


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Tariff Payable as follows:

Transmission Charges for Element 1			Transmission Charges for Element 2		
1-Feb-18 to 31-Mar-18	$140 \times 25\% \times ((28+31)/365)$	5.65		--	0.00
1-Apr-18 to 30-Nov-18	$140 \times 25\% \times (244/365)$	23.39		--	0.00
1-Dec-18 to 31-Mar-19	$140 \times 100\% \times (121/365)$				46.41
2	$140 \times 100\% \times 1$				140
3	$140 \times 100\% \times 1$				140
4	$140 \times 100\% \times 1$				140
5	$140 \times 100\% \times 1$				140
.....					
.....					
36 (1-Apr to 30-Nov)	$140 \times 100\% \times (244/365)$				93.59

Illustration-2: In case of extension of Scheduled COD as per Article 4.4.1 & 4.4.2 of this Agreement

Quoted Transmission Charges: Rs. 140 Million

Completion Schedule:

Element No.	Completion Schedule in Months	Scheduled CoD of the Element	Actual CoD of the Element	% Charges recoverable on Scheduled CoD of the Element
Element 1	20	1-Feb-2018	1-Jul-2018	25%
Element 2	28	1-Oct-2018	1-Dec-2018	75%


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Tariff Payable as follows:

Transmission Charges for Element 1			Transmission Charges for Element 2		
1-Feb-18 to 31-Mar-18	--	0.00		--	0.00
1-Apr-18 to 30-Jun-18	--	0.00		--	0.00
1-Jul-18 to 30-Nov-18	140 X 25% X (153/365)	14.67		--	0.00
1-Dec-18 to 31-Mar-19	140 X 100% X (121/365)				46.41
2	140 X 100% X 1				140
3	140 X 100% X 1				140
4	140 X 100% X 1				140
5	140 X 100% X 1				140

36 (1-Apr to 30-Nov)	140 X 100% X (244/365)				93.59

Illustration-3: In case of delay in achieving COD of Project & all individual Elements (COD of the Project achieved in Contract Year 1)

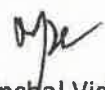
Quoted Transmission Charges: Rs. 140 Million

Completion Schedule:

Element No.	Completion Schedule in Months	Scheduled CoD of the Element	Actual CoD of the Element	% Charges recoverable on Scheduled CoD of the Element
Element 1	20	1-Feb-2018	1-Dec-2018	25%
Element 2	28	1-Oct-2018	1-Dec-2018	75%


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Tariff Payable as follows:

Transmission Charges for Element 1			Transmission Charges for Element 2		
1-Feb-18 to 31-Mar-18	--	0.00		--	0.00
1-Apr-18 to 30-Sept-18	--	0.00		--	0.00
1-Oct-18 to 30-Nov-18	--	0.00	1-Oct-18 to 30-Nov-18	--	0.00
1-Dec-18 to 31-Mar-19	140 X 100% X (121/365)				46.41
2	140 X 100% X 1				140
3	140 X 100% X 1				140
4	140 X 100% X 1				140
5	140 X 100% X 1				140
.....					
.....					
36 (1-Apr to 30-Nov)	140 X 100% X (244/365)				93.59


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Illustration-4: In case of delay in achieving COD of Project & all individual Elements (COD of the Project achieved in Contract Year other than Contract Year 1)Quoted Transmission Charges: **Rs. 140 Million**

Completion Schedule:

Element No.	Completion Schedule in Months	Scheduled CoD of the Element	Actual CoD of the Element	% Charges recoverable on Scheduled CoD of the Element
Element 1	38	1-Oct-2019	1-May-2020	25%
Element 2	38	1-Oct-2019	1-May-2020	75%

Tariff Payment to be paid as:

Transmission Charges for Element 1			Transmission Charges for Element 2		
1-Oct-19 to 31-Mar-20	--	0.00	1-Oct-19 to 31-Mar-20	--	0.00
1-Apr-20 to 30-Apr-20	-	0.00	1-Apr-20 to 30-Apr-20	-	0.00
1-May-20 to 31-Mar-21	140 X 100% X (335/365)				128.49
2	140 X 100% X 1				140
3	140 X 100% X 1				140
4	140 X 100% X 1				140
5	140 X 100% X 1				140
.....					
.....					
36 (1-Apr to 30-Apr)	140 X 100% X (30/ 365)				11.51


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Illustration5: In case of delay in achieving COD of Element but Project COD achieved on timeQuoted Transmission Charges: **Rs. 140 Million**

Completion Schedule:

Element No.	Completion Schedule in Months	Scheduled CoD of the Element	Actual CoD of the Element	% Charges recoverable on Scheduled CoD of the Element
Element 1	20	1-Feb-2018	1-Jul-2018	25%
Element 2	30	1-Dec-2018	1-Dec-2018	75%

Tariff Payable as follows:

Transmission Charges for Element 1			Transmission Charges for Element 2		
1-Feb-18 to 31-Mar-18	--	0.00		--	0.00
1-Apr-18 to 30-Jun-18	--	0.00		--	0.00
1-Jul-18 to 30-Nov-18	140 X 25% X (153/365)	14.67		--	0.00
1-Dec-18 to 31-Mar-19	140 X 100% X (121/365)				46.41
2	140 X 100% X 1				140
3	140 X 100% X 1				140
4	140 X 100% X 1				140
5	140 X 100% X 1				140
.....					
.....					
36 (1-Apr to 30-Nov)	140 X 100% X (244/365)				93.59


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Illustration-6: In case of early commissioning of ProjectQuoted Transmission Charges: **Rs. 140 Million**

Completion Schedule:

Element No.	Completion Schedule in Months	Scheduled CoD of the Element	Actual CoD of the Element	% Charges recoverable on Scheduled CoD of the Element
Element 1	38	1-Oct-2019	1-Jul-2019	25%
Element 2	38	1-Oct-2019	1-Jul-2019	75%

Tariff Payment to be paid as:

Transmission Charges for Element 1		Transmission Charges for Element 2	
1-July-19 to 31-Mar-20	140 X 100% X (274/365)		105.09
2	140 X 100% X 1		140
3	140 X 100% X 1		140
4	140 X 100% X 1		140
5	140 X 100% X 1		140
.....			
.....			
36 (1-Apr to 30-Jun)	140 X 100% X (91/365)		34.91


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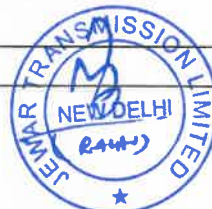

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Illustration-7: In case of early commissioning of an element

Quoted Transmission Charges: Rs. 140 Million

Completion Schedule:

Element No.	Completion Schedule in Months	Scheduled CoD of the Element	Actual CoD of the Element	% Charges recoverable on Scheduled CoD of the Element
Element 1	38	1-Oct-2019	1-Apr-2019	25%
Element 2	38	1-Jul-2019	1-Jul-2019	75%

Tariff Payment to be paid as:

Transmission Charges for Element 1			Transmission Charges for Element 2		
1-Apr-2019 to 30-Jun-19	140 X 25% X (91/365)	8.72	1-Apr-2019 to 30-Jun-19	--	0.00
1-July-19 to 31-Mar-20	140 X 100% X (274/ 365)				105.09
2	140 X 100% X 1				140
3	140 X 100% X 1				140
4	140 X 100% X 1				140
5	140 X 100% X 1				140
.....					
.....					
36 (1-Apr-30-Jun)	140 X 100% X (91/365)				34.91

The Transmission Charges shall be payable on monthly basis as computed above.

1.2 Computation of Monthly Transmission Charges

The Monthly Transmission Charges for any month m in a Contract Year n shall be calculated as below:

For AC System:


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- a. If Actual Transmission System Availability for the month m of contract year n is greater than or equal to 98% and less than or equal to 98.5%;

$$\text{Monthly Transmission Charges MTC}(m) = T_{mn} * 1$$

- a. If Actual Transmission System Availability for the month m of contract year n exceeds 98.5% and less than or equal to 99.75%;

$$\text{Monthly Transmission Charges MTC}(m) = T_{mn} * (AA / 98.5\%)$$

- c. If Actual Transmission System Availability for the month m of contract year n is greater than 99.75%;

$$\text{Monthly Transmission Charges MTC}(m) = T_{mn} * (99.75\% / 98.5\%)$$

- d. If Actual Transmission System Availability for the month m of contract year n is less than 98% and greater than or equal to 95.00%;

$$\text{Monthly Transmission Charges MTC}(m) = T_{mn} * (AA / 98\%)$$

- e. If Actual Transmission System Availability for the month m of contract year falls below 95%;

$$\text{Monthly Transmission Charges MTC}(m) = T_{mn} * (AA / 98\%) - 0.02 * (T_{mn} * (AA / 95\%))$$

For DC System:

- a. If Actual Transmission System Availability for the month m of contract year n is greater than or equal to 95% and less than or equal to 96%;

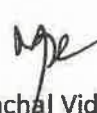
$$\text{Monthly Transmission Charges MTC}(m) = T_{mn} * 1$$

- b. If Actual Transmission System Availability for the month m of contract year n exceeds 96% and less than or equal to 99.75%;

$$\text{Monthly Transmission Charges MTC}(m) = T_{mn} * (AA / 96\%)$$


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- c. If Actual Transmission System Availability for the month m of contract year n is greater than 99.75%;

$$\text{Monthly Transmission Charges MTC}(m) = T_{mn} * (99.75\% / 96\%)$$

- d. If Actual Transmission System Availability for the month m of contract year n is less than 95% and greater than or equal to 92.00%;

$$\text{Monthly Transmission Charges MTC}(m) = T_{mn} * (AA / 95\%)$$

- e. If Actual Transmission System Availability for the month m of contract year falls below 92%;

$$\text{Monthly Transmission Charges MTC}(m) = T_{mn} * (AA / 95\%) - 0.02 * (T_{mn} * (AA / 92\%))$$

where:

- AA is the actual Availability, as certified by RPC, as per procedure provided in Schedule 6.
- m is the month in Contract Year 'n'
- T_{mn} = Transmission Charges for the month 'm' in Contract Year 'n' = $(\text{Transmission Charge} / \text{no. of days in the Year } n) * \text{no. of days in month } m$

Provided, no Transmission Charges shall be paid during the period for which the RLDC has not allowed the operation of the Element/Project due to the failure of the TSP to operate it as per the provisions of the Grid Code.

1.3 Recovery from Short Term Transmission Customers

The charges payable by the Short Term Intra State Transmission Customers shall be calculated on the basis of the provisions of the Uttar Pradesh Electricity Regulatory Commission (Terms and Conditions or Open Access) Regulations, 2019 or as amendment from time to time.

In accordance to Uttar Pradesh Electricity Regulatory Commission (Terms and Conditions or Open Access) Regulations, 2019 or as amendment from time to time, the


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Short Term Intra State Transmission Consumers shall pay the transmission Charges to STU. However, even in special case, any payment made directly to TSP, for use of element/project, the same shall be reduced from the transmission charge payable by Long Term Transmission Customer's to TSP.

1.4 Scheduling Charges

The payment of RLDC fee & charges, in accordance with relevant regulations of UPERC, shall be the responsibility of the TSP. Whereas, the payment of scheduling charges to the respective SLDC, as the case may be, shall be the responsibility of the Long Term Transmission Customer's.


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Schedule: 5

Quoted Transmission Charges

[Quoted Transmission Charges from Annexure - 21 of the RFP of the Selected Bidder to be inserted here]

[To be incorporated from the Bid of the Selected Bidder submitted during the e-reverse auction after its selection]

Quoted Transmission Charges: Rs. 795.86 Million per annum

.Proportionate Transmission Charges payable for each Element of the Project:

S. No.	Name of the Transmission Element	Percentage of total Transmission Charges payable to the TSP on Commissioning / COD of the Element
A.	Construction of 400/220kV, 2×500 MVA GIS substation Jewar with associated lines	
A1	Construction of 400/220 kV, 2×500MVA GIS substation Jewar (GautamBudh Nagar) (alongwith 125MVAR reactor)	30.85%
A2	LILO of one ckt. of 400 kV Gr. Noida (765 kV) – Sector-148 (400) Noida DC line at400/220 kV GIS	
B.	Construction of 220/33 kV, 2×60 MVA GIS substation Cantt. (Chaukaghat) Varanasi with associated lines	
B1	Construction of 220/33 kV GIS substation Cantt. (Chaukaghat) Varanasi	26.78%
B2	LILO of one ckt. of 220 kV Sarnath (400) – Gajokhar DC line at Cantt. (Chaukaghat) Varanasi construction of 41.5 Km (37 Km overhead line	


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	(Zebra Conductor) on Lattice Tower and construction of 4.5 Km 630 mm ² line with copper XLPE cable	
C.	Construction of 220/33 kV, 3×60 MVA GIS substation Vasundhara (Ghaziabad) with associated lines	
C1	Construction of 220/33 kV GIS substation Vasundhara	17.11%
C2	LILO of one ckt. of 220 kV Muradnagar (400) – Sahibabad (220) SC line at 220 kV substation Vasundhara (Ghaziabad) (Multi Ckt./Monopole Tower) (Zebra conductor)	
C3	220 kV Indirapuram (400) – Vasundhara SC line (Monopole and Narrowbase multi circuit tower)	
D.	Construction of 220/132/33 kV, 2×160+2×40MVA substationKhaga (Fatehpur) with associated lines	
D1	Construction of 220/132/33 kV substation Khaga (Fatehpur)	25.26%
D2	220 kV Fatehpur (765) PG – Khaga DC line (Zebra Conductor)	
D3	132 kV Khaga (220) – Khaga DC line	
D4	132 kV Khaga (220) – Hussainganj SC line	
D5	132 kV Bay at 132 kV substation Khaga- 02Nos.	
D6	132 kV Hybrid Bay at 132 kV substation Hussainganj- 01 No.	


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Schedule: 6**Appendix B of Uttar Pradesh Electricity Regulatory Commission (Multi Year Tariff for Distribution and Transmission) Regulations, 2019****Procedure for Calculation of Transmission System Availability Factor for a Month**


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Annexure-B: Procedure for calculation of Transmission System Availability Factor for a Month

- 1) Transmission System Availability Factor for a Calendar Month (TAFM) shall be calculated by the respective Transmission Licensee, got verified and certified by the SLDC and separately for each A.C. Transmission System and grouped according to sharing of transmission charges.
- 2) TAFM, in percent, shall be equal to $(100 - 100 \times \text{NAFM})$, where NAFM is the non-availability factor in per unit for the month, for the Transmission System / sub-system.
- 3) NAFM for A.C. systems / sub-systems shall be equal to:

$$= \frac{[\sum_{i=1}^L (OH_i \times Ckt km_i \times NSC_i) + \sum_{t=1}^T (OH_t \times MVA_t \times 2.5) + \sum_{r=1}^R (OH_r \times MVAR_r \times 4)]}{THM \times [\sum_{i=1}^L (Ckt km_i \times NSC_i) + \sum_{t=1}^T (MVA_t \times 2.5) + \sum_{r=1}^R (MVAR_r \times 4)]}$$

Where,

I = identifies a transmission line circuit;

t = identifies a transformer / Inter connecting transformer (ICT);

r = identifies a bus reactor, switchable line reactor or Static VAR Compensation (SVC);

L = total number of line circuits;

T = total number of bus reactors, switchable line reactors and SVCs;

R = total number of bus reactors, switchable line reactors and SVCs;

OH = Outage hours or hours of non-availability in the month, excluding the duration of outages not attributable to the Transmission Licensee,

Ckt km = Length of a transmission line circuit in km;

NSC = Number of sub-conductors per phase;

MVA = MVA rating of a transformer / ICT;

MVAR = MVAR rating of a bus reactor switchable line reactor or an SVC (in which case it would be the sum of inductive and capacitive capabilities);

THM = Total hours in the month;

- 4) The transmission elements under outage due to following reasons shall be deemed to be available:
 - a. Shutdown availed for maintenance or construction of elements of another transmission scheme. If the other transmission scheme belongs to Transmission Licensee, the SLDC may restrict the deemed availability period to that considered reasonably by him for the work involved.
 - b. Switching off of a transmission line to restrict over voltage and manual tripping of switched reactors as per the directions of SLDC.
- 5) Outage time of transmission elements for the following contingencies shall be excluded from the total time of the element under period of consideration:
 - a. Outage of elements due to force majeure events such as war, strike riot, floods, earthquake etc. beyond the control of the Transmission Licensee.
 - b. However, onus of satisfying the SLDC that element outage was due to aforesaid events and not due to design failure shall rest with the Transmission Licensee. A reasonable restoration time for the element shall be considered by SLDC and any additional time taken by the Transmission Licensee for restoration of the element beyond the reasonable time shall be treated as outage time attributable to the Transmission Licensee. SLDC may consult the Transmission Licensee or any expert for estimation of reasonable time. Circuits restored through ERS (Emergency Restoration System) shall be considered as available.
- 6) Outage caused by grid incident / disturbance not attributable to the Transmission Licensee, e.g. faults in substation or bays owned by other agency causing outage of the Transmission Licensee's elements and tripping of lines, ICTs, etc due to grid disturbance. However, if the element is not restored on receipt of direction from SLDC while normalizing the system following grid incident / disturbance within reasonable time, the element will be considered not available for the period of outage after issuance of SLDC's direction for restoration.

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Schedule: 7

Entire Bid (both financial bid and technical bid) of the Selected Bidder to be attached here


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Schedule: 8

Contract Performance Guarantee

(To be on non-judicial stamp paper of appropriate value as per Stamp Act relevant to place of execution. Foreign entities submitting Bids are required to follow the applicable law in their country.)

In consideration of the[Insert name of the SPV or Selected Bidder on behalf of the TSP, or Lead Member in case of the Consortium, with address] agreeing to undertake the obligations under the Transmission Service Agreement dated and the other RFP Project Documents and the Long Term Transmission Customers and the[Insert the name of the BPC], agreeing to execute the *RFP Project Documents* with the Selected Bidder, regarding setting up the Project, the [Insert name and address of the bank issuing the guarantee and address of the head office] (hereinafter referred to as "Guarantor Bank") hereby agrees unequivocally, irrevocably and unconditionally to pay to Long Term Transmission Customers at[Insert the Place from the address of the Long Term Transmission Customers indicated in the TSA] forthwith on demand in writing from the Long Term Transmission Customers or any Officer authorized by it in this behalf, any amount up to and not exceeding Rupees Crores (Rs.) only [Insert the amount of the bank guarantee] on behalf of M/s. [Insert name of the Selected Bidder or SPV].

This guarantee shall be valid and binding on the Guarantor Bank up to and including and shall not be terminable by notice or any change in the constitution of the Bank or the term of the Transmission Service Agreement or by any other reasons whatsoever and our liability hereunder shall not be impaired or discharged by any extension of time or variations or alternations made, given, or agreed with or without our knowledge or consent, by or between parties to the respective agreement.

Our liability under this Guarantee is restricted to Rs. Crores (Rs.) only. Our Guarantee shall remain in force until [Insert the date of validity of the Guarantee as per Article 3.1.2 of this Agreement]. The Long Term Transmission Customers, shall be entitled to invoke


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this Guarantee up to three hundred sixty five (365) days of the last date of the validity of this Guarantee.

The Guarantor Bank hereby expressly agrees that it shall not require any proof in addition to the written demand from (in its roles as the Long Term Transmission Customers), made in any format, raised at the above mentioned address of the Guarantor Bank, in order to make the said payment to Long Term Transmission Customers.

The Guarantor Bank shall make payment hereunder on first demand without restriction or conditions and notwithstanding any objection by [Insert name of the Selected Bidder], ... [Insert name of the TSP] and / or any other person. The Guarantor Bank shall not require Long Term Transmission Customers to justify the invocation of this BANK GUARANTEE, nor shall the Guarantor Bank have any recourse against Long Term Transmission Customers in respect of any payment made hereunder.

THIS BANK GUARANTEE shall be interpreted in accordance with the laws of India.

The Guarantor Bank represents that this BANK GUARANTEE has been established in such form and with such content that it is fully enforceable in accordance with its terms as against the Guarantor Bank in the manner provided herein.

THIS BANK GUARANTEE shall not be affected in any manner by reason of merger, amalgamation, restructuring, liquidation, winding up, dissolution or any other change in the constitution of the Guarantor Bank.

THIS BANK GUARANTEE shall be a primary obligation of the Guarantor Bank and accordingly Long Term Transmission Customers shall not be obliged before enforcing this BANK GUARANTEE to take any action in any court or arbitral proceedings against Jewar Transmission Limited or the Selected Bidder, as the case may be, to make any claim against or any demand on Jewar Transmission Limited or the Selected Bidder, as the case may be, or to give any notice to Jewar Transmission Limited or the Selected Bidder, as the case may be, or to enforce any security held by the Long Term Transmission Customers or to exercise, levy or enforce any distress, diligence or other process against Jewar Transmission Limited or the Selected Bidder, as the case may be.


Pashchimanchal Vidyut
Vitran Nigam Limited


Purvanchal Vidyut
Vitran Nigam Limited


Dashinanchal Vidyut
Vitran Nigam Limited


Madhyanchal Vidyut
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Supply Company Limited


Jewar Transmission
Limited



Transmission Service Agreement

The Guarantor Bank acknowledges that this BANK GUARANTEE is not personal to Long Term Transmission Customers and may be assigned, in whole or in part, (whether absolutely or by way of security) by Long Term Transmission Customers to any entity to whom the Long Term Transmission Customers is entitled to assign its rights and obligations under the Transmission Service Agreement.

The Guarantor Bank hereby agrees and acknowledges that Long Term Transmission Customers shall have a right to invoke this Bank Guarantee either in part or in full, as it may deem fit.

Notwithstanding anything contained hereinabove, our liability under this Guarantee is restricted to Rs. Crores (Rs.) only and it shall remain in force until[Date to be inserted on the basis of Article 3.1.2 of the Transmission Service Agreement], with an additional claim period of three hundred sixty five (365) days thereafter. This BANK GUARANTEE shall be extended from time to time for such period, as may be desired by [Insert name of the Selected Bidder or Lead Member in case of the Consortium or SPV]. We are liable to pay the guaranteed amount or any part thereof under this Bank Guarantee only if Long Term Transmission Customers serves upon us a written claim or demand.

In witness where of:

Signature

Name:

Power of attorney No.:

For:

..... [Insert Name of the Bank]

Banker's Seal and Full Address, including mailing address of the Head Office


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Vitran Nigam Limited


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Vitran Nigam Limited


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Transmission Service Agreement

Schedule: 9**Methodology for determining the Relief Under Force Majeure Event & Change in Law during Construction Period**

The relief in the form of revision in tariff due to Force Majeure Event leading to extension of Scheduled COD for a period beyond one hundred eighty (180) days and/ or Change in Law during the construction period shall be as under:

$$\Delta T = [(P \times d)] \div [1 - (1 + d)^{-n}]$$

Where,

ΔT = Change in Transmission Charges for each year

P = Sum of cumulative increase or decrease in the cost of the Project due to Change in Law and interest cost during construction corresponding to the period exceeding one hundred eighty (180) due to Force Majeure Event leading to extension of Scheduled COD for a period beyond one hundred eighty (180) days

n = number of years over which the Transmission Charges has to be paid

d = Discount rate as notified by the CERC, applicable on the Bid Deadline

The increase in Transmission Charges as stated above shall be applicable only if the value of increase in Transmission Charges as calculated above exceeds 0.30% (zero point three percent) of the quoted Transmission Charges of the TSP.


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Transmission Service Agreement

Schedule: 10**List of Long Term Transmission Customer**

Note: As referred in the recital of this Agreement and in the definition of "Long Term Transmission Customer" in this Agreement

Sl. No.	Name of the Long Term Transmission Customer	Address of Registered Office	Law under which incorporated	Allocated Project Capacity (in %)
1.	Paschimanchal Vidyut Vitran Nigam Ltd.	Hydel Colony, Victoria Park, Meerut-250001 E-mail: md@pvvnl.org Fax: 0121-2666062 Phone: 0121-2665734	Companies Act	31%
2.	Madhyanchal Vidyut Vitran Nigam Ltd.	4A Gokhale Marg, Lucknow-226001 E-mail: md.mvvn12010@gmail.com Fax: 0522-2208769 Phone: 0522-2208737	Companies Act	21%
3.	Purvanchal Vidyut Vitran Nigam Ltd.	Vidyut Nagar, Bhikharipur, P.O. DLW, Varanasi-221010 E-mail: mdpurvanchalvvn1@gmail.com Fax: 0542-2319158 Phone: 0542-2318437	Companies Act	24%
4.	Dakshinanchal Vidyut Vitran Nigam Ltd.	Urja Bhawan, NH-2 (Agra-Delhi bypass Road) Sikandra Agra-282002 E-mail: dvvn1md@gmail.com Fax: 0562-2605465 Phone: 0562-2605699	Companies Act	21%
5.	Kanpur Electricity Supply Co. Ltd.	Kesa House, 14/17 Civil Lines, Kanpur - 208001 E-mail: md@kesco.co.in Phone: 0512-2530832	Companies Act	3%


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Transmission Service Agreement

Note: The above list of Long Term Transmission Customer subject to change. Any addition or deletion in this list after the award of LoI shall be duly notified to the parties to the Agreement.

The new Long Term Transmission Customer shall become a party to the TSA after agreeing to the terms and conditions of this Agreement and signing a Supplemental Agreement as annexed in Schedule 11 to this Agreement.


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Purvanchal Vidyut
Vitran Nigam Limited


Dashinanchal Vidyut
Vitran Nigam Limited


Madhyanchal Vidyut
Vitran Nigam Ltd.


Kanpur Electricity
Supply Company Limited


Jewar Transmission
Limited



Transmission Service Agreement

Schedule: 11**SUPPLEMENTARY AGREEMENT**

BETWEEN

..... [Insert name of the TSP]

AND

..... [Insert name of the new Long Term Transmission Customer 1],

..... [Insert name of the new Long Term Transmission Customer 2],

.

..... [Insert name of the new Long Term Transmission Customer n]

THIS SUPPLEMENTARY AGREEMENT entered into on [Insert date] [Insert day] of [Insert month] in [Insert year] by and between, ... [Insert name of the Transmission Service Provider] incorporated under the Companies Act, 1956, having its registered office at (here in after referred to as Transmission Service Provider or "TSP", which expression shall unless repugnant to the context or meaning thereof include its successors, and permitted assigns) as Party of the first part,

AND

..... [Insert name of the new Long Term Transmission Customer '1'] having its registered office at..... [Insert address of the new Long Term Transmission Customer 1] and having an Allocated Project Capacity as specified in the Table 2 of this Supplementary Agreement, (which expression shall unless repugnant to the context or meaning thereof include its successors, and permitted assigns) as Party of the second part,


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 Vitran Nigam Limited


 Dashinanchal Vidyut
 Vitran Nigam Limited


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 Vitran Nigam Ltd.


 Kanpur Electricity
 Supply Company Limited


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..... [Insert name of the new Long Term Transmission Customer '2'] having its registered office at..... [Insert address of the new Long Term Transmission Customer 1] and having an Allocated Project Capacity as specified in the Table 2 of this Supplementary Agreement, (which expression shall unless repugnant to the context or meaning thereof include its successors, and permitted assigns) as Party of the third part,

..... [Insert name of the new Long Term Transmission Customer 'n'] having its registered office at..... [Insert address of the new Long Term Transmission Customer 1] and having an Allocated Project Capacity as specified in the Table 2 of this Supplementary Agreement, (which expression shall unless repugnant to the context or meaning thereof include its successors, and permitted assigns) as Party of the nth part.

WHEREAS:

- A. The TSP has executed the TSA with the existing Long Term Transmission Customer as listed out in Schedule 10 of the TSA.
- B. The existing Long Term Transmission Customer as listed out in Schedule 10 of the TSA have executed the TSA with the TSP.
- C. The TSP has agreed to provide the Transmission Service to the existing Long Term Transmission Customer as per the terms and conditions of the TSA.
- D. The Allocated Project Capacity of the existing Long Term Transmission Customer as on this date.....[Insert date] is as detailed below:

Table : 1

Sl. No.	Name of the existing Long Term Transmission Customer	Allocated Project Capacity (in MW)
1		
2		
3		
.		
.		
.		


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Purvanchal Vidyut
Vitran Nigam Limited


Dashinanchal Vidyut
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Kanpur Electricity
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Transmission Service Agreement

- E. The existing Long Term Transmission Customer have agreed, on the terms and subject to the conditions of the TSA, to use the available transmission capacity of the Project and pay TSP the Transmission Charges as determined in accordance with the terms of the TSA.

NOW THEREFORE THIS AGREEMENT WITNESSETH as under:

- 1) The new Long Term Transmission Customer and their Allocated Project Capacity as on this date.... [Insert date] are as detailed below:

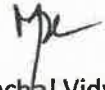
Table 2:

Sl. No.	Name of the new Long Term Transmission Customer	Allocated Project Capacity (in MW)
1		
2		
3		
.		
.		

- 2) The new Long Term Transmission Customer have been granted long term open access from the CTU/STU, as the case may be, and are beneficiaries to the Project.
- 3) The new Long Term Transmission Customer agree to the terms and conditions laid down in the TSA, to use the Project and pay the TSP the Transmission Charges as determined in accordance with the terms of the TSA and the provisions of this Supplementary Agreement.
- 4) The TSP agrees to provide the Transmission Service to the new Long Term Transmission Customer as per the terms and conditions of the TSA.
- 5) All terms and conditions of the TSA between the TSP and the existing Long Term Transmission Customer (as listed out in Table 1 of this Supplementary Agreement) shall apply, mutatis mutandis without any change, to the new Long Term Transmission Customer (as listed out in Table 2 of this Supplementary Agreement)


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Kanpur Electricity
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Transmission Service Agreement

IN WITNESS WHEREOF the parties have executed these presents through their Authorised Representatives

WITNESS:

**Table 3:
WITNESS**

- | | |
|--------------------|------------------------------|
| 1. Signature: | For and on behalf of |
| Name: | [Insert name of the TSP] |
| Designation: | |
| 2. Signature: | For and on behalf of |
| Name: | [Insert name of the new Long |
| Designation: | Term Transmission Customer |
| | 1] |
| 3. Signature: | For and on behalf of |
| Name: | [Insert name of the new Long |
| Designation: | Term Transmission Customer |
| | 1] |
| 4. Signature: | For and on behalf of |
| Name: | [Insert name of the new Long |
| Designation: | Term Transmission Customer |
| | n] |


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Purvanchal Vidyut
Vitran Nigam Limited


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Vitran Nigam Limited


Madhyanchal Vidyut
Vitran Nigam Ltd.


Kanpur Electricity
Supply Company Limited


Jewar Transmission
Limited



Dated 07th March, 2024

SHARE PURCHASE AGREEMENT

BETWEEN

PFC CONSULTING LIMITED

AND

JEWAR TRANSMISSION LIMITED

AND

MEGHA ENGINEERING & INFRASTRUCTURES LIMITED





INDIA NON JUDICIAL

Government of Uttar Pradesh



IN-UP87486470963423W

Share Purchase Agreement

Indirapuram

e-Stamp

Certificate No. : IN-UP87486470963423W
Certificate Issued Date : 05-Mar-2024 07:21 PM
Account Reference : NEWIMPACC (SV)/ up14075304/ GHAZIABAD SADAR/ UP-GZB
Unique Doc. Reference : SUBIN-UPUP1407530471149997425382W
Purchased by : PFC CONSULTING LIMITED
Description of Document : Article 19 Certificate or other Document
Property Description : Not Applicable
Consideration Price (Rs.) :
First Party : PFC CONSULTING LIMITED
Second Party : Not Applicable
Stamp Duty Paid By : PFC CONSULTING LIMITED
Stamp Duty Amount(Rs.) : 1,200
(One Thousand Two Hundred only)

**SHARE PURCHASE AGREEMENT**

This **SHARE PURCHASE AGREEMENT** ('Agreement') made this 07th Day of March 2024 at Lucknow by and between:

PFC CONSULTING LIMITED (a wholly owned subsidiary of Power Finance Corporation Ltd.), a company incorporated under the Companies Act, 1956, with CIN No. U74140DL2008GOI175858 having its registered office at First Floor, "Urjanidhi", 1 Barakhamba Lane, Connaught Place, New Delhi 110001, (hereinafter referred to as "**PFCCL**", which expression shall, unless it be repugnant to the context or meaning thereof, be deemed to mean and include its successors and permitted assigns) of the **FIRST PART**;

AND

JEWAR TRANSMISSION LIMITED, a company incorporated under the Companies Act, 2013, with CIN No. U42201DL2023GOI416714 having its registered office at First Floor, "Urjanidhi", 1 Barakhamba Lane, Connaught Place, New Delhi 110001, (hereinafter referred to as "**Company**" which expression shall, unless repugnant to the context or meaning thereof, be deemed to mean and include its successors and permitted assigns) of the **SECOND PART**; and



Notary Alert:

- The authenticity of this Stamp certificate should be verified at least once a year by the user in the world's for this Certificate and as mentioned on the stamp.
- The onus of checking the authenticity is on the users of the certificate.
- In case of any discrepancy please inform the Government Authority.

AND

MEGHA ENGINEERING & INFRASTRUCTURES LIMITED, a company incorporated under the Companies Act, 1956 with CIN No. U45202TG2006PLC050271 having its registered office at **S-2, Technocrat Industrial Estate, Balanagar Hyderabad - 500 037** (hereinafter referred to as "**Selected Bidder**") which expression shall, unless repugnant to the context or meaning thereof, be deemed to mean and include its successors and permitted assigns) of the **THIRD PART**.

WHEREAS:

- A. UP Power Transmission Corporation Limited (UPPTCL) vide its Letter of Intent (LoI) dated 23.02.2023 has appointed PFC Consulting Ltd. to be the Bid Process Coordinator (BPC) for the purpose of selection of Bidder as Transmission Service Provider (TSP) to establish Intra-state transmission system for "**Construction of 400/220 kV, 2x500 MVA GIS Substation Jewar, 220/33 kV, 2x60 MVA GIS substation Cantt (Chaukaghat) Varanasi, 220/33 kV, 3x60 MVA GIS substation Vasundhara (Ghaziabad), 220/132/33 kV, 2x160+2x40 MVA substation khaga (Fatehpur) with associated line**" through tariff based competitive bidding process (hereinafter referred to as the "**Project**").
- B. In accordance with the Bidding Guidelines, PFCCL had initiated a Bid Process through issuance of RFP documents for selecting a Successful Bidder to build, own, operate and transfer the Project in accordance with and on the terms and conditions mentioned in the RFP Project Documents (as defined hereinafter).
- C. PFCCL has incorporated the **Company** and PFCCL along with the Nominees hold One hundred per cent (100 %) of total issued and paid up equity share capital of the Company.
- D. PFCCL has initiated the development of the Project and has obtained survey report, certain clearances, consents and permits as specified in the RFP regarding the Project.
- E. Pursuant to the said Bid Process, Megha Engineering & Infrastructures Limited has been identified as the Selected Bidder vide Letter of Intent dated February 16, 2024 issued by the PFCCL in favor of the Selected Bidder.
- F. As envisaged in the RFP, the Shares Seller (as defined hereinafter) has agreed to sell the Sale Shares (as defined hereinafter) to the Selected Bidder and the Selected Bidder has agreed to purchase the Sale Shares from the Shares Seller, subject to and on the terms and conditions set forth in this Agreement.

NOW THEREFORE, IN CONSIDERATION OF THE MUTUAL COVENANTS AND AGREEMENTS SET FORTH IN THIS AGREEMENT AND FOR OTHER GOOD AND VALUABLE CONSIDERATION, THE PARTIES HEREBY AGREE AS FOLLOWS:

1. DEFINITIONS

- 1.1 Capitalised terms in this Agreement, unless defined in this Agreement shall, in so far as the context admits, have the same meaning in this Agreement as has been ascribed to them in the Transmission Service Agreement.



1.2 Additionally, the following terms shall have the meaning hereinafter respectively assigned to them herein below:

- (i) **"Acquisition Price"** shall mean INR 3,55,73,288/- (Rupees Three Crore Fifty Five Lakh Seventy Three Thousand Two Hundred Eighty Eight Only), which is the aggregate consideration payable by the Selected Bidder towards purchase of the **Sale Shares at par** along with assets and liabilities of the Company as on the Closing Date subject to adjustment as per the audited accounts of the Company as on the Closing Date;
- (ii) **"Agreement"** or **"the Agreement"** or **"this Agreement"** shall mean this Share Purchase Agreement and shall include the recitals and/or annexures attached hereto, and the contracts, certificates, disclosures and other documents to be executed and delivered pursuant hereto, if any, and any amendments made to this Agreement by Parties in writing;
- (iii) **"Bid Process"** shall mean the competitive bidding process initiated by the Company, by issuance of RFP Documents for selecting a Successful Bidder to build, own, operate and transfer the Project in accordance with and on the terms and conditions mentioned in the RFP Project Documents;
- (iv) **"Board"** shall mean the board of directors of the Company
- (v) **"Closing Date"** shall mean a mutually agreed date between the Parties falling within the period as mentioned in Clause 2.4 of RFP or on failure of such mutual agreement between the Parties shall be the date falling on the last date of such period;
- (vi) **"CTU"** or **"Central Transmission Utility of India Limited"** shall have same meaning as defined in the Electricity Act, 2003;
- (vii) **"Encumbrance"** shall mean any mortgage, pledge, lien, charge, security assignment, hypothecation, trust, encumbrance or any other agreement having the effect of creating security interest;
- (viii) **"Letter of Intent"** shall have the meaning ascribed thereto under the RFP;
- (ix) **"Nominees"** shall mean the Persons, who are named in Annexure A, holding the Sale Shares as nominees of PFCCL.
- (x) **"Party"** shall mean PFCCL, Company and the Selected Bidder, referred to individually, and **"Parties"** shall mean PFCCL, Company and the Selected Bidder collectively referred to, as relevant;
- (xi) **"Person"** shall include an individual, an association, a corporation, a partnership, a joint venture, a trust, an unincorporated organisation, a joint stock company or other entity or organisation, including a government or political subdivision, or an agency or instrumentality thereof, and/or any other legal entity;
- (xii) **"Rfp Project Documents"** shall mean the following documents, referred to collectively:



- a) Transmission Services Agreement;
 - b) this Agreement; and
 - c) Any other agreement(s) as may be required.
- (xiii) **"Representations and Warranties"** shall mean the representations and warranties mentioned in **Clause 4** hereto;
- (xiv) **"Sale Shares"** shall mean **10,000 (Ten Thousand)** Shares, representing 100 percent of the total issued, subscribed and fully paid-up equity share capital of the Company held by the Shares Seller and Nominees as more particularly described in Annexure A attached hereto;
- (xv) **"Shares"** shall mean the fully paid-up equity shares of Company, of face value Rs. 10 each;
- (xvi) **"Shares Seller"** shall mean PFCCL;
- (xvii) **"Transmission Services Agreement"** or **"TSA"** means the agreement titled 'Transmission Services Agreement' dated March 07, 2024 entered into between Central Transmission Utility of India Limited and the TSP pursuant to which the TSP shall build, own, operate and transfer the Project and make available the assets of the Project to Central Transmission Utility of India Limited on a commercial basis, as may be amended from time to time;
- (xviii) **"Transmission Service Provider"** or **"TSP"** shall mean Jewar Transmission Limited which has executed the Transmission Service Agreement and which shall be acquired by the Selected Bidder.

1.3 Interpretation Clause

Unless the context otherwise requires, the provisions of the TSA relating to the interpretation of the TSA shall apply to this Agreement as if they were set out in full in this Agreement and to this end are incorporated herein by reference.

2. TRANSFER OF SHARES

- 2.1 Subject to the terms and conditions of this Agreement, the Shares Seller agrees to sell and transfer to the Selected Bidder and the Selected Bidder hereby agrees to purchase from the Shares Seller, the Sale Shares of the Company free from Encumbrances with rights and benefits attached thereto in consideration of the Acquisition Price and the covenants, undertakings and the agreements of the Selected Bidder contained in this Agreement.
- 2.2 The Shares Seller hereby undertakes to cause the Nominees to transfer part of the Sale Shares held by them as Nominees of the Shares Seller to the Selected Bidder and execute any documents required to deliver good title to the Sale Shares to the Selected Bidder.



3. CLOSING

- 3.1 Prior to the Closing Date, the Selected Bidder shall provide to the Shares Seller, valid share transfer forms ("Share Transfer Forms") duly stamped with requisite amount of stamp duty payable on the transfer of Sale Shares.
- 3.2 On the Closing Date, the Shares Seller shall hand over to the Selected Bidder or its authorised representative, the original share certificates representing the Sale Shares ("Sale Share Certificates") along with the Share Transfer Forms duly executed by the Shares Seller and the Nominees in favour of the Selected Bidder, simultaneously against the Selected Bidder handing over to the Shares Seller demand drafts drawn in favour of the Shares Seller for the Acquisition Price payable to it.

Provided that prior to the handing over of the Sale Share Certificates to the Selected Bidder as mentioned above, the Selected Bidder shall provide satisfactory evidence to PFCCCL that on or before the Closing Date, the Selected Bidder has furnished the Performance Bank Guarantee to Central Transmission Utility of India Limited and is in a position to comply with all other requirements of Clause 2.4 of the RFP.

- 3.3 The Selected Bidder shall immediately upon receiving the Sale Share Certificates and the Share Transfer Forms, duly execute the Share Transfer Forms and duly lodge the Share Transfer Forms and the Sale Share Certificates with the Company. The Selected Bidder may also propose the names of its nominees to be appointed on the Board of the Company and the address within the jurisdiction of the Registrar of Delhi and Haryana, which would be the new registered office of the Company. The Company shall, upon receipt of the said documents from the Selected Bidder, do the following:

- (i) Immediately on the Closing Date convene a meeting of the Board, wherein the Board shall pass the following necessary resolutions:
- (a) approving the transfer of the Shares constituting the Sale Shares from the Shares Seller and the Nominees to the name of the **Megha Engineering & Infrastructures Limited and its nominees;**
 - (b) approving the **Megha Engineering & Infrastructures Limited and its nominees** as a member of the Company and entering the name of the **Megha Engineering & Infrastructures Limited and its nominees** in the register of members.
 - (c) changing the address of the registered office of the Company to the new address, within the jurisdiction of the Registrar of Delhi and Haryana, as may be provided by the Selected Bidder.
 - (d) appointing the nominees of the Selected Bidder on the Board and accepting the resignations of the other existing Directors on the Board and the Chair of the meeting which was taken by one of the existing Directors shall be vacated and appointment of a new Chairman who shall be one of the newly appointed Director, for the rest of the meeting.



Immediately pursuant to the acceptance of resignation of the existing Directors and appointment of new Chairman, the newly constituted Board of Directors shall continue with the meeting and pass the following resolution:

- (e) terminating all the authorizations granted regarding the business and/or operations of the Company or the operations of the bank accounts of the Company, with prospective effect; and
 - (f) acknowledging and accepting the terms and conditions as contained in the executed copies of the RFP Project Documents and to abide by the provisions contained therein.
- (ii) Enter the name of the **Megha Engineering & Infrastructures Limited and its nominees** as the legal and beneficial owner of the Sale Shares, free of all Encumbrances, in the register of members of the Company;
 - (iii) Make the necessary endorsements on the Sale Share Certificates, indicating the name of the **Megha Engineering & Infrastructures Limited and its nominees** as the legal and beneficial owner of the Sale Shares evidenced there under;
 - (iv) Return the original Sale Share Certificates, duly endorsed in the name of the **Megha Engineering & Infrastructures Limited and its nominees**, to the **Megha Engineering & Infrastructures Limited and its nominees**, as the case may be or its authorised representative;
 - (v) Handover all the statutory registers and records, if any, of the Company to the Selected Bidder.
 - (vi) Handover certified true copies of the Board resolution passed by the Company as per (i)(a) to (i)(e) of Clause 3.3 (i) to Central Transmission Utility of India Limited.
- 3.4 The Parties to this Agreement agree to take all measures that may be required to ensure that all the events contemplated in the **Clauses 3.1 to 3.3** above on the Closing Date are completed on the same day.

Notwithstanding the provisions of **Clause 3.3** hereto, all proceedings to be taken and all documents to be executed and delivered by the Parties at the Closing Date shall be deemed to have been taken and executed simultaneously and no proceedings shall be deemed to have been taken nor documents executed or delivered until all have been taken, executed and delivered.

- 3.5 The Selected Bidder hereby acknowledges and agrees that after the date of acquisition of one hundred percent (100%) of the equity shareholding of the Company, by the Selected Bidder as per Clause 3.3, (a) the authority, rights and obligations of the PFCCL/Company in respect of the Bid Process shall forthwith cease and any actions to be taken thereafter regarding the Bid Process will be undertaken by Central Transmission Utility of India Limited themselves or through their any other authorized representative(s), (b) all rights and obligations of the PFCCL/Company shall be of the Selected Bidder and (d) any decisions taken by the PFCCL/Company prior to the date of its acquisition by the Selected Bidder shall continue to be binding on the Selected



Bidder. The Parties hereby agree that this provision shall survive the termination of this Agreement.

- 3.6 This agreement shall be effective from the date of its signing by the Parties and shall remain in force until all the obligations of the respective Parties under Clause 3.3 hereto are fulfilled.

4. REPRESENTATIONS AND WARRANTIES

- 4.1 The Selected Bidder hereby represents and warrants to the Shares Seller that:

4.1.1 The Selected Bidder has full legal right, power and authority to enter into, execute and deliver this Agreement and to perform the obligations, undertakings and transactions set forth herein, and this Agreement has been duly and validly executed and delivered by the Selected Bidder and constitutes its legal, valid and binding obligations, enforceable against it in accordance with its terms;

4.1.2 The execution, delivery and performance of this Agreement by the Selected Bidder will not violate or contravene any provision of the Memorandum of Association or Articles of the Selected Bidder, (ii) will not violate or contravene any law, statute, rule, regulation, licensing requirement, order, writ, injunction or decree of any court, governmental instrumentality or other regulatory, governmental or public body, agency or authority by which the Selected Bidder are bound or by which any of its and/or their properties or assets are bound, and (iii) except to the extent that the same have been duly and properly completed or obtained, will not require any filing with, or permit, consent or approval of or license from, or the giving of any notice to, any court, governmental instrumentality or other regulatory, governmental or public body, agency or authority, joint venture party, or any other entity or person whatsoever; and

4.1.3 The Selected Bidder is not restricted in any manner whatsoever, including without limitation, on account of any judicial or governmental order, action or proceeding, or any contractual obligation assumed by the Selected Bidder, from purchasing the Sale Shares from the Shares Seller in the manner provided for in this Agreement.

- 4.2 The Shares Seller hereby represents and warrants to the Selected Bidder that;

4.2.1 The Shares Seller and the Nominees are the legal and beneficial owners of the Sale Shares, free and clear of any Encumbrance and the delivery to the Selected Bidder of the Sale Shares pursuant to the provisions of this Agreement will transfer to the Selected Bidder a good title to the Sale Shares.

4.2.2 The Shares Seller has full legal right, power and authority to enter into, execute and deliver this Agreement and to perform the obligations, undertakings and transactions set forth herein. The execution, delivery and performance of this Agreement will not violate the Memorandum and Articles of Association of the Shares Seller or contravene any contract by which it is bound.



- 4.2.3 The Shares Seller has obtained requisite authorizations to sell and transfer the Sale Shares to the Selected Bidder. The Shares Seller also represent that it is not prevented from transferring and selling the Sale Shares. Also, to the best of its knowledge, the Sale Shares are not the subject matter of any claim or pending proceeding or threatened by any legal proceeding made by any third party.
- 4.3 Except as specified in Clause 4.2, above the Shares Seller shall not be deemed to have, made any representation or warranty whatsoever, whether express or implied, in relation to the Sale Shares or Company, including but not limited to any implied warranty or representation as to the business or affairs of the Company.
- 4.4 The Representations and Warranties are given as at the date of this Agreement except that where a Representation and Warranty is expressed to be made as at another date, the Representation and Warranty is given with respect to that date only.
- 4.5 Each Representation and Warranty is to be construed independently of the others and is not limited by reference to any other Warranty. The Representations, Warranties and undertakings contained in this **Clause 4** hereto or in any document delivered pursuant to or in connection with this Agreement are continuing in nature and shall survive the Closing Date for one (1) year.
- 4.6 The Parties represent to each other that all Representations and Warranties provided herein by the respective Party shall be true as of Closing Date.

5. OBLIGATIONS OF THE SELECTED BIDDER

The Selected Bidder agrees that the Shares Seller shall not be liable in any manner, nor shall it assume any responsibility or liability whatsoever, in respect of the business of the Company and its operations or activities, arising after Closing Date, to any Person or any authority, central, state, local or municipal or otherwise and the same shall be the sole responsibility of the Selected Bidder.

6. MISCELLANEOUS

6.1 NOTICES

- a) All notices to be given under this Agreement shall be in writing and in the English language.
- b) All notices must be delivered personally or by registered or speed post or by recognised courier to the addresses below:

Selected Bidder (Lead Member in case of Consortium)	Company Secretary Megha Engineering & Infrastructures Limited S-2, Technocrat Industrial Estate, Balanagar Hyderabad - 500 037
Name of the Holding Company of the SPV	Company Secretary, PFC Consulting Limited



	First Floor, "Urjanidhi", 1 Barakhamba Lane, Connaught Place, New Delhi- 110001
Company (Before Closing Date)	Project In-charge Jewar Transmission Limited First Floor, "Urjanidhi", 1 Barakhamba Lane, Connaught Place, New Delhi- 110001
Company (After Closing Date)	Jewar Transmission Limited 2 nd Floor, Niryat Bhawan, Rao Tularam Marg, Vasant Vihar, Opposite Army Hospital & Referral, New Delhi-110057

- c) Any Party may by notice of at least fifteen (15) days to the other Parties change the address and / or addresses to which such notices and communications to it are to be delivered or mailed.

6.2 RESOLUTION OF DISPUTES

- 6.2.1 If any dispute arises between the Parties, in connection with the validity, interpretation, implementation or alleged breach of any provision of this Agreement ("Dispute"), the disputing Parties hereto shall endeavour to settle such Dispute amicably. The attempt to bring about an amicable settlement shall be considered to have failed if not resolved within 60 days from the date of the Dispute.
- 6.2.2 If the Parties are unable to amicably settle the Dispute in accordance with Clause 6.2.1 within the period specified therein, any of the Parties shall be entitled to within 30 days after expiry of the aforesaid period, refer the Dispute to the Company Secretary of PFCCCL and Chief Executive/ Managing Director of the Selected Bidder for resolution of the said Dispute. The attempt to bring about such resolution shall be considered to have failed if not resolved within 30 days from the date of receipt of a written notification in this regard.
- 6.2.3 In the event the Dispute is not settled in accordance with Clause 6.2.2 above, any Party to the Dispute shall be entitled to serve a notice invoking this Clause and making a reference to a sole arbitrator. If the Parties to the Dispute cannot agree as to the appointment of the sole arbitrator within 30 days of receipt of the notice of the Party making the reference, then the Shares Seller along with the Company shall appoint one arbitrator and the Selected Bidder shall appoint one arbitrator and the two arbitrators, so appointed shall appoint a third arbitrator. However, after the Closing Date, in such an event the Shares Seller shall appoint one arbitrator and the Selected Bidder along with the Company shall appoint



one arbitrator and the two arbitrators, so appointed shall appoint the third arbitrator.

6.2.4 The place of the arbitration shall be New Delhi. The Arbitration proceedings shall be governed by the Arbitration and Conciliation Act, 1996.

6.2.5 The proceedings of arbitration shall be in English language.

6.2.6 The arbitrator's award shall be substantiated in writing. The arbitrators shall also decide on the costs of the arbitration proceedings. In case the arbitrators have not decided on the costs of the arbitration proceedings, each Party to the Dispute shall bear its own costs, in relation to the arbitration proceedings.

6.3 AUTHORISED PERSON

For the purposes of this Agreement; the Selected Bidder is represented by **Mr. M Raghu Kumar, Associate Vice President**, pursuant to an authorization granted to **Mr. M Raghu Kumar, Associate Vice President** through necessary Board resolutions. Further, **Mr. M Raghu Kumar, Associate Vice President** is also authorized by such resolutions to take any decision which may be required to be taken, do all acts and execute all documents which are or may be required by the Selected Bidder for the proper and effective fulfillment of the rights and obligations under this Agreement. Any action taken or document executed by **Mr. M Raghu Kumar** shall be deemed to be acts done or documents executed by the Selected Bidder and shall be binding on the Selected Bidder.

6.4 RESERVATION OF RIGHTS

No forbearance, indulgence or relaxation or inaction by any Party at any time to require performance of any of the provisions of this Agreement shall in any way affect, diminish or prejudice the right of such Party to require performance of that provision, and any waiver or acquiescence by any Party of any breach of any of the provisions of this Agreement shall not be construed as a waiver or acquiescence of any continuing or succeeding breach of such provisions, a waiver of any right under or arising out of this Agreement or acquiescence to or recognition of rights other than that expressly stipulated in this Agreement.

6.5 CUMULATIVE RIGHTS

All remedies of either Party under this Agreement whether provided herein or conferred by statute, civil law, common law, custom or trade usage, are cumulative and not alternative and may be enforced successively or concurrently.

6.6 PARTIAL INVALIDITY

If any provision of this Agreement or the application thereof to any person or circumstance shall be invalid or unenforceable to any extent, the remainder of this



Agreement and the application of such provision to persons or circumstances other than those as to which it is held invalid or unenforceable shall not be affected thereby, and each provision of this Agreement shall be valid and enforceable to the fullest extent permitted by law. Any invalid or unenforceable provision of this Agreement shall be replaced with a provision, which is valid and enforceable and most nearly reflects the original intent of the unenforceable provision.

6.7 TERMINATION

If (i) the Closing does not occur on the Closing Date for any reason whatsoever, or (ii) the Letter of Intent is withdrawn or terminated for any reason, or (iii) due to termination of the TSA by Central Transmission Utility of India Limited in accordance with Article 3.3.2 or Article 13 of the TSA thereof, PFCCL shall have a right to terminate this Agreement forthwith by giving a written notice to the other Parties hereto.

6.8 AMENDMENTS

No modification or amendment of this Agreement and no waiver of any of the terms or conditions hereof shall be valid or binding unless made in writing and duly executed by all the Parties.

6.9 ASSIGNMENT

This Agreement and the rights and liabilities hereunder shall bind and inure to the benefit of the respective successors of the Parties hereto, but no Party hereto shall assign or transfer its rights and liabilities hereunder to any other Person without the prior written consent of the other Parties, which will not be unreasonably withheld.

6.10 ENTIRE AGREEMENT

This Agreement constitutes the entire Agreement between the Parties with respect to the subject matter herein and supersedes and cancels any prior oral or written agreement, representation, understanding, arrangement, communication or expression of intent relating to the subject matter of this Agreement.

6.11 COSTS

Each of the Parties hereto shall pay their own costs and expenses relating to the negotiation, preparation and execution of this Agreement and the transactions contemplated by this Agreement.

The Selected Bidder shall be liable to bear and pay the stamp duty and other costs in respect of this Agreement and the Share Transfer Forms.



6.12 RELATIONSHIP

None of the provisions of this Agreement shall be deemed to constitute a partnership between the Parties hereto and no Party shall have any authority to bind the other Party otherwise than under this Agreement or shall be deemed to be the agent of the other in any way.

6.13 GOVERNING LAW AND JURISDICTION

This Agreement shall be governed by and construed in accordance with the laws of India and shall be subject to the exclusive jurisdiction of the courts of Delhi.

6.14 COUNTERPARTS

This Agreement may be executed in counterparts by the Parties and each fully executed counterpart shall be deemed to be original.

6.15 CONFIDENTIALITY

The Parties undertake to hold in confidence and not to disclose the terms and conditions of the transaction contemplated hereby to third parties, except:

- (a) to their professional advisors;
- (b) to their officers, employees, agents or representatives, who need to have access to such information for the proper performance of their activities;
- (c) disclosures required under Law;

without the prior written consent of the other Parties.

Provided that Central Transmission Utility of India Limited and PFCCL may at any time, disclose the terms and conditions of transactions contemplated hereby to any person, to the extent stipulated under the law or the Bidding Guidelines.

6.16 INDEMNIFICATION

- The Parties hereby agree that transfer of Sale Shares to the Selected Bidder shall vest all the rights, privileges, licenses, responsibilities, liabilities and other obligations pertaining to the Company in the Selected Bidder.
- The Selected Bidder hereby agrees that the Selected Bidder shall not be entitled to any claims or initiate any legal proceedings, by itself or through the Transmission Service Provider against the Share Sellers, its directors, officers, employees and the subscribers including the members of any committees appointed by them in respect of any actions or decisions taken by any of them up to the Closing Date in furtherance of the Project referred to in recital A of this Agreement.



- Further, the Selected Bidder hereby indemnifies and holds harmless at all times the Share Seller against all losses, damages, charges, and expenses which the Share Seller may sustain or incur towards contractual obligations with respect to the contracts awarded by the Share Seller or any other liability arising with regard to any action/ activity undertaken by the Share Seller for and on behalf of the Company in furtherance of the Project referred to above or otherwise concerning the Company. All such actions shall be defended by the Selected Bidder either itself or through the TSP at its own cost.
- The Parties hereby agree that the provisions of this clause shall survive the termination of this Agreement.

IN WITNESS WHEREOF, THE PARTIES HERETO HAVE CAUSED THIS AGREEMENT TO BE DULY EXECUTED AND DELIVERED AS OF THE DAY AND YEAR FIRST ABOVE WRITTEN

SIGNED AND DELIVERED

BY THE WITHIN NAMED "PFCCCL" PFC CONSULTING LIMITED



BY THE HAND OF **MR. SACHIN ARORA, COMPANY SECRETARY**

PURSUANT TO THE RESOLUTION PASSED BY THE BOARD OF DIRECTORS ON 15th FEBRUARY 2024

ON THE 07th DAY OF MARCH 2024.

IN THE PRESENCE OF:

WITNESS:

NAME, SIGNATURE, DESIGNATION AND ADDRESS:

Nitin Shrivastava
EA - PFCCCL

[Signature]

SIGNED AND DELIVERED

BY THE WITHIN NAMED "COMPANY" JEWAR TRANSMISSION LIMITED



BY THE HAND OF **MR. SANJAY KUMAR NAYAK, DIRECTOR**

PURSUANT TO THE

RESOLUTION PASSED BY THE BOARD OF DIRECTORS ON 30th JANUARY 2024

ON THE 07th DAY OF MARCH 2024.

IN THE PRESENCE OF:

WITNESS:

NAME, SIGNATURE, DESIGNATION AND ADDRESS:

Naveen Kumar
GM - PFCCCL






SIGNED AND DELIVERED

BY THE WITHIN NAMED "SELECTED BIDDER" MEGHA ENGINEERING & INFRASTRUCTURES LIMITED

BY THE HAND OF M RAGHU KUMAR, ASSOCIATE VICE PRESIDENT

PURSUANT TO THE
RESOLUTION PASSED BY THE BOARD OF DIRECTORS ON 29TH DAY OF FEBRUARY 2024

ON THE 07th DAY OF MARCH 2024.

IN THE PRESENCE OF:
WITNESS:

NAME, SIGNATURE, DESIGNATION AND ADDRESS:

Alok Dubey
Alok Kumar Dubeydi
G.M.
Bala Nagar Hyderabad.



ANNEXURE A**DESCRIPTION OF THE SALE SHARES**

S. NO.	NAME OF THE SHAREHOLDER	NUMBER OF EQUITY SHARES HELD	PERCENTAGE OF THE TOTAL PAID UP EQUITY CAPITAL
1.	PFC Consulting Limited	9400	94 %
2.	Shri Manoj Kumar Rana (Nominee of PFC Consulting Limited)	100	1 %
3.	Shri Milind Madhusudan Dafade (Nominee of PFC Consulting Limited)	100	1 %
4.	Shri Neeraj Singh (Nominee of PFC Consulting Limited)	100	1 %
5.	Shri Sanjay Kumar Nayak (Nominee of PFC Consulting Limited)	100	1 %
6.	Shri Sachin Shukla (Nominee of PFC Consulting Limited)	100	1 %
7.	Shri Naveen Kumar (Nominee of PFC Consulting Limited)	100	1 %
	Total	10,000	100%





Scope of JTL
(GIS Substation at Jewar, Varanasi, Vasundhara & AIS Substation Khaga with Associated Lines)



By : PFC Consulting Limited – New Delhi (PFCCL)		ANNEXURE A-13
Project Brief	❖ Construction of 400/220 kV, 2x500 MVA GIS Substation Jewar (Gautam Budh Nagar) with associated lines.	
	✓ Construction of 400/220 kV, 2x500 MVA GIS Substation Jewar (Gautam Budh Nagar) (along with 125 MVAR reactor)	
	✓ LILO of one ckt. of 400 kV Greater Noida (765 kV) – Sector - 148 (400). Noida DC line at 400/220 kV GIS Substation Jewar (Gautam Budh Nagar) (for LILO, twin HTLS conductor and OPGW stringing work on narrow base multi circuit towers)	
	❖ Construction of 220/33 kV, 2x60 MVA GIS substation Cantt. (Chaukaghat) Varanasi with associated lines	
	✓ Construction of 220/33 kV. GIS Substation Cantt. (Chaukaghat) Varanasi	
Location	✓ LILO of one ckt. of 220 kV Satnath (400)- Gajokhar DC line at Cantt.(Chaukaghat) Varanasi construction of 41.5 Km (37 Km overhead line) (Zebra Conductor) on Lattice Tower and construction of 4.5 Km 630 mm ² line with copper XLPE cable	
	❖ Construction of 220/33 kV, 3x60 MVA GIS substation Vasundhara (Ghaziabad) with associated lines	
	✓ Construction of 220/33 kV GIS substation Vasundhara (Ghaziabad)	
	✓ LILO of one ckt. of 220 kV Muradnagar(400)- Sahibabad (220) SC line at 220 kV Substation Vasundhara (Ghaziabad) (Multi Ckt. / Monopole Tower) (Zebra conductor) & 220 kV Indrapuram (400) – Vasundhara SC line (Monopole and Narrow base M/c tower)	
	❖ Construction of 220/132/33 kV, 2x160+2x40 MVA Substation Khaga (Fatehpur) with associated lines	
Time Line	✓ Construction of 220/132/33 kV. Substation Khaga (Fatehpur)	
	✓ 220 kV Fatehpur (765) PG -Khaga DC line (Zebra Conductor)	
	✓ 132 kV Khaga (220) – Khaga DC line and 132 kV Khaga (220) — Hussainganj SC line	
	✓ 132 kV Bay 132 kV Substation Khaga – 02 Nos and 132 kV Hybrid Bay at 132 kV substation Hussainganj – 01 No.	
Location	Jewar, Gautam Budh Nagar (Gr. Noida), Chaukaghat (Varanasi), Vasundhara (Ghaziabad) & Khaga (Fatehpur)	
Time Line	18 months for Each Element from the Date of Signing of TSA. (Total Element: 4 Nos.)	





Organogram for JTL

