

**Amendment – III dated 29.05.2020 on the Request for Proposal and Transmission Service Agreement issued for selection of bidder as Transmission Service Provider to establish “Transmission System Strengthening Scheme For Evacuation of power from Solar Energy Zones in Rajasthan (8.1 GW) under Phase II (Part C)” through tariff based competitive bidding process**

Sl. No.	Existing Provision	New / Revised Provision
1	<p><b>Scope of Work</b> .....</p> <p><b>Note:</b></p> <p><i>i. POWERGRID to provide space for 2 no of 765 kV bays at Bhadla-II and space for 2 no of switchable line reactors at Bhadla-II substation.</i></p> <p><i>ii. POWERGRID to provide space for 2 no of 400 kV bays at Neemrana.</i></p> <p><i>iii. <u>The spare unit of 765kV, 1x80 MVAR Reactor proposed to be provided at Bhadla-II PS under ‘Transmission system strengthening for evacuation of power from solar energy zones in Rajasthan (8.1 GW) under Phase II-Part-B’ shall be utilized as common spare for 6x80 MVAR Switchable Line Reactors to be provided at Bhadla-II PS each under ‘Transmission system strengthening for evacuation of power from solar energy zones in Rajasthan (8.1 GW) under Phase II –Part C’ and ‘Transmission system strengthening for evacuation of power from solar energy zones in Rajasthan (8.1 GW) under Phase II –Part E’.</u></i></p> <p>.....</p>	<p><b>Scope of Work</b> .....</p> <p><b>Note:</b></p> <p><i>i. POWERGRID to provide space for 2 no of 765 kV bays at Bhadla-II and space for 2 no of switchable line reactors at Bhadla-II substation.</i></p> <p><i>ii. POWERGRID to provide space for 2 no of 400 kV bays at Neemrana.</i></p> <p><i>iii. Deleted.</i></p> <p>.....</p>

### Amendment in Technical Specifications of Transmission System

Sl. No.	Existing Provision	New / Revised Provision																				
<b><u>SPECIFIC TECHNICAL REQUIREMENTS FOR TRANSMISSION LINE</u></b>																						
1.	2.1  Steel section of grade E 250 and/or grade E 350 as per IS 2062, <b><u>are only</u></b> permitted for use in towers, extensions, gantry structures and stub setting templates. For towers in snowbound areas, steel sections shall conform to Grade-C of IS-2062.	2.1  Steel section of grade E 250 and/or grade E 350 as per IS 2062, <b><u>only are</u></b> permitted for use in towers, extensions, gantry structures and stub setting templates. For towers in snowbound areas, steel sections shall conform to Grade-C of IS-2062.																				
2.	6.0  .....  <b><u>For 400kV transmission line</u></b>  i) Type of HTLS conductor: <b><u>INVAR/ GAP/ Composite core/ ACSS</u></b>  ii) Basic parameters:	6.0  .....  <b><u>For 400kV transmission line</u></b>  i) Type of conductor: <b><u>HTLS</u></b>  ii) Basic parameters:																				
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3.	8.0 b) Minimum ground clearance: <b>15 m</b>	8.0 b) Minimum ground clearance: <b>18 m</b>						
4.	8.0 c) Minimum mid span separation between earthwire and conductor: 9.0 m	8.0 c) Minimum mid span separation between earthwire and conductor: 9.0 m <b>400 kV:</b> <b><u>The minimum live metal clearances for 400 kV D/C transmission lines shall be considered as follows:</u></b>  (i) <b><u>Under stationary conditions</u></b> <b><u>From tower body: 3.05m</u></b>  (ii) <b><u>Under Swing conditions</u></b> <table border="1" data-bbox="1265 751 2078 962"> <thead> <tr> <th data-bbox="1265 751 1720 842"><b><u>Wind Pressure Condition</u></b></th> <th data-bbox="1720 751 2078 842"><b><u>Minimum Electrical Clearance</u></b></th> </tr> </thead> <tbody> <tr> <td data-bbox="1265 842 1720 901"><b><u>a) Swing angle (22°)</u></b></td> <td data-bbox="1720 842 2078 901"><b><u>3.05 mtrs</u></b></td> </tr> <tr> <td data-bbox="1265 901 1720 962"><b><u>b) Swing angle (44°)</u></b></td> <td data-bbox="1720 901 2078 962"><b><u>1.86 mtrs</u></b></td> </tr> </tbody> </table>	<b><u>Wind Pressure Condition</u></b>	<b><u>Minimum Electrical Clearance</u></b>	<b><u>a) Swing angle (22°)</u></b>	<b><u>3.05 mtrs</u></b>	<b><u>b) Swing angle (44°)</u></b>	<b><u>1.86 mtrs</u></b>
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5.	12.0 Each tower shall be earthed such that tower footing impedance does not exceed 10 ohms. Pipe type or Counterpoise type earthing shall be provided in accordance with relevant IS. Additional earthing shall be provided on every 7 to 8 kms distance at tension tower for direct earthing of both shield wires.	12.0 Each tower shall be earthed such that tower footing impedance does not exceed 10 ohms. Pipe type or Counterpoise type earthing shall be provided in accordance with relevant IS. Additional earthing shall be provided on every 7 to 8 kms distance at tension tower for direct earthing of both shield wires. <b><u>If site condition demands, multiple earthing or use of earthing enhancement compound shall be used.</u></b>						
6.	New Point to be inserted	<b>13.0</b>						

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		<b>Pile foundation shall be used for towers located in the river bed, or on river banks or in areas where river flow or river course is anticipated to change based on previous years' hydrology data.</b>
7.	New Point to be inserted	<b>14.0</b> <b>Transmission line route shall be finalized, in consultation with appropriate authorities so as to avoid the habitant zones of Great Indian Bustard and other protected species. Bird diverters, wherever required, shall be provided on the line.</b>

**SPECIFIC TECHNICAL REQUIREMENTS FOR SUBSTATION**

8.	<p>General</p> <p>The proposed new substation shall be conventional AIS type generally conforming to the requirements of <b><u>CEA regulation for construction of substation.</u></b></p> <p>The proposed augmentation at Bhadla-II PS &amp; Neemrana S/s shall be AIS type generally conforming to the requirement of <b><u>CEA regulation for construction of substation.</u></b></p>	<p>General</p> <p>The proposed new substation shall be conventional AIS type generally conforming to the requirements of <b><u>CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2010, as amended from time to time.</u></b></p> <p>The proposed augmentation at Bhadla-II PS &amp; Neemrana S/s shall be AIS type generally conforming to the requirement of <b><u>CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2010, as amended from time to time.</u></b></p>																																								
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12.	<p><b>2.1 (765/<math>\sqrt{3}</math>) / (400/<math>\sqrt{3}</math>) / 33 kV Single Phase Autotransformer</b></p> <p>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 IV, HV and tertiary (LV) terminals of the transformer. The tertiary <b>is not</b> considered <b>to be</b> connected to source. The maximum short circuit output current at the tertiary terminals shall be limited to a safe value to make the transformer short circuit proof. The Tertiary winding shall be designed to withstand mechanical and thermal stresses due to dead short circuit on its terminals. However, the cooling for continuous thermal rating of the tertiary winding shall be of at least 5 MVA capacity.</p> <p>Core shall be constructed from high grade, non-ageing cold rolled super grain oriented silicon steel laminations with requisite BIS certification (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. The Transformers shall withstand without damage and over-heating due to over fluxing conditions of <b>105%</b> for continuous, 125% for 1 minute and 150% for 5 seconds.</p> <p>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 from HV &amp; IV Terminals. The air core reactance of the HV winding shall be not less than <b>25%</b>. External or internal reactors shall not be used to achieve the specified HV/IV, HV/LV and IV/LV impedances.</p>	<p><b><u>2.1 (765/<math>\sqrt{3}</math>) / (400/<math>\sqrt{3}</math>) / 33 kV Single Phase Autotransformer</u></b></p> <p><b><u>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 IV, HV and tertiary (LV) terminals of the transformer. The tertiary shall be considered not connected to source. The maximum short circuit output current at the tertiary terminals shall be limited to a safe value to make the transformer short circuit proof. The Tertiary winding shall be designed to withstand mechanical and thermal stresses due to dead short circuit on its terminals. However, the cooling for continuous thermal rating of the tertiary winding shall be of at least 5 MVA capacity.</u></b></p> <p><b><u>Core shall be constructed from high grade, non-ageing cold rolled super grain oriented silicon steel laminations with requisite BIS certification (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. The Transformers shall withstand without damage and over-heating due to over fluxing conditions of 110% for continuous, 125% for 1 minute and 150% for 5 seconds.</u></b></p> <p><b><u>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 from HV &amp; IV Terminals. The air core reactance of the HV winding shall be not</u></b></p>

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	<p><u>Transformer shall be fitted with 4x33.3 % independent cooler banks, out of which 3x33.3 % shall be capable of dissipating total losses at continuous maximum rating and 1x33.3% radiator bank shall be used as stand by. Each cooler bank (1x33.3%) shall be capable of dissipating 33.3 per cent of the loss at continuous maximum rating independently. Cooling shall be so designed that during total failure of power supply to cooling fans and oil pumps (considering only three cooler bank (3x33%), the transformer shall be able to operate at full load for at least twenty (20) minutes without the calculated winding hot spot temperature exceeding 140 deg C. Transformer shall be designed so that tank hotspot shall not exceed 110 deg C, considering maximum ambient temperature of 50 Deg. C.</u></p> <p>The transformer shall be complete with all required accessories, Bushing CTs, Neutral CT (outdoor type), cooler control cabinet, individual and common marshalling box, <u>RTCC</u> etc. as required for satisfactory operations of transformer. <u>The transformer shall be provided with IEC 61850 compliant digital RTCC relay having automatic voltage regulating features using Bay control and protection unit used for SAS to operate OLTC including parallel operation of transformers. Neutral of the transformer shall be solidly grounded.</u></p> <p><u>HV &amp; IV bushings shall be porcelain / composite type and hermetically sealed oil filled condenser type. LV bushing shall be of RIP (resin impregnated paper condenser) with composite insulator type. 36kV Neutral bushing shall be solid or oil communicating type with porcelain housing.</u></p>	<p><u>less than 20%. External or internal reactors shall not be used to achieve the specified HV/IV, HV/LV and IV/LV impedances.</u></p> <p><u>Transformer 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 110 deg C, considering maximum ambient temperature of 50 Deg. C.</u></p> <p><u>The transformer shall be complete with all required accessories, Bushing CTs, Neutral CT (outdoor type), cooler control cabinet, individual and common marshalling box, etc. as required for satisfactory operations of transformer. Remote tap changer control and monitoring system including parallel operation of transformers shall be carried out using Bay control unit or digital RTCC relay through Substation Automation System.</u></p> <p><u>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.</u></p>

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	The Technical Particulars / Parameters of Transformer are given below:			The Technical Particulars / Parameters of Transformer are given below:				
	<b>Sr. No.</b>	<b>Description</b>	<b>Unit</b>	<b>Parameters</b>	<b>S. No.</b>	<b>Description</b>	<b>Unit</b>	<b>Parameters</b>
	1	Rated Capacity: HV/IV	MVA	500MVA, 1- phase	1.	<b><u>Voltage ratio (Line to ground)</u></b>	<b><u>kV</u></b>	<b><u>(765/√3)/(400/√3)/33 kV</u></b>
	2	Voltage ratio (Phase Voltage)	kV	$(765/\sqrt{3}) / (400/\sqrt{3}) / 33$ kV	2.	<b><u>Rated Capacity</u></b>		
	3	Vector Group (3 -		YNaOd11		<b><u>HV</u></b>	<b><u>MVA</u></b>	<b><u>500</u></b>
	4	Cooling		ONAN/ONAF/(OFAF or ODAF) OR ONAN/ONAF1/ONAF2		<b><u>IV</u></b>	<b><u>MVA</u></b>	<b><u>500</u></b>
	5	Rating at different cooling	%	60/80/100		<b><u>LV (Tertiary)</u></b>	<b><u>MVA</u></b>	<b><u>5 MVA active loading</u></b>
	6	Frequency	Hz	50	3.	<b><u>No of phases</u></b>		<b><u>1 (Single)</u></b>
	7	Impedance at 75 Deg C		Tolerances as per IEC	4.	<b><u>Vector Group</u></b>		<b><u>YNaOd11 (in 3-phase bank)</u></b>
		HV - IV	%	At Max. / Principal / Min. Voltage tap: 12.8 / 14.0 / 16.3	5.	<b><u>Type of Transformer</u></b>		<b><u>Auto transformer</u></b>
		HV - LV	%	At Max. / Principal / Min. Voltage tap: 160 / 195 / 240	6.	<b><u>Applicable Standard</u></b>		<b><u>IEC-60076 / IS 2026</u></b>
		IV - LV	%	At Max. / Principal / Min. Voltage tap: 150 / 180 / 220	7.	<b><u>Cooling</u></b>		<b><u>ONAN / ONAF / OFAF (or) ONAN / ONAF/ ODAF (or) ONAN / ONAF1 / ONAF2</u></b>
	8	Temp. rise over 50deg C Ambient Temp	Deg. C	Top oil: 40, Winding: 45, Hotspot:59	8.	<b><u>Rating at different cooling</u></b>	<b><u>%</u></b>	<b><u>60 / 80 / 100</u></b>
	9	<b>Losses</b>			9.	<b><u>Cooler Bank Arrangement</u></b>		<b><u>2 X 50%</u></b>
					10.	<b><u>Frequency</u></b>	<b><u>Hz</u></b>	<b><u>50</u></b>
					11.	<b><u>Impedance at 75 Deg C at highest MVA base</u></b>		
					i)	<b><u>HV - IV</u></b>	<b><u>%</u></b>	<b><u>14.0</u></b>
					ii)	<b><u>HV - LV</u></b>	<b><u>%</u></b>	<b><u>195.0</u></b>

Sl. No.	Existing Provision			New / Revised Provision				
	a)	Maximum No-Load Loss at rated voltage and frequency	kW	70	iii)	<b>IV - LV</b>	%	<b>180.0</b>
	b)	Maximum Load Loss at rated current and 75°C	kW	450	12.	<b>Tolerance on Impedance</b>	%	<b>As per IEC</b>
	c)	Maximum Auxiliary Loss at rated voltage and frequency	kW	10	13.	<b>Service</b>		<b>Outdoor</b>
	10	<b>Windings</b>			14.	<b>Duty</b>		<b>Continuous</b>
	i)	Insulation Level (LI/SI/PF)		kVp/kVp/kVrms	15.	<b>Overload Capacity</b>		<b>IEC-60076-7</b>
		HV		1950/1550/-	16.	<b>Max. temperature rise over 50 deg C ambient temperature</b>	°C	
		IV		1300/1050/570	i)	<b>Top oil measured by thermometer</b>	°C	<b>45</b>
		LV		250/-/95	ii)	<b>Average winding measured by resistance method</b>	°C	<b>50</b>
		Neutral		170/-/70	17.	<b>Winding hot spot rise over yearly weighted temperature of 32 °C</b>	°C	<b>61</b>
	ii)	Tan delta of windings	%	< 0.5	18.	<b>Tank Hotspot Temperature</b>	°C	<b>110</b>
	11	Tap Changer on the neutral side of the winding & Tapping details		OLTC with range ± 5.5% for HV variation in step of 0.5%, 22 steps	19.	<b>Max. design Ambient temp</b>	°C	<b>50</b>
	12	Partial discharge (PD) level at 1.58 x 765kV /√3	pC	≤ 100	20.	<b>Windings</b>		
	13	Noise level at rated voltage and at principal tap at full load and all cooling active	dB	≤ 80	i)	<b>Lightning Impulse Withstand Voltage</b>		
						<b>HV</b>	<b>kV<sub>p</sub></b>	<b>1950</b>
						<b>IV</b>	<b>kV<sub>p</sub></b>	<b>1300</b>
						<b>LV</b>	<b>kV<sub>p</sub></b>	<b>250</b>
						<b>Neutral</b>	<b>kV<sub>p</sub></b>	<b>170</b>

Sl. No.	Existing Provision			New / Revised Provision				
	14	Insulating oil		virgin high grade inhibited, conforming to IEC-60296	ii)	<b><u>Chopped Wave Lightning Impulse Withstand Voltage</u></b>		
	15	<b>Bushing</b>				<b>HV</b>	<b>kV<sub>p</sub></b>	<b><u>2140</u></b>
						<b>IV</b>	<b>kV<sub>p</sub></b>	<b><u>1430</u></b>
						<b>LV</b>	<b>kV<sub>p</sub></b>	<b><u>275</u></b>
	A	Rated voltage HV/IV/LV/Neutral	kV	800/420/52/36	iii)	<b><u>Switching Impulse withstand Voltage</u></b>		
	B	Rated current (Min.): HV/IV/LV/Neutral	A	2500/2500/3150/3150		<b>HV</b>	<b>kV<sub>p</sub></b>	<b><u>1550</u></b>
						<b>IV</b>	<b>kV<sub>p</sub></b>	<b><u>1050</u></b>
	C	Insulation Level (LI/SI/PF)		kV <sub>p</sub> /kV <sub>p</sub> /kV <sub>rms</sub>	iv)	<b><u>One Minute Power Frequency Withstand Voltage</u></b>		
		HV		2100/1550/970		<b>HV</b>	<b>kV<sub>rms</sub></b>	<b>-</b>
		IV		1425/1050/695		<b>IV</b>	<b>kV<sub>rms</sub></b>	<b><u>570</u></b>
		LV		250/-/105		<b>LV</b>	<b>kV<sub>rms</sub></b>	<b><u>95</u></b>
		Neutral		170/-/77		<b>Neutral</b>	<b>kV<sub>rms</sub></b>	<b><u>70</u></b>
	D	Tan delta of bushings	%	< 0.5	v)	<b><u>Neutral</u></b>		<b><u>Solidly Earthed</u></b>
	E	PD Level of Bushing at Um	pC	≤ 10	vi)	<b><u>Insulation</u></b>		
						<b>HV</b>		<b><u>Graded</u></b>
						<b>IV</b>		<b><u>Graded</u></b>
						<b>LV</b>		<b><u>Uniform</u></b>
					vii)	<b><u>Tertiary Connection</u></b>		<b><u>Ungrounded Delta</u></b>
					viii)	<b><u>Tan delta of windings at ambient Temperature</u></b>	<b>%</b>	<b><u>≤ 0.5</u></b>

Sl. No.	Existing Provision	New / Revised Provision			
		21.	<b>Bushing</b>		
		i)	<b>Rated voltage</b>		
			<b>HV</b>	<b>kV</b>	<b>800</b>
			<b>IV</b>	<b>kV</b>	<b>420</b>
			<b>LV</b>	<b>kV</b>	<b>52</b>
			<b>Neutral</b>	<b>kV</b>	<b>36</b>
		ii)	<b>Rated current</b>		
			<b>HV</b>	<b>A</b>	<b>2500</b>
			<b>IV</b>	<b>A</b>	<b>2500</b>
			<b>LV</b>	<b>A</b>	<b>3150</b>
			<b>Neutral</b>	<b>A</b>	<b>3150</b>
		iii)	<b>Lightning Impulse withstand Voltage</b>		
			<b>HV</b>	<b>kV<sub>p</sub></b>	<b>2100</b>
			<b>IV</b>	<b>kV<sub>p</sub></b>	<b>1425</b>
			<b>LV</b>	<b>kV<sub>p</sub></b>	<b>250</b>
			<b>Neutral</b>	<b>kV<sub>p</sub></b>	<b>170</b>
		iv)	<b>Switching Impulse withstand Voltage</b>		<b>(Specific creepage distance: 25mm/kV corresponding to the line to line highest system voltage)</b>
			<b>HV</b>	<b>kV<sub>p</sub></b>	<b>1550</b>
			<b>IV</b>	<b>kV<sub>p</sub></b>	<b>1050</b>
			<b>LV</b>	<b>kV<sub>p</sub></b>	<b>:</b>
			<b>Neutral</b>	<b>kV<sub>p</sub></b>	<b>:</b>

Sl. No.	Existing Provision	New / Revised Provision			
		v)	<u>One Minute Power Frequency withstand Voltage</u>		
			<u>HV</u>	<u>kV<sub>rms</sub></u>	<u>970</u>
			<u>IV</u>	<u>kV<sub>rms</sub></u>	<u>695</u>
			<u>LV</u>	<u>kV<sub>rms</sub></u>	<u>105</u>
			<u>Neutral</u>	<u>kV<sub>rms</sub></u>	<u>77</u>
		vi)	<u>Minimum total creepage distances</u>		
			<u>HV</u>	<u>mm</u>	<u>20000</u>
			<u>IV</u>	<u>mm</u>	<u>10500</u>
			<u>LV</u>	<u>mm</u>	<u>1300</u>
			<u>Neutral</u>	<u>mm</u>	<u>900</u>
		vii)	<u>Max Partial discharge level at U<sub>m</sub></u>		
			<u>HV</u>	<u>pC</u>	<u>10</u>
			<u>IV</u>	<u>pC</u>	<u>10</u>
			<u>LV</u>	<u>pC</u>	<u>10</u>
			<u>Neutral</u>	<u>pC</u>	<u>-</u>
		22.	<u>Max Partial discharge level at 1.58 * U<sub>r</sub> / √3</u>	<u>pC</u>	<u>100</u>
		23.	<u>Max Noise level at rated voltage, principal tap &amp; no load and all cooling active</u>		<u>80</u>
		24.	<u>Maximum Permissible Losses of Transformers</u>		

Sl. No.	Existing Provision	New / Revised Provision			
		i)	<u>Max. No Load Loss at rated voltage and frequency</u>	<u>kW</u>	<u>80</u>
		ii)	<u>Max. Load Loss at rated current and frequency and at 75° C for HV and IV windings, at principal tap position</u>	<u>kW</u>	<u>450</u>
		iii)	<u>Max I<sup>2</sup>R loss at rated current and frequency and at 75° C for HV and IV windings, at principal tap position</u>	<u>kW</u>	<u>335</u>
		iv)	<u>Max. Auxiliary Loss at rated voltage and frequency</u>	<u>kW</u>	<u>10</u>
		25.	<u>Insulating oil</u>		<u>Unused inhibited or uninhibited transformer oil conforming to IEC -60296: 2012.</u>
13.	<p><b>2.2 765/<math>\sqrt{3}</math> kV Single Phase Shunt Reactor</b></p> <p>.....</p> <p>The shunt reactor shall be of <b><u>either</u></b> gapped core type <b><u>or magnetically shielded air core type (shell type)</u></b> construction. The impedance ratio (X0/X1) specified shall be achieved adopting by either single phase construction in separate tanks or 3 limb core construction. <b><u>In case of coreless construction, a magnetic shield shall be provided around the coreless coils and non-magnetic material sheet shall form the central core to minimize the vibrations.</u></b> Core shall be constructed from non-ageing, cold rolled grain oriented silicon steel laminations with requisite BIS certification.</p>	<p><b>2.2 765/<math>\sqrt{3}</math> kV Single Phase Shunt Reactor</b></p> <p>.....</p> <p>The shunt reactor shall be of gapped core type construction. The impedance ratio (X0/X1) specified shall be achieved adopting by either single phase construction in separate tanks or 3 limb core construction. Core shall be constructed from non-ageing, cold rolled grain oriented silicon steel laminations with requisite BIS certification.</p>			

Sl. No.	Existing Provision	New / Revised Provision																																
	<p>.....</p> <p>The reactor shall be complete with all required accessories, Bushing CTs, Neutral CT (outdoor type) (if required), individual and common marshalling box etc. as required for satisfactory operations of reactor. HV bushing shall be porcelain/composite type and hermetically sealed oil filled condenser type. Neutral Bushing shall be 145kV RIP (resin impregnated paper <b>condenser</b>) with composite insulator type.</p> <p>The Technical Particulars / Parameters of Reactor are given below:</p> <table border="1" data-bbox="259 1050 1189 1362"> <thead> <tr> <th>Sr. No.</th> <th>Description</th> <th>Unit</th> <th>Parameters</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Rated Capacity at 765/√3 kV</td> <td>MVAR</td> <td>110/80 (As applicable) 1-phase</td> </tr> <tr> <td>2</td> <td>Rated Voltage (Ur)</td> <td>kV</td> <td>765/√3</td> </tr> <tr> <td>3</td> <td>Maximum continuous operating voltage (Um)</td> <td>kV</td> <td>800/√3</td> </tr> </tbody> </table>	Sr. No.	Description	Unit	Parameters	1	Rated Capacity at 765/√3 kV	MVAR	110/80 (As applicable) 1-phase	2	Rated Voltage (Ur)	kV	765/√3	3	Maximum continuous operating voltage (Um)	kV	800/√3	<p>.....</p> <p>The reactor shall be complete with all required accessories, Bushing CTs, Neutral CT (outdoor type) (if required), individual and common marshalling box etc. as required for satisfactory operations of reactor. HV bushing shall be porcelain/composite type and hermetically sealed oil filled condenser type. Neutral Bushing shall be 145kV RIP (Resin Impregnated Paper) <b><u>/RIS (Resin Impregnated Synthetic)</u></b> with composite insulator type.</p> <p><b><u>Spare unit of 765 kV, 1x110 MVAR reactor proposed to be provided at Sikar-II PS under this package shall be utilised as common spare for switchable line reactors to be provided at Sikar-II PS under “Transmission system strengthening for evacuation of power from solar energy zones in Rajasthan (8.1 GW) under phase-II part-D &amp; part-E”. The TSP shall place the spare unit in such a way that the spare unit can be utilized for all the reactor banks without its physical movement.</u></b></p> <p>The Technical Particulars / Parameters of <b><u>1-phase, 80 MVAR &amp; 110 MVAR, 765/√3 kV Shunt</u></b> Reactor are given below:</p> <table border="1" data-bbox="1223 1082 2096 1369"> <thead> <tr> <th>S. No.</th> <th>Description</th> <th>Unit</th> <th>Technical Parameters</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td><b><u>Rated capacity at 765/√3 kV</u></b></td> <td><b><u>MVAR</u></b></td> <td><b><u>80</u></b>      <b><u>110</u></b></td> </tr> <tr> <td>2.</td> <td><b><u>Rated Voltage (Ur)</u></b></td> <td><b><u>kV</u></b></td> <td><b><u>765/√3</u></b></td> </tr> <tr> <td>3.</td> <td><b><u>Maximum continuous operating voltage (Um) (1 p.u.)</u></b></td> <td><b><u>kV</u></b></td> <td><b><u>800/√3</u></b></td> </tr> </tbody> </table>	S. No.	Description	Unit	Technical Parameters	1.	<b><u>Rated capacity at 765/√3 kV</u></b>	<b><u>MVAR</u></b>	<b><u>80</u></b> <b><u>110</u></b>	2.	<b><u>Rated Voltage (Ur)</u></b>	<b><u>kV</u></b>	<b><u>765/√3</u></b>	3.	<b><u>Maximum continuous operating voltage (Um) (1 p.u.)</u></b>	<b><u>kV</u></b>	<b><u>800/√3</u></b>
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Sl. No.	Existing Provision			New / Revised Provision				
	4	Cooling System		ONAN	4.	<u>Winding connection</u>		<u>Star with neutral (in 3 Phase Bank)</u>
	5	Permissible current unbalance among different phases		±1%	5.	<u>Cooling type</u>		<u>ONAN</u>
	6	Crest value of Third Harmonic content in phase current at rated voltage with sinusoidal wave form	%	≤ 3% of the crest value of fundamental	6.	<u>Frequency</u>	<u>Hz</u>	<u>50</u>
	7	Range of constant current		Up to 1.25 p.u. voltage	7.	<u>No of Phases</u>		<u>1 (Single)</u>
	8	Tolerance on current	%	(i) 0 to +5% for a single phase unit ±1% for between units	8.	<u>Reference standard</u>		<u>IEC 60076-6</u>
	9	Ratio of zero sequence reactance to positive reactance (X0/X1)	Range	0.9 - 1.0	9.	<u>Service</u>		<u>Outdoor</u>
	10	Max. Temp. rise over 50 deg C Ambient Temp and Voltage at 800/√3 KV		Top oil/Winding/Hotspot: 40/45/59	10.	<u>Duty</u>		<u>Continuous at 800/√3kV</u>
	11.	<b>Losses</b>			11.	<u>Permissible unbalance current among phases</u>		<u>±1%</u>
	a)	Maximum Permissible Losses at rated Voltage, Frequency and at 75°C (kW) for 110 MVAR	kW	120	12.	<u>Crest value of third harmonic content in phase current at rated voltage with sinusoidal wave form</u>		<u>≤ 3% of the crest value of fundamental</u>
	b)	Maximum Permissible Losses at rated Voltage, Frequency and at 75°C (kW) for 80 MVAR	kW	98	13.	<u>Range of constant impedance</u>		<u>Up to 1.25 p.u.</u> <u>(However, complete saturation characteristics of the Reactors upto 1.5 p.u. Voltage shall be furnished)</u>
	12	<b>Windings</b>			14.	<u>Tolerance on current</u>		<u>(i) 0 to +5% for a single-phase unit</u> <u>(ii) ±1% for between units</u>
	i)	Insulation level (LI/SI/PF)		kVp / kVp / kVrms	15.	<u>Ratio of zero sequence reactance to positive reactance (X0/X1)</u>		<u>Between 0.9 &amp; 1.0.</u>
		HV		1950/1550/830 (Ph-Earth) for 5 min.	16.	<u>Temperature rise over 50 °C Ambient Temp. and at 800/√3 kV</u>		
		Neutral		550/-/230				

Sl. No.	Existing Provision				New / Revised Provision			
	ii)	Tan delta of windings	%	< 0.5	i)	<u>Top oil measured by thermometer</u>	°C	<u>40</u>
	13	Vibration at 800/√3 kV and rated frequency	micron	≤ 200 microns peak to peak	ii)	<u>Average winding measured by resistance method</u>	°C	<u>45</u>
	14	Noise level at at 800/√3 kV and rated frequency	dB	≤ 80dBA	17.	<u>Winding hot spot temperature rise over yearly weighted average temperature of 32 °C</u>	°C	<u>61</u>
	15	Insulating Oil		virgin high grade inhibited, conforming to IEC-60296	18.	<u>Max. tank surface temperature</u>	°C	<u>110</u>
	16	Partial discharge (PD) level at 1.58 Ur / √3	pC	< 100	19.	<u>Max design ambient temperature</u>	°C	<u>50</u>
	17	<b>Bushing</b>			20.	<u>Windings</u>		
	i)	Rated voltage: HV / Neutral	kV	800/145	i)	<u>Lightning Impulse withstand Voltage</u>		
	ii)	Rated current (Min.): HV / Neutral	A	2500/1250		<u>Line end</u>	kV <sub>p</sub>	<u>1950</u>
	iii)	Insulation level (LI/SI/PF)		kVp / kVp / kVrms		<u>Neutral</u>	kV <sub>p</sub>	<u>550</u>
		HV		2100/1550/970	ii)	<u>Chopped Wave Lightning Impulse Withstand Voltage</u>		
		Neutral		650/-/305		<u>Line end</u>	kV <sub>p</sub>	<u>2145</u>
	iv)	Tan delta of bushings: HV/Neutral	%	< 0.5	iii)	<u>Switching Impulse withstand Voltage at Line end</u>	kV <sub>p</sub>	<u>1550</u>
	v)	PD of Bushing at Um: HV/Neutral	pC	< 10	iv)	<u>Power Frequency withstand Voltage</u>		
						<u>Line end</u>	kVrms	<u>830kV rms (Ph to Earth) for 5 min</u> <u>(to be tested)</u>
						<u>Neutral</u>	kVrms	<u>230 (for one minute)</u>

Amendment to RFP & TSA: Transmission System Strengthening Scheme for Evacuation of Power from Solar Energy Zones in Rajasthan (8.1 GW) under Phase II (Part C)

Sl. No.	Existing Provision	New / Revised Provision			
		21.	<u>Neutral earthing</u>		<u>Solidly Earthed</u>
		22.	<u>Whether neutral is to be brought out</u>		<u>Yes (through 145kV class bushing)</u>
		23.	<u>Tan-delta of windings at ambient Temperature</u>		<u>&lt; 0.005</u>
		24.	<u>Bushing</u>		
		i)	<u>Rated voltage</u>		
			<u>Line bushing</u>	<u>kV</u>	<u>800</u>
			<u>Neutral bushing</u>	<u>kV</u>	<u>145</u>
		ii)	<u>Rated current</u>		
			<u>Line bushing</u>	<u>A</u>	<u>2500</u>
			<u>Neutral bushing</u>	<u>A</u>	<u>1250</u>
		iii)	<u>Lightning Impulse withstand Voltage</u>		
			<u>Line bushing</u>	<u>kV<sub>p</sub></u>	<u>2100</u>
			<u>Neutral bushing</u>	<u>kV<sub>p</sub></u>	<u>650</u>
		iv)	<u>Switching Impulse withstand Voltage of Line bushing</u>	<u>kV<sub>p</sub></u>	<u>1550</u>
		v)	<u>One minute power frequency withstand of bushings (dry)</u>		
			<u>Line bushing</u>	<u>kV rms</u>	<u>970</u>
			<u>Neutral bushing</u>	<u>kV rms</u>	<u>305</u>

Sl. No.	Existing Provision	New / Revised Provision			
		v)	<u>Minimum creepage distance</u>		<u>(Specific Creepage Distance: of 25mm/kV corresponding to highest line to line voltage)</u>
			<u>Line bushing</u>	<u>mm</u>	<u>20000</u>
			<u>Neutral bushing</u>	<u>mm</u>	<u>3625</u>
		vi)	<u>Partial discharge of bushings at Um (line end and neutral)</u>	<u>pC</u>	<u>&lt; 10</u>
		1.	<u>Vibration and tank stress at Um</u>		<u>Max ≤200microns peak to peak</u> <u>Average ≤ 60microns peak to peak</u> <u>Tank stress: ≤2.0kg/sq.mm at any point of tank</u>
		2.	<u>Maximum noise pressure level at rated voltage &amp; frequency</u>	<u>dB</u>	<u>80</u>
		3.	<u>Maximum Permissible Losses of Reactor</u>		<u>80 MVar</u> <u>110MVar</u>
		i)	<u>Max. Total loss at rated current and frequency and at 75° C</u>	<u>kW</u>	<u>98</u> <u>120</u>
		ii)	<u>Max. I<sup>2</sup>R Loss at rated current and frequency and at 75° C</u>	<u>kW</u>	<u>52</u> <u>60</u>
		4.	<u>Insulating oil</u>		<u>Unused inhibited or uninhibited transformer oil conforming to IEC-60296:2012</u>

Sl. No.	Existing Provision	New / Revised Provision
	<p>.....</p> <p><b>Neutral Grounding Reactor (NGR) and Surge Arrester for 765kV line reactors</b></p> <p><u>The neutral grounding reactors are required for grounding of the neutral point of shunt reactors to limit the secondary arc current and the recovery voltage to a minimum value. TSP shall provide NGR of suitable value (Ohm) as per actual line length. NGR shall be dry type air core for outdoor application. Line and ground side of NGR shall be rated for 145kV and 36kV class of insulation respectively. NGR shall be rated for continuous current of 20A and short time current of 240A r.m.s for 1 minute. However, the NGR shall be designed for a short time current of 600 Amp r.m.s to ensure mechanical robustness. It shall be solidly connected between neutral of shunt reactor and earth. The NGR shall be mounted on support structure (non-magnetic material) high above ground level (2.55 meter) to allow free and safe access at ground level for personnel. Further, a suitable bypass switching arrangement should be provided across NGR so that neutral of line reactor can be solidly grounded by bypassing NGR and line reactor can be used as bus reactor, if required.</u></p> <p><u>The surge arresters (rated voltage 132kV) shall be of heavy duty station class type. It shall be physically located between the neutral of shunt reactor (brought out at 145kV class bushing) and neutral grounding reactor. The surge arresters shall conform in general to IEC-60099-4. Surge arresters shall be of gapless type without any series or shunt gap. Arresters shall be hermetically sealed units, of self-supporting construction, suitable for mounting on structures.</u></p>	<p>.....</p> <p><b>Neutral Grounding Reactor (NGR) and Surge Arrester for 765kV line reactors</b></p> <p><u>TSP shall provide NGR of suitable value (Ohm) as per actual line length. NGR shall be oil filled or dry type air core for outdoor application. Line and ground side of NGR shall be rated for 145kV and 36kV class of insulation respectively. Oil filled NGR shall be rated for continuous current of 10A and short time current of 60A r.m.s for 10 seconds while air core NGR shall be rated for continuous current of 20A and short time current of 240A r.m.s for 1 minute. However, the air core NGR shall be designed for a short time current of 600 Amp r.m.s to ensure mechanical robustness. The air core NGR shall be mounted on support structure (non-magnetic material) high above ground level (2.55 meter) to allow free and safe access at ground level for personnel.</u></p> <p><u>The surge arresters (rated voltage 120kV) shall be provided &amp; physically located between the neutral of shunt reactor (brought out at 145kV class bushing) and neutral grounding reactor. The surge arresters shall be of heavy duty station class gapless Metal oxide (ZnO) type conforming in general to IEC-60099-4. Arresters shall be hermetically sealed units, of self-supporting construction, suitable for mounting on structures.</u></p>

Sl. No.	Existing Provision	New / Revised Provision																												
14.	<p><b>2.3 420kV, 3-Phase, Shunt Reactor</b></p> <p>.....</p> <p>The reactor shall be of <b>either</b> gapped core type <b>or magnetically shielded air core type (shell type)</b> construction. The impedance ratio (X0/X1) specified shall be achieved by adopting either single phase construction in separate tanks or three phase with 3 limb or 5 limb core construction. <b><u>In case of coreless construction, a magnetic shield shall be provided around the coreless coils and non-magnetic material sheet shall form the central core to minimize the vibrations.</u></b> Core shall be constructed from non-ageing, cold rolled grain oriented silicon steel laminations with requisite BIS certification.</p> <p>Shunt Reactors shall be capable of operating continuously at a voltage 5% higher than their rated voltage without exceeding winding and tank hot spot temperature 140 Deg and 110 Deg Celsius respectively, considering maximum ambient temperature as 50 Deg C.</p> <p>The reactor shall be complete with all required accessories, Bushing CTs, marshalling box etc as required for satisfactory operations of reactor. HV and Neutral bushings shall be RIP (resin impregnated paper <b>condenser</b>) with composite insulator type.</p> <p>The Technical Particulars / Parameters of Shunt Reactor are given below:</p> <table border="1" data-bbox="264 1193 1173 1350"> <thead> <tr> <th>Sl. No.</th> <th>Description</th> <th>Unit</th> <th>Parameters</th> </tr> </thead> <tbody> <tr> <td>1.1</td> <td>Rated Voltage, Ur (1p.u)</td> <td>kV</td> <td>420</td> </tr> <tr> <td>1.2</td> <td>Rated Capacity at 420 kV</td> <td>MVAR</td> <td>125</td> </tr> </tbody> </table>	Sl. No.	Description	Unit	Parameters	1.1	Rated Voltage, Ur (1p.u)	kV	420	1.2	Rated Capacity at 420 kV	MVAR	125	<p><b>2.3 420kV, 3-Phase, Shunt Reactor</b></p> <p>.....</p> <p>The reactor shall be of gapped core type construction. The impedance ratio (X0/X1) specified shall be achieved by adopting either single phase construction in separate tanks or three phase with 3 limb or 5 limb core construction. Core shall be constructed from non-ageing, cold rolled grain oriented silicon steel laminations with requisite BIS certification.</p> <p>Shunt Reactors shall be capable of operating continuously at a voltage 5% higher than their rated voltage without exceeding winding and tank hot spot temperature 140 Deg and 110 Deg Celsius respectively, considering maximum ambient temperature as 50 Deg C.</p> <p>The reactor shall be complete with all required accessories, Bushing CTs, marshalling box etc as required for satisfactory operations of reactor. HV and Neutral bushings shall be <b><u>RIP (Resin Impregnated Paper) / RIS (Resin Impregnated Synthetic)</u></b> with composite insulator type.</p> <p>The Technical Particulars / Parameters of <b><u>3-phase, 125 MVar, 420 kV</u></b> Shunt Reactor are given below:</p> <table border="1" data-bbox="1227 1182 2114 1385"> <thead> <tr> <th>S. No</th> <th>Description</th> <th>Unit</th> <th>Technical Parameters</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td><b><u>Rated Capacity at 420kV</u></b></td> <td><b><u>MVar</u></b></td> <td><b><u>125</u></b></td> </tr> <tr> <td>2.</td> <td><b><u>Rated Voltage (Ur) (1.0 pu)</u></b></td> <td><b><u>kV</u></b></td> <td><b><u>420</u></b></td> </tr> <tr> <td>3.</td> <td><b><u>Number of phases</u></b></td> <td></td> <td><b><u>3 (three)</u></b></td> </tr> </tbody> </table>	S. No	Description	Unit	Technical Parameters	1.	<b><u>Rated Capacity at 420kV</u></b>	<b><u>MVar</u></b>	<b><u>125</u></b>	2.	<b><u>Rated Voltage (Ur) (1.0 pu)</u></b>	<b><u>kV</u></b>	<b><u>420</u></b>	3.	<b><u>Number of phases</u></b>		<b><u>3 (three)</u></b>
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Sl. No.	Existing Provision			New / Revised Provision				
	1.3	Cooling System		ONAN	4.	<b>Connection</b>		<b>Star</b>
	1.4	Permissible current unbalance among different phases	%	± 2	5.	<b>Cooling type</b>		<b>ONAN</b>
	1.5	Crest value of Third Harmonic content in phase current at rated voltage with sinusoidal wave form	%	≤ 3% of the crest value of fundamental	6.	<b>Frequency</b>	<b>Hz</b>	<b>50</b>
	1.6	Range of constant Impedance		Up to 1.5 p.u. voltage	7.	<b>Reference standard</b>		<b>IEC 60076-6</b>
	1.7	Tolerance on current	%	0 to +5%	8.	<b>Service</b>		<b>Outdoor</b>
	1.8	Ratio of zero sequence reactance to positive reactance (X0/X1)	Range	0.9 - 1.0	9.	<b>Permissible unbalance current among phases</b>	<b>%</b>	<b>±2%</b>
	1.9	Max. Temperature rise over 50 deg C Ambient Temp at rated voltage	Deg.C	Top oil: 40 & Winding: 45	10.	<b>Crest value of third harmonic content in phase current at rated voltage with sinusoidal wave form</b>	<b>%</b>	<b>≤ 3% of the crest value of fundamental</b>
	1.10	(a) Maximum Permissible load Losses at rated Voltage, Frequency and at 75° C (kW) for 420kV, 125 MVAR, 3-Phase Reactor	kW	160	11.	<b>Range of constant impedance</b>		<b>Up to 1.5 p.u voltage (However, complete saturation characteristics of the Reactors upto 2.5 p.u. Voltage shall be furnished)</b>
		(b) Maximum Permissible I2R Losses of Reactor at rated Voltage, Frequency and at 75° C	kW	90	12.	<b>Tolerance on current</b>	<b>%</b>	<b>0 to +5%</b>
	1.11	Windings			13.	<b>Ratio of zero sequence reactance to positive reactance (X0/X1)</b>		<b>Between 0.9 &amp; 1.0.</b>
	a)	Insulation level (LI/SI/PF)		kVp/ kVp/kVrms	14.	<b>Temperature rise over 50 °C Ambient Temp. at 420 kV</b>		
		HV		1300/1050/-	i)	<b>Top oil measured by thermometer</b>	<b>°C</b>	<b>40</b>
		Neutral		550/-/230	ii)	<b>Average winding measured by resistance method</b>	<b>°C</b>	<b>45</b>
	b)	Tan delta of windings	%	< 0.5				

Sl. No.	Existing Provision				New / Revised Provision			
	1.11	Partial discharge (PD) level at 1.58 Ur / $\sqrt{3}$	pC	< 100	15.	<u>Winding hot spot temperature rise over yearly weighted average temperature of 32 °C</u>	°C	<b>61</b>
	1.12	Vibration & Tank stress level at rated voltage and frequency		≤ 200 microns peak to peak; Average: ≤60 microns peak to peak.  Stress: ≤ 2.0kg/sq.mm at any point on tank.	16.	<u>Max. tank surface temperature</u>	°C	<b>110</b>
	1.13	Noise level at rated voltage and frequency	dB	< 80	17.	<u>Max design ambient temperature</u>	°C	<b>50</b>
	1.14	Bushings			18.	<u>Windings</u>		
	a)	Rated voltage : HV / Neutral	kV	420/145	i)	<u>Lightning Impulse withstand Voltage</u>		
	b)	Rated current (Min.) HV / Neutral	A	800/800		<u>Line end</u>	kV <sub>p</sub>	<b>1300</b>
	c)	Insulation level (LI/SI/PF)		kVp/ kVp / kVrms		<u>Neutral</u>	kV <sub>p</sub>	<b>550</b>
		HV		1425/1050/695	ii)	<u>Chopped Wave Lightning Impulse Withstand Voltage</u>		
		Neutral		650/-/305		<u>Line end</u>	kV <sub>p</sub>	<b>1430</b>
	d)	Tan delta of bushings: HV/ Neutral	%	< 0.5	iii)	<u>Switching Impulse withstand Voltage at Line end</u>	kV <sub>p</sub>	<b>1050</b>
	e)	PD of bushings at level Um	pC	<10	iv)	<u>One Minute Power Frequency withstand Voltage</u>		
	1.15	Insulating Oil		virgin high grade inhibited, conforming to IEC-60296		<u>Neutral</u>	kVrms	<b>230</b>
					19.	<u>Tan-delta of windings</u>		<b>&lt; 0.005</b>
					20.	<u>Neutral earthing</u>		<b>Solidly Earthed</b>
					21.	<u>Whether neutral brought out</u>		<b>Yes (through 145kV class bushing)</b>
					22.	<u>Bushing</u>		
	i)	<u>Rated voltage</u>				<u>Line bushing</u>	kV	<b>420</b>
						<u>Neutral bushing</u>	kV	<b>145</b>

Sl. No.	Existing Provision	New / Revised Provision			
		ii)	<b>Rated current</b>		
			<b>Line bushing</b>	<b>A</b>	<b>800</b>
			<b>Neutral bushing</b>	<b>A</b>	<b>800</b>
		iii)	<b>Lightning Impulse withstand Voltage</b>		
			<b>Line bushing</b>	<b>kV<sub>p</sub></b>	<b>1425</b>
			<b>Neutral bushing</b>	<b>kV<sub>p</sub></b>	<b>650</b>
		iv)	<b>Switching Impulse withstand Voltage of Line bushing</b>	<b>kV<sub>p</sub></b>	<b>1050</b>
		v)	<b>1minute power frequency withstand of bushings (dry)</b>		
			<b>Line bushing</b>	<b>kV rms</b>	<b>695</b>
			<b>Neutral bushing</b>	<b>kV rms</b>	<b>305</b>
		vi)	<b>Minimum creepage distance</b>		<b>(Specific Creepage Distance: of 25mm/kV corresponding to highest line to line voltage)</b>
			<b>Line bushing</b>	<b>mm</b>	<b>10500</b>
			<b>Neutral bushing</b>	<b>mm</b>	<b>3625</b>
		vii)	<b>Partial discharge of bushings at Ur (line end and neutral)</b>	<b>pC</b>	<b>≤ 10</b>
		23.	<b>Maximum partial discharge level at <math>1.58U_r/\sqrt{3}</math></b>	<b>pC</b>	<b>100</b>
		24.	<b>Vibration and tank stress at rated voltage</b>		<b>Max ≤200microns peak to peak</b>

Sl. No.	Existing Provision	New / Revised Provision			
	<p>.....</p> <p><b>Neutral Grounding Reactor (NGR) and Surge Arrester for 400kV Line Reactors <u>(as applicable)</u></b></p> <p><b><u>The neutral grounding reactors are required for grounding of the neutral point of shunt reactors to limit the secondary arc current and the recovery voltage to a minimum value. NGR shall be oil filled type suitable for outdoor application. Line and ground side of NGR shall be rated for 145kV and 36kV class of insulation respectively. NGR shall be rated for continuous current of 10A and short time current of 60A r.m.s for 10 seconds. It shall be solidly connected between neutral of shunt reactor and earth.</u></b></p>				<p><b><u>Average ≤ 60microns peak to peak</u></b></p> <p><b><u>Tank stress: ≤2.0kg/sq.mm at any point of tank</u></b></p>
25.			<b><u>Maximum noise pressure level at rated voltage &amp; frequency</u></b>	<b><u>dB</u></b>	<b><u>80</u></b>
26.			<b><u>Maximum Permissible Losses of Reactor at rated current and frequency and at 75°C</u></b>	<b><u>Total loss</u></b>	<b><u>I<sup>2</sup>R Loss</u></b>
i)			<b><u>125MVAr 420kV</u></b>	<b><u>kW</u></b>	<b><u>160</u></b> <b><u>90</u></b>
27.			<b><u>Insulating oil</u></b>		<b><u>Unused inhibited or uninhibited transformer oil conforming to IEC-60296:2012</u></b>
			<p>.....</p> <p><b>Neutral Grounding Reactor (NGR) and Surge Arrester for 400kV Line Reactors</b></p> <p><b><u>TSP shall provide NGR of suitable value (Ohm) as per actual line length. NGR shall be oil filled or dry type air core suitable for outdoor application. Line and ground side of NGR shall be rated for 145kV and 36kV class of insulation respectively. Oil filled NGR shall be rated for continuous current of 10A and short time current of 60A r.m.s for 10 seconds while air core NGR shall be rated for continuous current of 20A and short time current of 240A r.m.s for 1 minute. However, the air core NGR shall be designed for a short time current of 600 Amp r.m.s to ensure mechanical robustness.</u></b></p>		

Sl. No.	Existing Provision	New / Revised Provision
	<p><u>The surge arresters (rated voltage 120kV) shall be of heavy duty station class type. It shall be physically located between the neutral of shunt reactor (brought out at 145kV class bushing) and neutral grounding reactor. The surge arresters shall conform in general to IEC-60099-4. Surge arresters shall be of gapless type without any series or shunt gap. Arresters shall be hermetically sealed units, of self-supporting construction, suitable for mounting on structures.</u></p>	<p><u>The air core NGR shall be mounted on support structure (non-magnetic material) high above ground level (2.55 meter) to allow free and safe access at ground level for personnel.</u></p> <p><u>The surge arresters (rated voltage 120kV) shall be provided &amp; physically located between the neutral of shunt reactor (brought out at 145kV class bushing) and neutral grounding reactor. The surge arresters shall be of heavy duty station class gapless Metal oxide (ZnO) type conforming in general to IEC-60099-4. Arresters shall be hermetically sealed units, of self-supporting construction, suitable for mounting on structures.</u></p>
15.	<p><b>2.4 Circuit Breakers (AIS)</b></p> <p>The circuit breakers and accessories shall conform to IEC: 62271-100, IEC: 62271-1 and shall be of SF<sub>6</sub> Type. The rated break time shall not exceed 40 ms for 765kV &amp; 400kV circuit breakers and 60 ms for 220kV circuit breakers. 765kV, 400kV and 220kV Circuit breakers shall be provided with single phase and three phase auto reclosing. The Circuit breakers controlling 765kV lines shall be provided with pre insertion closing resistor of about 450 ohms maximum with 9 ms minimum insertion time or Controlled Switching Device. The Circuit breakers controlling 400kV lines of more than 200km length shall be provided with pre insertion closing resistor of about 400 ohms maximum with 8 ms minimum insertion time or Controlled Switching Device. 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 bay and in Main &amp; Tie bay circuit breakers of line with non-switchable line reactors, Bus reactors and 765/400kV Transformers <b>(wherever applicable).</b></p>	<p><b>2.4 Circuit Breakers (AIS)</b></p> <p>The circuit breakers and accessories shall conform to IEC: 62271-100, IEC: 62271-1 and shall be of SF<sub>6</sub> Type. <b><u>The circuit breakers shall be of class C2-M2 (as per IEC) with regard to restrike probability during capacitive current breaking and mechanical endurance.</u></b> The rated break time shall not exceed 40 ms for 765kV &amp; 400kV circuit breakers and 60 ms for 220kV circuit breakers. 765kV, 400kV and 220kV Circuit breakers shall be provided with single phase and three phase auto reclosing. The Circuit breakers controlling 765kV lines shall be provided with pre insertion closing resistor of about 450 ohms maximum with 9 ms minimum insertion time or Controlled Switching Device. The Circuit breakers controlling 400kV lines of more than 200km length shall be provided with pre insertion closing resistor of about 400 ohms maximum with 8 ms minimum insertion time or Controlled Switching Device. 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 bay and in Main &amp; Tie bay circuit breakers of line</p>

Sl. No.	Existing Provision	New / Revised Provision
		with non-switchable line reactors, Bus reactors and 765/400 kV transformers.
16.	<p><b>2.5 Isolators (AIS)</b></p> <p>The isolators shall comply to IEC 62271-102 in general. 765kV Isolator design shall be double break or vertical break or knee-type. 400 kV and 220kV Isolators shall be double break type. All Isolators and earth switches shall be motor operated. Earth switches shall be provided at various locations to facilitate maintenance. Isolator rated for 765kV, 400kV and 220kV shall be of extended mechanical endurance class-M2 and <b>all earth switches shall be class M0</b> as per IEC-62271-102. Main blades and earth blades shall be interlocked and interlock shall be fail safe type. 765kV, 400kV and 220kV earth switch for line isolator shall be suitable for induced current switching duty as defined for Class-B.</p>	<p><b>2.5 Isolators (AIS)</b></p> <p>The isolators shall comply to IEC 62271-102 in general. 765kV Isolator design shall be double break or vertical break or knee-type. 400 kV and 220kV Isolators shall be double break type. All Isolators and earth switches shall be motor operated. Earth switches shall be provided at various locations to facilitate maintenance. Isolator rated for 765kV, 400kV and 220kV shall be of extended mechanical endurance class-M2 and <b>suitable for bus transfer current switching duty</b> as per IEC-62271-102. Main blades and earth blades shall be interlocked and interlock shall be fail safe type. 765kV, 400kV and 220kV earth switch for line isolator shall be suitable for induced current switching duty as defined for Class-B.</p>
17.	<p><b>2.6 Current Transformers (AIS)</b></p> <p>Current Transformers shall comply with IEC 61869 in general. All ratios shall be obtained by secondary taps only. Generally, Current Transformers (CT) for 765kV &amp; 400kV shall have six cores (four for protection and two for metering). 220kV Current Transformers shall have five cores (four for protection and one for metering). 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. The rated burden of cores shall be closer to the maximum burden requirement of metering &amp; protection system for better sensitivity and accuracy.</p>	<p><b>2.6 Current Transformers (AIS)</b></p> <p>Current Transformers shall comply with IEC 61869 in general. All ratios shall be obtained by secondary taps only. Generally, Current Transformers (CT) for 765kV &amp; 400kV shall have six cores (four for protection and two for metering). 220kV Current Transformers shall have five cores (four for protection and one for metering). 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. The rated burden of cores shall be closer to the maximum burden requirement of metering &amp; protection system <b>(not more than 20VA for metering core)</b> for better sensitivity and accuracy. <b>The instrument security factor shall be less than 5 for CTs upto 400 kV voltage class and less than 10 for CTs of 765 kV voltage class.</b></p>
18.	<b>2.7 Capacitor Voltage Transformers (AIS)</b>	<b>2.7 Capacitor Voltage Transformers (AIS)</b>

Sl. No.	Existing Provision	New / Revised Provision
	<p>Capacitive Voltage transformers shall comply to IEC 61869 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 it shall be 0.2. The Capacitive voltage transformers on lines shall be suitable for Carrier Coupling. The Capacitance of CVT for 765kV shall be 8800 pF. The Capacitance of CVT for 400kV and 220kV shall be of 4400/8800 pF depending on PLCC requirements. The rated burden of cores shall be closer to the maximum burden requirement of metering &amp; protection system for better sensitivity and accuracy.</p>	<p>Capacitive Voltage transformers shall comply to IEC 61869 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 it shall be 0.2. The Capacitive voltage transformers on lines shall be suitable for Carrier Coupling. The Capacitance of CVT for 765kV shall be 8800 pF. The Capacitance of CVT for 400kV and 220kV shall be of 4400/8800 pF depending on PLCC requirements. The rated burden of cores shall be closer to the maximum burden requirement of metering &amp; protection system <b><u>(not more than 50VA for metering core)</u></b> for better sensitivity and accuracy.</p>
19.	<p><b>2.8 Surge Arresters (AIS)</b></p> <p>624kV, 336kV &amp; 216kV Station class, <b><u>current limiting</u></b>, heavy duty gapless type Surge arresters conforming to IEC 60099-4 in general shall be provided for 800kV, 420kV &amp; 245kV systems respectively. 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 &amp; Reactor so as to achieve proper insulation coordination. Surge Arresters shall be provided with porcelain/ polymer housing fitted with pressure relief devices. A leakage current monitor with surge counter shall be provided with each surge arrester</p>	<p><b>2.8 Surge Arresters (AIS)</b></p> <p>624kV, 336kV &amp; 216kV Station class, heavy duty gapless type Surge arresters conforming to IEC 60099-4 in general shall be provided for 800kV, 420kV &amp; 245kV systems respectively. 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 &amp; Reactor so as to achieve proper insulation coordination. Surge Arresters shall be provided with porcelain/ polymer housing fitted with pressure relief devices. A leakage current monitor with surge counter shall be provided with each surge arrester.</p>
20.	<p><b>2.9 Protection Relaying &amp; Control System</b></p> <p>The protective relaying system proposed to be provided for transmission lines, auto-transformers, reactors and bus bars to minimize the damage to the equipment 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.</p>	<p><b>2.9 Protection Relaying &amp; Control System</b></p> <p>The protective relaying system proposed to be provided for transmission lines, auto-transformers, reactors and bus bars to minimize the damage to the equipment 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.</p> <p><b><u>The protection circuits and relays of transformer and reactor shall be electrically and physically segregated into two groups each being independent and capable of providing uninterrupted protection even in the event of one of the protection groups failing.</u></b></p>

Sl. No.	Existing Provision	New / Revised Provision
	<p>.....</p> <p><b>a) Transmission Lines Protection</b>  765kV, 400kV and 220kV lines shall have Main-I numerical three zone distance protection scheme with carrier aided inter-tripping feature. 765kV, 400kV and 220kV lines shall also have Main-II numerical distance protection scheme like Main-I but from different make that of Main-I. The Main-I and Main-II protection relays of same make may be provided only if they are of different hardware <b>&amp; manufacturing platform.</b></p> <p>Line Current Differential relay (with back up distance protection feature) as Main-I and Main-II shall be considered at both ends for short lines (line length below 30kM) having Fibre Optic communication link. Differential relay at remote end shall be provided by the TSP. Associated power &amp; control cabling and integration with SAS at remote end shall be provided by respective bay owner.</p> <p>....</p> <p><b>b) Auto Transformer Protection</b></p> <p>.....</p> <p>Suitable monitoring, control (operation of associated circuit breaker &amp; isolator) and protection for LT auxiliary transformer connected to tertiary winding of auto-transformer for the purpose of auxiliary supply shall be provided. The Over current <b>and open delta protection is required</b> to be provided for the auxiliary transformer. These protection and control may be provided as built in feature either in the bay controller to be provided for</p>	<p><b><u>to obtain redundancy, and to take protection systems out for maintenance while the equipment remains in service.</u></b></p> <p>.....</p> <p><b>a) Transmission Lines Protection</b>  765 kV, 400kV and 220kV lines shall have Main-I numerical three zone distance protection scheme with carrier aided inter-tripping feature. 765 kV, 400kV and 220kV lines shall also have Main-II numerical distance protection scheme like Main-I but from different make that of Main-I. The Main-I and Main-II protection relays of same make may be provided only if they are of different hardware, <b>manufacturing platform or different principle of operation.</b></p> <p><b>However,</b> Line Current Differential relay (with back up distance protection feature) as Main-I and Main-II shall be considered at both ends for short lines (line length below 30kM) having Fibre Optic communication link. Differential relay at remote end shall be provided by the TSP. Associated power &amp; control cabling and integration with SAS at remote end shall be provided by respective bay owner.</p> <p>....</p> <p><b>b) Auto Transformer Protection</b></p> <p>.....</p> <p>Suitable monitoring, control (operation of associated circuit breaker &amp; isolator) and protection for LT auxiliary transformer connected to tertiary winding of auto-transformer for the purpose of auxiliary supply shall be provided. The Over current <b>and other necessary protection shall be provided</b> for the auxiliary transformer. These protection and control may be provided as built in feature either in the bay controller to</p>

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	<p>the auxiliary system or in the control &amp; protection IEDs to be provided for autotransformer.</p> <p>....</p>	<p>be provided for the auxiliary system or in the control &amp; protection IEDs to be provided for autotransformer.</p> <p>.....</p>
21.	<p><b>2.10 Substation Automation System</b></p> <p>a) For 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 220kV and above. All bay control units as well as protection units are normally connected through an Optical 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.</p> <p>The functions of control, annunciation, disturbance recording, event logging and measurement of electrical parameters shall be integrated in Substation Automation System.</p> <p><b><u>The Automation System shall be provided with the facility of communication and control for remote end operation so that by providing remote HMI and suitable communication link, the substation can be controlled from a remote location. Mode of communication shall be considered as optical fibre or leased line based on IEC-60870-5-104 communication protocol.</u></b></p> <p>.....</p>	<p><b>2.10 Substation Automation System</b></p> <p>a) For 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 220kV and above. All bay control units as well as protection units are normally connected through an Optical 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.</p> <p>The functions of control, annunciation, disturbance recording, event logging and measurement of electrical parameters shall be integrated in Substation Automation System.</p> <p>.....</p>
22.	<p>3.1 i) .....</p> <p>Additionally, Active Energy Meters may be provided at the same point in the 33kV tertiary of Transformer by local SEB/DISCOM for energy</p>	<p>3.1 i) .....</p>

Sl. No.	Existing Provision	New / Revised Provision
	<p>.....</p> <p>iii) Suitable AC &amp; DC distribution boards and associated LT Switchgear shall be provided at new substation. <b><u>For new substation, following switch boards with minimum rating as specified here under shall be considered with duplicate supply:</u></b></p> <p>(a) 415V Main Switch board – <b><u>2 nos. (two sections separated by one bus coupler)</u></b></p> <p>(b) AC distribution board – <b><u>2 nos. (two sections separated by one bus coupler)</u></b></p> <p>(c) Main lighting distribution board – 1 no.</p> <p>(d) Emergency lighting distribution board – 1 no.</p> <p>(e) 220 Volt DC distribution board – 2 nos.</p> <p>(f) 48 Volt DC distribution board – 2 nos.</p> <p><b><u>Sizing of LT Switchgear shall be suitable to cater the requirement for all present and future bays. AC &amp; DC distribution boards shall have modules for all the feeders (including future as specified).</u></b></p>	<p>Additionally, Active Energy Meters may be provided at the same point in the 33kV tertiary of Transformer by local SEB/DISCOM for energy accounting</p> <p>.....</p> <p>iii) Suitable AC &amp; DC distribution boards and associated LT Switchgear shall be provided at new substation. <b><u>Sizing of LT Switchgear shall be suitable to cater the requirement for all present and future bays. AC &amp; DC distribution boards shall have modules for all the present and future feeders as specified.</u></b></p> <p><b><u>For new substation, following switch boards shall be considered with duplicate supply with bus coupler/ sectionalizer and duplicate outgoing feeders except for Emergency lighting distribution board which shall have only one incoming feeder:</u></b></p> <p>(a) 415V Main Switch board – <b><u>1 nos.</u></b></p> <p>(b) AC distribution board – <b><u>1 nos.</u></b></p> <p>(c) Main lighting distribution board – 1 no.</p> <p>(d) Emergency lighting distribution board – 1 no.</p> <p>(e) 220 Volt DC distribution board – 2 nos.</p> <p>(f) 48 Volt DC distribution board – 2 nos.</p>
23.	<p><b>3.2 Fire Fighting System</b></p> <p>Fire-fighting system for substation including Transformer &amp; Reactor shall conform to CEA (Measures Relating to Safety &amp; Electric Supply) Regulations.</p>	<p><b>3.2 Fire Fighting System</b></p> <p>Fire-fighting system for substation including Transformer &amp; Reactor shall conform to CEA (Measures Relating to Safety &amp; Electric Supply) Regulations.</p>

Sl. No.	Existing Provision	New / Revised Provision
	<p>Further, adequate water hydrants and portable fire extinguishers shall be provided in the substations. The main header of firefighting system shall be suitable for extension to bays covered under the future scope; necessary piping interface in this regard shall be provided.</p> <p><b><u>Beam type heat detection for GIS hall fire protection system shall be provided for all the GIS halls.</u></b></p> <p>At existing substations, the fire-fighting systems as available shall be extended to meet the additional requirements.</p>	<p>Further, adequate water hydrants and portable fire extinguishers shall be provided in the substations. The main header of firefighting system shall be suitable for extension to bays covered under the future scope; necessary piping interface in this regard shall be provided.</p> <p>At existing substations, the fire-fighting systems as available shall be extended to meet the additional requirements.</p>
24.	<p><b>3.7 Visual monitoring system for watch and ward of substation premises:</b></p> <p><b><u>Visual monitoring system for effective watch and ward of substation premises covering the areas of entire switchyard. Control room building, other buildings/stores and main gate, shall be provided. The Visual Monitoring System shall have provision of WAN connectivity for remote monitoring.</u></b></p> <p><b><u>The number of cameras and their locations shall be decided in such a way that any location covered in the substation area can be scanned. The cameras shall be located in such a way to monitor at least:</u></b></p> <ol style="list-style-type: none"> <li>1. <b><u>The operation of each and every isolator pole of the complete yard in case of AIS Sub-station.</u></b></li> <li>2. <b><u>The Operation of each bay bays of GIS Hall as applicable.</u></b></li> <li>3. <b><u>All the Transformer and Reactors, all the Entrance doors of Control Room Building, GIS hall and any other building as applicable.</u></b></li> </ol>	<p><b>3.7 Visual monitoring system for watch and ward of substation premises:</b></p> <p><b><u>Visual monitoring system for effective watch and ward of substation premises shall cover all the transformers and reactors, all other major AIS Equipment (such as CB, isolators, CT, CVT, SA etc. as applicable), GIS bays, panel room, all the gates of switchyard and all entry and exit points of control room building and accordingly the location of cameras shall be decided. The camera shall be high definition color CCD camera with night vision feature. The VMS data partly/completely shall be recorded (minimum for 15 days) at least @25fps (or better) and stored on network video recorder. The system shall use video signals from various cameras installed at different locations, process them for viewing on workstations/monitors in the control room and simultaneously record all the cameras. Mouse/keyboard controllers shall be used for pan, tilt, zoom and other functions of the desired camera. The Visual Monitoring System shall have provision of WAN connectivity for remote monitoring.</u></b></p>

Sl. No.	Existing Provision	New / Revised Provision
	<p>4. <u>All the gates of switchyard.</u></p> <p>5. <u>Main entrance Gate</u></p> <p>6. <u>All other major AIS Equipment (such as CB, CT, CVT, SA etc. as applicable)</u></p> <p><u>At existing substations, the visual monitoring system as available shall be augmented as required.</u></p>	<p><u>All camera recordings shall have Camera ID &amp; location/area of recording as well as date/time stamp. The equipment should generally conform to Electromagnetic compatibility requirement for outdoor equipment in EHV substation.</u></p> <p><u>At existing substations, the visual monitoring system if available shall be augmented as per existing or better specification as required.</u></p>
25.	4.0 e) In 765 & 400kV switchyard, if spare bay of half diameter is identified as future, all the equipment for Tie & Future bay shall be designed considering the current rating of line bay i.e. <b>3000A</b> .	4.0 e) In 765 & 400kV switchyard, if spare bay of half diameter is identified as future, all the equipment for Tie & Future bay shall be designed considering the current rating of line bay i.e. <b>3150A</b> .
26.	<p><b>PLCC &amp; PBAX:</b> Power line carrier communication (PLCC) equipment complete for speech, teleprotection commands and data channels shall be provided on each transmission line. The protections for transmission line and the line compensating equipment shall have hundred percent back up communication channels i.e. two channels for tele- protection in addition to one channel for speech plus data for each direction. The PLCC equipment shall in brief include the following:-</p> <p>Coupling device, line traps, carrier terminals, protection couplers, HF cables, PABX (if applicable) and maintenance and testing instruments.</p> <p>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 centers (RLDC/SLDC) etc.</p> <p>Coupling devices shall be suitable for phase to phase coupling for 765kV &amp; 400kV Transmission lines. The pass band of coupling devices shall have sufficient margin for adding communication channel in future if required. Necessary protection devices for safety of personnel and low voltage part</p>	<b>Deleted.</b>

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	<p>against power frequency voltages and transient over voltage shall also be provided.</p> <p>The line traps shall be broad band tuned suitable for blocking the complete range of carrier frequencies. Line Trap shall have necessary protective devices such as lightning arresters for the protection of tuning device. Decoupling network consisting of line traps and coupling capacitors may also be required at certain substation in case of extreme frequency congestion.</p> <p>The carrier terminals shall be of single side-band (SSB) amplitude modulation (AM) type and shall have 4 kHz band width. PLCC Carrier terminals and Protection couplers shall be considered for both ends of the line.</p> <p>PLCC equipment for all the transmission lines covered under the scheme (consisting of one set of analog PLCC channel along with circuit protection coupler and one set of Digital protection coupler for both ends) shall be provided by TSP. Further, PLCC equipment for both ends of transmission lines not covered under present scope shall be provided by developer of lines. However, CVT &amp; Wave trap for all the line bays under present scope shall be provided by TSP.</p> <p>TSP shall provide/undertake necessary addition/modification/shifting/re-commissioning etc. of PLCC equipment due to LILO of transmission lines (wherever applicable).</p> <p>All other associated equipment like cabling, coupling device and HF cable shall also be provided by the TSP. The wave trap and CVT required for PLCC at remote end shall be provided by respective bay owner.</p>	
<b><u>SPECIFIC TECHNICAL REQUIRMENTS FOR COMMUNICATION</u></b>		
27.	<p><b>Bhadla-II PS – Sikar-II 765kV D/c line</b></p> <p>On Bhadla-II PS – Sikar-II 765kV D/c line one OPGW containing 24 Fibres is to be installed by the TSP in place of conventional earth wire during the</p>	<p><b>Bhadla-II PS – Sikar-II 765kV D/c line</b></p> <p><b><u>OPGW:</u></b></p>

Sl. No.	Existing Provision	New / Revised Provision
	<p>construction of line. The installation of OPGW shall be done from gantry of Bhadla – II PS up to gantry of Sikar – II and shall be terminated in a Joint Box to be provided by TSP at both the ends. In case of requirement of repeater to establish link between Bhadla-II PS – Sikar-II, the OPGW (48F) connectivity from power line crossing point upto repeater station shall also be in the scope of TSP.</p>	<p>On Bhadla-II PS – Sikar-II 765kV D/c line <b><u>under present scope</u></b> one OPGW containing 24 Fibres is to be installed by the TSP in place of conventional earth wire during the construction of line. The installation of OPGW shall be done from gantry of Bhadla – II PS up to gantry of Sikar – II and shall be terminated in a Joint Box to be provided by TSP at both the ends. In case of requirement of repeater to establish link between Bhadla-II PS – Sikar-II, the OPGW (48F) connectivity from power line crossing point upto repeater station shall also be in the scope of TSP.</p> <p><b><u>The protection system for 400kV and higher voltage transmission line and the line compensating equipment shall have one hundred percent back up communication channels i.e. two channels for tele-protection in addition to one channel for speech plus data for each direction.</u></b></p>
28.	<p><b>Sikar-II – Neemrana 400kV D/c line</b></p> <p>Sikar-II – Neemrana 400kV D/c line one OPGW containing 24 Fibres is to be installed by the TSP in place of conventional earth wire during the construction of line. The installation of OPGW shall be done from gantry of Sikar – II up to gantry of Neemrana and shall be terminated in a Joint Box to be provided by TSP at both the ends. In case of requirement of repeater to establish link between Sikar-II – Neemrana , the OPGW (48F) connectivity from power line crossing point upto repeater station shall also be in the scope of TSP.</p>	<p><b>Sikar-II – Neemrana 400kV D/c line</b></p> <p><b><u>OPGW:</u></b></p> <p><b><u>On</u></b> Sikar-II – Neemrana 400kV D/c line <b><u>under present scope</u></b> one OPGW containing 24 Fibres is to be installed by the TSP in place of conventional earth wire during the construction of line. The installation of OPGW shall be done from gantry of Sikar – II up to gantry of Neemrana and shall be terminated in a Joint Box to be provided by TSP at both the ends. In case of requirement of repeater to establish link between Sikar-II – Neemrana , the OPGW (48F) connectivity from power line crossing point upto repeater station shall also be in the scope of TSP.</p> <p><b><u>The protection system for 400kV and higher voltage transmission line and the line compensating equipment shall have one hundred percent back up communication channels i.e. two channels for tele-protection in addition to one channel for speech plus data for each direction.</u></b></p>
29.	New Point to be inserted	<b><u>PLCC &amp; PBAX:</u></b>

Sl. No.	Existing Provision	New / Revised Provision
		<p><b><u>Power line carrier communication (PLCC) equipment complete for speech, tele-protection commands and data channels shall be provided on each transmission line. The protections for transmission line and the line compensating equipment shall have hundred percent back up communication channels i.e. two channels for tele- protection in addition to one channel for speech plus data for each direction. The PLCC equipment shall in brief include the following:-</u></b></p> <ul style="list-style-type: none"> <li>• <b><u>Coupling device, line traps, carrier terminals, protection couplers, HF cables, PABX (if applicable) and maintenance and testing instruments.</u></b></li> <li>• <b><u>At new substation, a telephone exchange (PABX) of 24 lines shall be provided at as means of effective communication among various buildings of the substation, remote end substations and with control centres (RLDC/SLDC) etc.</u></b></li> <li>• <b><u>Coupling devices shall be suitable for phase to phase coupling for 765kV &amp; 400kV Transmission lines. The pass band of coupling devices shall have sufficient margin for adding communication channel in future if required. Necessary protection devices for safety of personnel and low voltage part against power frequency voltages and transient over voltage shall also be provided.</u></b></li> <li>• <b><u>The line traps shall be broad band tuned suitable for blocking the complete range of carrier frequencies. Line Trap shall have necessary protective devices such as lightning arresters for the protection of tuning device. Decoupling network consisting of line traps and coupling capacitors may also be required at certain substation in case of extreme frequency congestion.</u></b></li> </ul>

Sl. No.	Existing Provision	New / Revised Provision
		<ul style="list-style-type: none"> <li>• <u>The carrier terminals shall be of single side-band (SSB) amplitude modulation (AM) type and shall have 4 kHz band width. PLCC Carrier terminals and Protection couplers shall be considered for both ends of the line.</u></li> <li>• <u>PLCC equipment for all the transmission lines covered under the scheme (consisting of one set of analog PLCC channel along with circuit protection coupler and one set of Digital protection coupler for both ends) shall be provided by TSP. CVT &amp; Wave trap for all the line bays under present scope shall be provided by TSP.</u></li> <li>• <u>TSP shall provide/undertake necessary addition/modification/shifting/re-commissioning etc. of PLCC equipment due to LILO of transmission lines (wherever applicable).</u></li> <li>• <u>All other associated equipment like cabling, coupling device and HF cable shall also be provided by the TSP.</u></li> </ul>