

**Amendment – III dated 01.06.2020 on the Request for Proposal and Transmission Service Agreement issued for selection of bidder as Transmission Service Provider to establish “Transmission Scheme for Solar Energy Zone in Gadag (2500 MW), Karnataka – Part A” through tariff based competitive bidding process**

Sl. No.	Existing Provisions	New / Revised Provisions																				
<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 GradeC 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  The relevant conductor configuration shall be as follows:- i) Type of <b><u>HTLS</u></b> conductor: <b><u>INVAR/ GAP/ Composite core/ ACSS</u></b> ii) Basic parameters: <table border="1"> <thead> <tr> <th>Transmission Line</th> <th>Ampacity of HTLS Conductor</th> <th>Minimum Conductor diameter (mm)</th> <th>Maximum DC Resistance at 20°C (Ω/km)</th> <th>Sub-conductor Spacing (mm)</th> </tr> </thead> <tbody> <tr> <td><b><u>400kV (Twin HTLS) transmission line</u></b></td> <td>1596 A</td> <td>28.62</td> <td>0.05552</td> <td>450 mm</td> </tr> </tbody> </table> <p><b><u>Note: The transmission lines shall have to be designed for a maximum operating conductor temperature of 85 deg C for ACSR as well as AAAC and AL59.</u></b></p>	Transmission Line	Ampacity of HTLS Conductor	Minimum Conductor diameter (mm)	Maximum DC Resistance at 20°C (Ω/km)	Sub-conductor Spacing (mm)	<b><u>400kV (Twin HTLS) transmission line</u></b>	1596 A	28.62	0.05552	450 mm	6.0  The relevant conductor configuration shall be as follows:- i) Type of conductor: <b><u>HTLS</u></b> ii) Basic parameters: <table border="1"> <thead> <tr> <th>Transmission Line</th> <th>Ampacity of HTLS Conductor <b><u>(for ambient temperature of 45°C)</u></b></th> <th>Minimum Conductor diameter (mm)</th> <th>Maximum DC Resistance at 20°C (Ω/km)</th> <th>Sub-conductor Spacing (mm)</th> </tr> </thead> <tbody> <tr> <td><b><u>400kV transmission line with Twin HTLS conductor</u></b></td> <td>1596 A</td> <td>28.62</td> <td>0.05552</td> <td><b><u>450</u></b></td> </tr> </tbody> </table>	Transmission Line	Ampacity of HTLS Conductor <b><u>(for ambient temperature of 45°C)</u></b>	Minimum Conductor diameter (mm)	Maximum DC Resistance at 20°C (Ω/km)	Sub-conductor Spacing (mm)	<b><u>400kV transmission line with Twin HTLS conductor</u></b>	1596 A	28.62	0.05552	<b><u>450</u></b>
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3.	<p>8.0</p> <p>All electrical clearances including minimum live metal clearance, ground clearance and minimum mid span separation between earth wire and conductor shall be as per Central Electricity Authority (Measures Relating to Safety &amp; Electric Supply) Regulations as amended from time to time and IS:5613.</p>	<p>8.0</p> <p>All electrical clearances including minimum live metal clearance, ground clearance and minimum mid span separation between earth wire and conductor shall be as per Central Electricity Authority (Measures Relating to Safety &amp; Electric Supply) Regulations as amended from time to time and IS:5613.</p> <p><b><u>The minimum live metal clearances for 400 kV D/c transmission lines shall be considered as follows:</u></b></p> <p><b><u>(i) Under stationary conditions</u></b>  <b><u>From tower body: 3.05m</u></b></p> <p><b><u>(ii) Under Swing conditions</u></b></p> <table border="1" data-bbox="1203 776 2013 899"> <thead> <tr> <th data-bbox="1203 776 1581 816"><b><u>Wind Pressure Condition</u></b></th> <th data-bbox="1581 776 2013 816"><b><u>Minimum Electrical Clearance</u></b></th> </tr> </thead> <tbody> <tr> <td data-bbox="1203 816 1581 857"><b><u>a) Swing angle (22°)</u></b></td> <td data-bbox="1581 816 2013 857"><b><u>3.05 mtrs</u></b></td> </tr> <tr> <td data-bbox="1203 857 1581 899"><b><u>b) Swing angle (44°)</u></b></td> <td data-bbox="1581 857 2013 899"><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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<b><u>b) Swing angle (44°)</u></b>	<b><u>1.86 mtrs</u></b>							
4.	<p><b><u>5.0</u></b></p> <p>The Fault current for design of line shall be 63 kA for 1 sec for 400 kV.</p>	<p><b><u>10.0</u></b></p> <p>The Fault current for design of line shall be 63 kA for 1 sec for 400 kV.</p>						
5.	<p>12.0</p> <p>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.</p>	<p>12.0</p> <p>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></p>						
6.	<p>New point to be inserted</p>	<p><b><u>13.0</u></b></p> <p><b><u>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.</u></b></p>						

Sl. No.	Existing Provisions	New / Revised Provisions
7.	New point to be inserted	<b>14.0</b> <u>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.</u>

**SPECIFIC TECHNICAL REQUIREMENTS FOR SUBSTATION**

8.	<p>General</p> <p><u>The proposed new substation shall be conventional AIS type generally conforming to the requirement of CEA regulation for construction of substation.</u></p> <p><u>The proposed augmentation at Narendra (New) GIS S/s shall be GIS type generally conforming to the requirement of CEA regulation for construction of substation.</u></p> <p><u>The proposed augmentation at Koppal PS shall be AIS type generally conforming to the requirement of CEA regulation for construction of substation.</u></p>	<p>General</p> <p><u>The proposed new substation at Gadag PS, proposed augmentation at Koppal PS shall be conventional AIS type and proposed augmentation at Narendra (New) S/s shall be GIS type generally conforming to the requirement of CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2010, as amended from time to time.</u></p>
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9.	<p><b>1.1 Insulation Coordination</b></p> <p>The system design parameters for substations/switchyards shall be as given below:</p> <table border="1"> <thead> <tr> <th>S. No.</th> <th>Description of parameters</th> <th colspan="2"><u>400/220kV Gadag PS</u></th> <th><u>400kV Narendra (New) GIS S/S Extn.</u></th> <th><u>400/220 kV Koppal PS Extn.</u></th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td>400 kV System</td> <td>220 kV System</td> <td>400 kV System</td> <td>400 kV System</td> </tr> <tr> <td>1.</td> <td>System operating</td> <td><u>400kV</u></td> <td><u>220kV</u></td> <td><u>400kV</u></td> <td><u>400kV</u></td> </tr> </tbody> </table>	S. No.	Description of parameters	<u>400/220kV Gadag PS</u>		<u>400kV Narendra (New) GIS S/S Extn.</u>	<u>400/220 kV Koppal PS Extn.</u>			400 kV System	220 kV System	400 kV System	400 kV System	1.	System operating	<u>400kV</u>	<u>220kV</u>	<u>400kV</u>	<u>400kV</u>	<p><b>1.1 Insulation Coordination</b></p> <p>The system design parameters for substations/switchyards shall be as given below:</p> <table border="1"> <thead> <tr> <th>Sl No</th> <th>Description of parameters</th> <th colspan="2"><u>400/220kV Gadag PS AIS (New)</u></th> <th><u>400 kV Narendra (New) Existing GIS S/S Extn.</u></th> <th><u>400/220kV Koppal (Existing AIS) Augmentation</u></th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td>400 kV System</td> <td>220 kV System</td> <td>400 kV System</td> <td>400 kV System</td> </tr> <tr> <td>1.</td> <td>System</td> <td><u>400kV</u></td> <td><u>220kV</u></td> <td><u>400kV</u></td> <td><u>400kV</u></td> </tr> </tbody> </table>	Sl No	Description of parameters	<u>400/220kV Gadag PS AIS (New)</u>		<u>400 kV Narendra (New) Existing GIS S/S Extn.</u>	<u>400/220kV Koppal (Existing AIS) Augmentation</u>			400 kV System	220 kV System	400 kV System	400 kV System	1.	System	<u>400kV</u>	<u>220kV</u>	<u>400kV</u>	<u>400kV</u>
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		voltage						operating voltage					
	2.	Maximum voltage of the system (rms)	<u>420kV</u>	<u>245kV</u>	<u>420kV</u>	<u>420kV</u>		2.	Maximum voltage of the system (rms)	<u>420kV</u>	<u>245kV</u>	<u>420kV</u>	<u>420kV</u>
	3.	Rated frequency	<u>50Hz</u>	<u>50Hz</u>	<u>50Hz</u>	<u>50Hz</u>		3.	Rated frequency	<u>50Hz</u>	<u>50Hz</u>	<u>50Hz</u>	<u>50Hz</u>
	4.	No. of phase	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>		4.	No. of phase	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>
	5.	Rated Insulation levels						5.	Rated Insulation levels				
	i)	Impulse withstand voltage for (1.2/50 micro sec.) - Transformer and Reactors - for Other Equipment - for Insulator String	<u>1300kVp</u> <u>1425kVp</u> <u>1550kVp</u>	<u>950 kVp</u> <u>1050kVp</u> <u>1050kVp</u>	= <u>1425kVp</u> <u>1550kVp</u>	= <u>1300kVp</u> <u>1425kVp</u> <u>1550kVp</u>		i)	Impulse withstand voltage for (1.2/50 micro sec.) -Transformer and Reactors - for Other Equipment - for Insulator String	<u>1300kVp</u> <u>1425kVp</u> <u>1550kVp</u>	<u>950 kVp</u> <u>1050kVp</u> <u>1050kVp</u>	= <u>1425kVp</u> <u>1550kVp</u>	= <u>1425kVp</u> <u>1550kVp</u>
	ii)	Switching impulse withstand voltage (250/2500 micro sec.) dry and wet	<u>1050kVp</u>	=	<u>1050kVp</u>	<u>1050kVp</u>		ii)	Switching impulse withstand voltage (250/2500 micro sec.) dry and wet	<u>1050kVp</u>	=	<u>1050kVp</u>	<u>1050kVp</u>
	iii)	One minute power frequency dry withstand voltage (rms)	<u>630kV</u>	=	<u>630kV</u>	<u>630kV</u>							
	iv)	One minute	=	<u>460kV</u>	=	=							

Sl. No.	Existing Provisions					New / Revised Provisions				
	) power frequency dry and wet withstand voltage (rms)					iii) One minute power frequency dry withstand voltage (rms)	<u>630kV</u>	=	<u>630kV</u>	<u>630kV</u>
6.	Corona extinction voltage	<u>320kV</u>	=	<u>320kV</u>	<u>320kV</u>	iv) One minute power frequency dry and wet withstand voltage (rms)	=	<u>460kV</u>	=	=
7.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz	<u>1000 micro-volts at 266kV rms</u>	<u>1000 micro-volts at 156kV rms</u>	<u>1000 micro volts at 266kV rms</u>	<u>1000 micro-volts at 266kV rms</u>	6.	<u>320kV</u>	=	<u>320kV</u>	<u>320kV</u>
8.	Minimum creepage distance for insulator string/ longrod insulators/ outdoor bushings	<u>13020 mm (31mm/kV)</u>	<u>7595 mm (31mm/kV)</u>	<u>13020 mm (31mm/kV)</u>	<u>13020 mm (31mm/kV)</u>	7.	<u>1000 micro-volts at 266kV rms</u>	<u>1000 micro-volts at 156kV rms</u>	<u>1000 micro-volts at 266kV rms</u>	<u>1000 micro-volts at 266kV rms</u>
9.	Minimum creepage distance for switchyard equipment	<u>10500m m (25mm/kV)</u>	<u>6125 mm (25mm/kV)</u>	<u>10500mm (25mm/kV)</u>	<u>10500m m (25mm/kV)</u>	8.	<u>13020 mm (31mm/kV)</u>	<u>7595 mm (31mm/kV)</u>	<u>13020 mm (31mm/kV)</u>	<u>13020 mm (31mm/kV)</u>
10.	Max. fault current	<u>63kA</u>	<u>50kA</u>	<u>50kA</u>	<u>63kA</u>					
11.	Duration of fault	<u>1 Sec</u>	<u>1 Sec</u>	<u>1 Sec</u>	<u>1 sec</u>					

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10.	<p><b>1.2 Switching Scheme</b></p> <p>The switching schemes, as mentioned below, shall be adopted at various voltage levels of substation/switchyard:</p> <table border="1" data-bbox="191 721 1062 1110"> <thead> <tr> <th>Substation</th> <th>400kV side</th> <th>220kV side</th> </tr> </thead> <tbody> <tr> <td>400/220kV Gadag PS</td> <td>One &amp; half breaker (AIS)</td> <td>Double Main &amp; Transfer (AIS) with sectionalization</td> </tr> <tr> <td>400/220kV Narendra <u>(New) S/s Extn.</u></td> <td>One &amp; half breaker (GIS)</td> <td>-----</td> </tr> <tr> <td>400/220 kV Koppal PS <u>Extn.</u></td> <td>One &amp; half breaker (AIS)</td> <td>-----</td> </tr> </tbody> </table> <p>i) Transformers of same HV rating shall be placed in different diameters.</p>	Substation	400kV side	220kV side	400/220kV Gadag PS	One & half breaker (AIS)	Double Main & Transfer (AIS) with sectionalization	400/220kV Narendra <u>(New) S/s Extn.</u>	One & half breaker (GIS)	-----	400/220 kV Koppal PS <u>Extn.</u>	One & half breaker (AIS)	-----	<p><b>1.2 Switching Scheme</b></p> <p>The switching schemes, as mentioned below, shall be adopted at various voltage levels of substation/switchyard:</p> <table border="1" data-bbox="1123 760 2003 1146"> <thead> <tr> <th>Substation</th> <th>400kV side</th> <th>200kV side</th> </tr> </thead> <tbody> <tr> <td>400/220kV Gadag PS <u>AIS (New)</u></td> <td>One &amp; Half breaker (AIS)</td> <td>Double Main &amp; Transfer (AIS) with sectionalization</td> </tr> <tr> <td><u>400/220 kV Narendra (New) Existing GIS S/S Extn.</u></td> <td>One &amp; Half breaker (GIS)</td> <td>-----</td> </tr> <tr> <td>400/220 kV Koppal PS <u>(Existing AIS) Augmentation</u></td> <td>One &amp; Half breaker (AIS)</td> <td>-----</td> </tr> </tbody> </table> <p><u>At 400kV voltage level, each circuit of a double circuit transmission line shall be terminated in different diameters.</u> Transformers of same HV rating shall be placed in different diameters. <u>However, both the circuits of 400kV Gadag- Narendra (New) GIS D/C line shall be terminated in the same diameter at Narendra (New) GIS end as a special case.</u></p> <p><u>At 220 kV switchyard, two numbers bus sectionalisers (one number for</u></p>	Substation	400kV side	200kV side	400/220kV Gadag PS <u>AIS (New)</u>	One & Half breaker (AIS)	Double Main & Transfer (AIS) with sectionalization	<u>400/220 kV Narendra (New) Existing GIS S/S Extn.</u>	One & Half breaker (GIS)	-----	400/220 kV Koppal PS <u>(Existing AIS) Augmentation</u>	One & Half breaker (AIS)	-----
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		<p><b><u>each bus) shall be used. One bus section shall accommodate 3 ICT bays (present + future); 6 line bays (present + future); 1 bus reactor bay (present); 1 bus coupler bay (present); 1 bus transfer bay (present) while other bus section shall accommodate 3 ICT bays (present + future); 6 line bays (present + future); 1 bus coupler bay (future); 1 bus transfer bay (future).</u></b></p>																																																																																																								
11.	<p><b>2.0 Substation Equipment and facilities:</b> .....</p> <table border="1" data-bbox="199 586 1073 1200"> <thead> <tr> <th rowspan="2">Sl.</th> <th rowspan="2">Description of bay</th> <th colspan="2">400/220kV Gadag PS</th> <th>400kV Narendra New GIS S/S Extn.</th> <th>400kV Koppal PS Extn.</th> </tr> <tr> <th>400k</th> <th>220</th> <th>400k</th> <th>400k</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Bus Bar</td> <td>4000</td> <td>4000A</td> <td><u>4000</u></td> <td><u>4000</u></td> </tr> <tr> <td>2.</td> <td>Line bay</td> <td>3150</td> <td>1600A</td> <td>3150</td> <td>3150</td> </tr> <tr> <td>3.</td> <td>ICT bay</td> <td>3150</td> <td>1600A</td> <td>-</td> <td>-</td> </tr> <tr> <td>4.</td> <td>Bus Reactor bay</td> <td>3150</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>5.</td> <td>Bus Coupler bay</td> <td>-</td> <td><b>4000A</b></td> <td>-</td> <td>-</td> </tr> <tr> <td>6.</td> <td>Transfer Bus coupler bay</td> <td>-</td> <td>1600A</td> <td>-</td> <td>-</td> </tr> <tr> <td>7.</td> <td>Bus sectionalizer bay</td> <td>-</td> <td><b>4000A</b></td> <td>-</td> <td>-</td> </tr> </tbody> </table> <p><b><u>However, current rating of all equipment in one diameter shall be the highest current rating required for connected line/ICT so that the system could operate without any constraint in case of outage of any bus bar.</u></b></p>	Sl.	Description of bay	400/220kV Gadag PS		400kV Narendra New GIS S/S Extn.	400kV Koppal PS Extn.	400k	220	400k	400k	1.	Bus Bar	4000	4000A	<u>4000</u>	<u>4000</u>	2.	Line bay	3150	1600A	3150	3150	3.	ICT bay	3150	1600A	-	-	4.	Bus Reactor bay	3150	-	-	-	5.	Bus Coupler bay	-	<b>4000A</b>	-	-	6.	Transfer Bus coupler bay	-	1600A	-	-	7.	Bus sectionalizer bay	-	<b>4000A</b>	-	-	<p><b>2.0 Substation Equipment and facilities:</b> .....</p> <table border="1" data-bbox="1136 586 2009 1414"> <thead> <tr> <th rowspan="2">Sl.</th> <th rowspan="2">Description of bay</th> <th colspan="2">400/220kV Gadag PS <b>AIS (New)</b></th> <th><b>400 kV Narendra (New) Existing GIS S/S Extn.</b></th> <th>400kV Koppal PS <b>(Existing AIS) Augmentation</b></th> </tr> <tr> <th>400kV</th> <th>220kV</th> <th>400kV</th> <th>400kV</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Bus Bar</td> <td><u>4000A</u></td> <td>4000A</td> <td><b>Same as existing</b></td> <td><b>Same as existing</b></td> </tr> <tr> <td>2.</td> <td>Line bay</td> <td><u>3150A</u></td> <td>1600A</td> <td><u>3150A</u></td> <td><u>3150A</u></td> </tr> <tr> <td>3.</td> <td>ICT bay</td> <td><u>3150A</u></td> <td>1600A</td> <td>-</td> <td>-</td> </tr> <tr> <td>4.</td> <td>Bus Reactor bay</td> <td><u>3150A</u></td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>5.</td> <td>Bus Coupler bay</td> <td>-</td> <td><b>3150A</b></td> <td>-</td> <td>-</td> </tr> <tr> <td>6.</td> <td>Transfer Bus coupler bay</td> <td>-</td> <td>1600A</td> <td>-</td> <td>-</td> </tr> <tr> <td>7.</td> <td>Bus sectionalizer bay</td> <td>-</td> <td><b>3150A</b></td> <td>-</td> <td>-</td> </tr> </tbody> </table>	Sl.	Description of bay	400/220kV Gadag PS <b>AIS (New)</b>		<b>400 kV Narendra (New) Existing GIS S/S Extn.</b>	400kV Koppal PS <b>(Existing AIS) Augmentation</b>	400kV	220kV	400kV	400kV	1.	Bus Bar	<u>4000A</u>	4000A	<b>Same as existing</b>	<b>Same as existing</b>	2.	Line bay	<u>3150A</u>	1600A	<u>3150A</u>	<u>3150A</u>	3.	ICT bay	<u>3150A</u>	1600A	-	-	4.	Bus Reactor bay	<u>3150A</u>	-	-	-	5.	Bus Coupler bay	-	<b>3150A</b>	-	-	6.	Transfer Bus coupler bay	-	1600A	-	-	7.	Bus sectionalizer bay	-	<b>3150A</b>	-	-
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	<p><u>At 400kV Narendra (New) GIS substation, 1 no. new 400kV diameter with Line-Tie- Line configuration shall be constructed and both the circuits of 400kV Gadag- Narendra (New) GIS D/C line shall be terminated in the same diameter at Narendra (New) GIS end as a special case.</u></p>	
12.	<p><b>2.1 400/220kV, 3-Phase Transformer</b></p> <p>Transformer shall conform to IEC 60076 in general. The 500 MVA transformers shall be designed based on design of dynamic short circuit tested 315 MVA or 500 MVA transformers. 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 <b>is not</b> considered <b>to be</b> connected to source.</p> <p>Core shall be constructed ..... temperature of 50 Deg. C.</p> <p>The transformer shall be complete with all required accessories, Bushing CTs, cooler control cabinet, individual and common marshalling box, <b>RTCC</b> etc as required for satisfactory operations of transformer. <b><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.</u></b></p> <p>Neutral of the transformer shall be solidly grounded.</p> <p><b><u>HV, IV and LV bushing shall be RIP (resin impregnated paper</u></b></p>	<p><b>2.1 400/220kV, 3-Phase Transformer</b></p> <p>Transformer shall conform to IEC 60076 in general. The 500 MVA transformers shall be designed based on design of dynamic short circuit tested 315 MVA or 500 MVA transformers. 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 <b>shall be</b> considered <b>not</b> connected to source. <b><u>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 for at least 5 MVA capacity.</u></b></p> <p>Core shall be constructed ..... temperature of 50 Deg. C.</p> <p>The transformer shall be complete with all required accessories, Bushing CTs, cooler control cabinet, individual and common marshalling box, etc as required for satisfactory operations of transformer. <b><u>Remote tap changer control and monitoring system including parallel operation of transformers shall be carried out using Bay control unit or digital RTCC relay (IEC 61850 compliant) through Substation Automation</u></b></p>

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13.	<p><b>2.2 420kV, 3-Phase, Shunt Reactor</b></p> <p>Reactor shall conform ..... beyond 1.5 p.u. voltage.</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 ..... 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 (<b><u>resin impregnated paper condenser</u></b>) with composite insulator type.</p> <p>The Technical Particulars / Parameters of Shunt Reactor are given below:</p> <table border="1"> <thead> <tr> <th data-bbox="184 1247 281 1284"></th> <th data-bbox="281 1247 564 1284">Description</th> <th data-bbox="564 1247 743 1284">Unit</th> <th data-bbox="743 1247 1073 1284">Parameters</th> </tr> </thead> <tbody> <tr> <td data-bbox="184 1284 281 1365"><b><u>1.1</u></b></td> <td data-bbox="281 1284 564 1365"><b><u>Rated Voltage, Ur (1p.u)</u></b></td> <td data-bbox="564 1284 743 1365"><b><u>kV</u></b></td> <td data-bbox="743 1284 1073 1365"><b><u>420</u></b></td> </tr> <tr> <td data-bbox="184 1365 281 1446"><b><u>1.2</u></b></td> <td data-bbox="281 1365 564 1446"><b><u>Rated Capacity at 420 kV</u></b></td> <td data-bbox="564 1365 743 1446"><b><u>MVAR</u></b></td> <td data-bbox="743 1365 1073 1446"><b><u>125</u></b></td> </tr> <tr> <td data-bbox="184 1446 281 1479"><b><u>1.3</u></b></td> <td data-bbox="281 1446 564 1479"><b><u>Cooling System</u></b></td> <td data-bbox="564 1446 743 1479"></td> <td data-bbox="743 1446 1073 1479"><b><u>ONAN</u></b></td> </tr> </tbody> </table>		Description	Unit	Parameters	<b><u>1.1</u></b>	<b><u>Rated Voltage, Ur (1p.u)</u></b>	<b><u>kV</u></b>	<b><u>420</u></b>	<b><u>1.2</u></b>	<b><u>Rated Capacity at 420 kV</u></b>	<b><u>MVAR</u></b>	<b><u>125</u></b>	<b><u>1.3</u></b>	<b><u>Cooling System</u></b>		<b><u>ONAN</u></b>	<p><b>2.2 420kV, 3-Phase, Shunt Reactor</b></p> <p>Reactor shall conform ..... beyond 1.5 p.u. voltage.</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 ..... 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 (<b><u>Resin Impregnated Paper</u></b>)/ <b><u>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"> <thead> <tr> <th data-bbox="1123 1247 1213 1284">S. No</th> <th data-bbox="1213 1247 1514 1284">Description</th> <th data-bbox="1514 1247 1644 1284">Unit</th> <th data-bbox="1644 1247 2007 1284">Technical Parameters</th> </tr> </thead> <tbody> <tr> <td data-bbox="1123 1284 1213 1365"><b><u>1.</u></b></td> <td data-bbox="1213 1284 1514 1365"><b><u>Rated Capacity at 420kV</u></b></td> <td data-bbox="1514 1284 1644 1365"><b><u>MVar</u></b></td> <td data-bbox="1644 1284 2007 1365"><b><u>125</u></b></td> </tr> <tr> <td data-bbox="1123 1365 1213 1446"><b><u>2.</u></b></td> <td data-bbox="1213 1365 1514 1446"><b><u>Rated Voltage (Ur) (1.0 pu)</u></b></td> <td data-bbox="1514 1365 1644 1446"><b><u>kV</u></b></td> <td data-bbox="1644 1365 2007 1446"><b><u>420</u></b></td> </tr> </tbody> </table>	S. No	Description	Unit	Technical Parameters	<b><u>1.</u></b>	<b><u>Rated Capacity at 420kV</u></b>	<b><u>MVar</u></b>	<b><u>125</u></b>	<b><u>2.</u></b>	<b><u>Rated Voltage (Ur) (1.0 pu)</u></b>	<b><u>kV</u></b>	<b><u>420</u></b>
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Sl. No.	Existing Provisions				New / Revised Provisions			
	1.4	<u>Permissible current unbalance among different phases</u>	%	<u>± 2</u>	3.	<u>Number of phases</u>		<u>3 (three)</u>
	1.5	<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>	4.	<u>Connection</u>		<u>Star</u>
	1.6	<u>Range of Constant Impedance</u>		<u>Up to 1.5 p.u. voltage</u>	5.	<u>Cooling type</u>		<u>ONAN</u>
	1.7	<u>Tolerance on current</u>	%	<u>0 to +5%</u>	6.	<u>Frequency</u>	<u>Hz</u>	<u>50</u>
	1.8	<u>Ratio of zero sequence reactance to positive reactance (X0/X1)</u>	<u>Range</u>	<u>0.9 - 1.0</u>	7.	<u>Reference standard</u>		<u>IEC 60076-6</u>
	1.9	<u>Max. Temperature rise over 50 deg C Ambient Temp at rated voltage</u>	<u>Deg.C</u>	<u>Top oil: 40 &amp; Winding: 45</u>	8.	<u>Service</u>		<u>Outdoor</u>
	9.	<u>Permissible unbalance current among phases</u>	%	<u>±2%</u>	10.	<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>
	11.	<u>Range of constant impedance</u>		<u>Up to 1.5 p.u voltage (However, complete saturation characteristics of the Reactors upto 2.5 p.u. Voltage shall be furnished)</u>	12.	<u>Tolerance on current</u>	%	<u>0 to +5%</u>
	13.	<u>Ratio of zero sequence reactance to positive reactance (X0/X1)</u>		<u>Between 0.9 &amp; 1.0.</u>	14.	<u>Temperature rise over 50 °C Ambient Temp. at 420 kV</u>		
i)	<u>Top oil measured by thermometer</u>	°C	<u>40</u>	ii)	<u>Average winding measured by resistance method</u>	°C	<u>45</u>	
15.	<u>Winding hot spot</u>	°C	<u>61</u>					

Sl. No.	Existing Provisions			New / Revised Provisions		
	<u>1.10</u> (a) <u>Maximum Permissible load Losses at rated Voltage, Frequency and at 75° C (kW) for 420kV, 125 MVAR, 3-Phase Reactor</u>	<u>kW</u>	<u>160</u>		<u>temperature rise over yearly weighted average temperature of 32 °C</u>	
	(b) <u>Maximum Permissible I<sup>2</sup>R Losses of Reactor at rated Voltage, Frequency and at 75° C</u>	<u>kW</u>	<u>90</u>	16. <u>Max. tank surface temperature</u>	°C	<u>110</u>
	<u>1.11</u> <u>Windings</u>			17. <u>Max design ambient temperature</u>	°C	<u>50</u>
	a) <u>Insulation level (LI/SI/PF)</u>		<u>kVp/ kVp/kVrms</u>	18. <u>Windings</u>		
			<u>1300/1050/-</u>	i) <u>Lightning Impulse withstand Voltage</u>		
			<u>550/-/230</u>	<u>Line end</u>	<u>kV<sub>p</sub></u>	<u>1300</u>
	b) <u>Tan delta of windings</u>	%	<u>&lt; 0.5</u>	<u>Neutral</u>	<u>kV<sub>p</sub></u>	<u>550</u>
	<u>1.11</u> <u>Partial discharge (PD) level at 1.58 Ur / √3</u>	<u>pC</u>	<u>&lt; 100</u>	ii) <u>Chopped Wave Lightning Impulse Withstand Voltage</u>		
	<u>1.12</u> <u>Vibration &amp; Tank stress level at rated voltage and frequency</u>		<u>≤ 200 microns peak to peak; Average: ≤60 microns peak to peak.</u>	<u>Line end</u>	<u>kV<sub>p</sub></u>	<u>1430</u>
			<u>Stress: ≤</u>	iii) <u>Switching Impulse withstand Voltage at Line end</u>		
				iv) <u>One Minute Power Frequency withstand Voltage</u>		
				<u>Neutral</u>	<u>kVrms</u>	<u>230</u>
				19. <u>Tan-delta of windings</u>		<u>&lt; 0.005</u>
				20. <u>Neutral earthing</u>		<u>Solidly Earthed</u>
				21. <u>Whether neutral brought out</u>		<u>Yes (through 145kV class bushing)</u>
				22. <u>Bushing</u>		
				i) <u>Rated voltage</u>		
				<u>Line bushing</u>	<u>kV</u>	<u>420</u>

Sl. No.	Existing Provisions			New / Revised Provisions		
			<u>2.0kg/sq.mm at any point on tank.</u>		<u>Neutral bushing</u>	<u>kV</u> <u>145</u>
	<u>1.13</u>	<u>Noise level at rated voltage and frequency</u>	<u>dB</u> <u>&lt; 80</u>	<u>ii)</u>	<u>Rated current</u>	
	<u>1.14</u>	<u>Bushing</u>			<u>Line bushing</u>	<u>A</u> <u>800</u>
	<u>a)</u>	<u>Rated voltage : HV / Neutral</u>	<u>kV</u> <u>420/145</u>		<u>Neutral bushing</u>	<u>A</u> <u>800</u>
	<u>b)</u>	<u>Rated current (Min.) HV / Neutral</u>	<u>A</u> <u>800/800</u>	<u>iii)</u>	<u>Lightning Impulse withstand Voltage</u>	
	<u>c)</u>	<u>Insulation level (LI/SI/PF)</u>	<u>kVp/ kVp / kVrms</u>		<u>Line bushing</u>	<u>kV<sub>p</sub></u> <u>1425</u>
		<u>HV</u>	<u>1425/1050/695</u>		<u>Neutral bushing</u>	<u>kV<sub>p</sub></u> <u>650</u>
	<u>d)</u>	<u>Tan delta of bushings : HV / Neutral</u>	<u>%</u> <u>&lt; 0.5</u>	<u>iv)</u>	<u>Switching Impulse withstand Voltage of</u>	<u>kV<sub>p</sub></u> <u>1050</u>
	<u>e)</u>	<u>PD of bushings at level Um</u>	<u>pC</u> <u>&lt;10</u>		<u>Line bushing</u>	<u>kV<sub>p</sub></u> <u>1050</u>
	<u>1.15</u>	<u>Insulating Oil</u>	<u>virgin high grade inhibited, conforming to IEC-60296</u>	<u>v)</u>	<u>1minute power frequency withstand of</u>	
.....					<u>bushings (dry)</u>	
		<u>Neutral</u>	<u>650/-/305</u>		<u>Line bushing</u>	<u>kV rms</u> <u>695</u>
					<u>Neutral bushing</u>	<u>kV rms</u> <u>305</u>
				<u>vi)</u>	<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>10500</u>
					<u>Neutral bushing</u>	<u>mm</u> <u>3625</u>
				<u>vii)</u>	<u>Partial discharge of bushings at Ur (line end and neutral)</u>	<u>pC</u> <u>&lt; 10</u>
	<u>23.</u>	<u>Maximum partial discharge level at</u>	<u>1.58Ur/√3</u>		<u>Line bushing</u>	<u>pC</u> <u>100</u>
	<u>24.</u>	<u>Vibration and tank stress at rated voltage</u>			<u>Neutral bushing</u>	<u>mm</u> <u>3625</u>
					<u>Line bushing</u>	<u>mm</u> <u>3625</u>
					<u>Neutral bushing</u>	<u>mm</u> <u>3625</u>
				<u>viii)</u>	<u>Partial discharge of bushings at Ur (line end and neutral)</u>	<u>pC</u> <u>&lt; 10</u>
					<u>Line bushing</u>	<u>mm</u> <u>3625</u>
					<u>Neutral bushing</u>	<u>mm</u> <u>3625</u>
					<u>Line bushing</u>	<u>mm</u> <u>3625</u>
				<u>ix)</u>	<u>Partial discharge of bushings at Ur (line end and neutral)</u>	<u>pC</u> <u>&lt; 10</u>
					<u>Line bushing</u>	<u>mm</u> <u>3625</u>
					<u>Neutral bushing</u>	<u>mm</u> <u>3625</u>
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				<u>x)</u>	<u>Partial discharge of bushings at Ur (line end and neutral)</u>	<u>pC</u> <u>&lt; 10</u>
					<u>Line bushing</u>	<u>mm</u> <u>3625</u>
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Sl. No.	Existing Provisions	New / Revised Provisions					
					<u>to peak Tank stress:</u> <u>&lt;2.0kg/sq.mm at any point of tank</u>		
		25.	<u>Maximum noise pressure level at rated voltage &amp; frequency</u>	<u>dB</u>	<u>80</u>		
		26.	<u>Maximum Permissible Losses of Reactor at rated current and frequency and at 75°C</u>		<table border="1"> <tr> <td data-bbox="1644 472 1892 703"><u>Total loss</u></td> <td data-bbox="1892 472 2034 703"><u>I<sup>2</sup>R Loss</u></td> </tr> </table>	<u>Total loss</u>	<u>I<sup>2</sup>R Loss</u>
<u>Total loss</u>	<u>I<sup>2</sup>R Loss</u>						
		i)	<u>125MVAr 420kV</u>	<u>kW</u>	<table border="1"> <tr> <td data-bbox="1644 703 1892 753"><u>160</u></td> <td data-bbox="1892 703 2034 753"><u>90</u></td> </tr> </table>	<u>160</u>	<u>90</u>
<u>160</u>	<u>90</u>						
		27.	<u>Insulating oil</u>		<u>Unused inhibited or uninhibited transformer oil conforming to IEC-60296:2012</u>		
14.	<p><b>2.3 400KV GIS Substation equipment</b></p> <p>GIS (Gas Insulated Switchgear) shall be Indoor type 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. <b>Outdoor</b> Surge Arrestor Voltage Transformer shall be AIS <b>or GIS</b> type</p> <p>The GIS assembly shall consist of separate modular compartments e.g. Circuit Breaker compartment, Bus bar compartment filled with SF6 Gas and separated by gas tight partitions so as to minimize risk to human life, allow ease of maintenance and limit the effects of gas leaks failures &amp;</p>	<p><b>2.3 400KV GIS Substation equipment</b></p> <p>GIS (Gas Insulated Switchgear) shall be Indoor type 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. <b>The</b> Surge Arrestor and Voltage Transformer shall be <b>either GIS or outdoor</b> AIS type</p> <p>The GIS assembly shall consist of separate modular compartments e.g. Circuit Breaker compartment, Bus bar compartment filled with SF6 Gas and separated by gas tight partitions so as to minimize risk to human life,</p>					

Sl. No.	Existing Provisions	New / Revised Provisions
	<p>internal arcs etc. These compartments shall be designed to minimize the risk of damage to adjacent sections and protection of personnel in the event of a failure occurring within the compartments. Rupture diaphragms with suitable deflectors shall be provided to prevent uncontrolled bursting pressures developing within the enclosures under worst operating conditions, thus providing controlled pressure relief in the affected compartment. The arrangement of gas sections or compartments shall be such as to facilitate future extension of any make without any drilling, cutting or welding on the existing equipment. To add equipment, it shall not be necessary to move or dislocate the existing switchgear bays.</p> <p>.....</p>	<p>allow ease of maintenance and limit the effects of gas leaks failures &amp; internal arcs etc. These compartments shall be designed to minimize the risk of damage to adjacent sections and protection of personnel in the event of a failure occurring within the compartments. Rupture diaphragms with suitable deflectors shall be provided to prevent uncontrolled bursting pressures developing within the enclosures under worst operating conditions, thus providing controlled pressure relief in the affected compartment. The arrangement of gas sections or compartments shall be such as to facilitate future extension of any make without any drilling, cutting or welding on the existing equipment. To add equipment, it shall not be necessary to move or dislocate the existing switchgear bays. <b><u>The layout of Gas Insulated Bus Ducts shall be properly planned to optimize the length of bus ducts and for easy accessibility for maintenance. The length of busbars, bus ducts, isolator sections shall be optimized considering effects of fast transient voltage due to isolator operations.</u></b></p> <p>.....</p>
15.	<p><b>2.3.1 Circuit Breakers</b></p> <p>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. Circuit breakers shall be provided with single phase and three phase auto reclosing. The Circuit breakers controlling 400kV lines wherever required shall be provided with pre insertion closing resistor of about 400 ohms with 8 ms insertion time or Controlled Switching Device (CSD) for lines longer than 200 km. 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 <b><u>and 765/400kV Transformers (wherever applicable).</u></b></p>	<p><b>2.3.1 Circuit Breakers</b></p> <p>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. Circuit breakers shall be provided with single phase and three phase auto reclosing. The Circuit breakers controlling 400kV lines wherever required shall be provided with pre insertion closing resistor of about 400 ohms with 8 ms insertion time or Controlled Switching Device (CSD) for lines longer than 200 km. 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 <b>400 kV</b> circuit breakers of line with non-switchable line reactors <b><u>and</u></b> Bus reactors .</p>
16.	<p><b>2.3.2 Isolators</b></p>	<p><b>2.3.2 Isolators</b></p>

Sl. No.	Existing Provisions	New / Revised Provisions
	<p>The isolators shall comply to IEC 62271-102 in general. <b><u>Isolators shall be motor (DC powered) operated.</u></b> 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.</p> <p>Isolator shall be suitable for Bus Transfer Current Switching duty as per IEC standard. High speed earthing switches shall be provided for grounding purpose at overhead line terminations &amp; cable terminations &amp; cable terminations and shall have fault making capability as specified. Earth switch for line isolator shall be of earthing switch class E1 and shall be suitable for induced current switching duty as defined for Class-B as per relevant standard.</p>	<p>The isolators shall comply to IEC 62271-102 in general. 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 <b><u>isolators and</u></b> earth switches shall be motor operated type.</p> <p>Isolator shall be <b><u>of extended mechanical endurance class-M2 and</u></b> suitable for Bus Transfer Current Switching duty as per IEC standard. High speed earthing switches shall be provided for grounding purpose at overhead line terminations &amp; cable terminations &amp; cable terminations and shall have fault making capability as specified. Earth switch for line isolator shall be of earthing switch class E1 and shall be suitable for induced current switching duty as defined for Class-B as per relevant standard.</p>
17.	<p><b>2.3.3 Current Transformers</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) shall have five cores (four for protection and one for metering) whereas; CT in Tie bays shall have six cores (four for protections &amp; two for metering) suitably distributed on both sides of CB (for 400kV and above voltage class). 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>2.3.3 Current Transformers</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) shall have five cores (four for protection and one for metering) whereas; CT in Tie bays shall have six cores (four for protections &amp; two for metering) suitably distributed on both sides of CB (for 400kV and above voltage class). 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><u>(not more than 20VA for metering core)</u></b> for better sensitivity and accuracy. <b><u>The instrument security factor shall be less than 5.</u></b></p>
18.	<p><b>2.3.4 Voltage Transformer</b></p> <p>The voltage transformers shall conform to IEC-61869. Voltage transformers shall be of 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 in the terminal box. The voltage transformers shall be located</p>	<p><b>2.3.4 Voltage Transformer</b></p> <p>The voltage transformers shall conform to IEC-61869. Voltage transformers shall be of 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 in the terminal box. The voltage transformers shall be located as</p>

Sl. No.	Existing Provisions	New / Revised Provisions
	<p>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 transformer shall be effectively shielded against high frequency electromagnetic transients. The voltage transformer 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 protection cores shall be 3P. The accuracy of 0.2 on metering core should be maintained throughout the entire burden range on all the three windings without any adjustments during operation. 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>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 transformer shall be effectively shielded against high frequency electromagnetic transients. The voltage transformer 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 protection cores shall be 3P. The accuracy of 0.2 on metering core should be maintained throughout the entire burden range on all the three windings without any adjustments during operation. 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>2.4 Circuit Breakers (AIS)</b></p> <p>The circuit breakers and accessories shall conform to IEC: 62271-100, IEC: 62271-1 and shall be of SF6 Type. The rated break time shall not exceed 40 ms for 400kV circuit breakers and 60 ms for 220kV circuit breakers. 400kV and 220kV 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 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. The controlled switching device shall be provided in 400kV Circuit breaker of switchable line reactor bay and in Main &amp; Tie bay circuit breakers of line with non-switchable line reactors, Bus reactors <b><u>and 765/400kV Transformers (wherever applicable).</u></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 SF6 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 400kV circuit breakers and 60 ms for 220kV circuit breakers. 400kV and 220kV 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 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. The controlled switching device shall be provided in 400kV Circuit breaker of switchable line reactor bay and in Main &amp; Tie bay <b><u>400 kV</u></b> circuit breakers of line with non-switchable line reactors <b><u>and</u></b> Bus reactors.</p>
20.	<p><b>2.5 Isolators (AIS)</b></p>	<p><b>2.5 Isolators (AIS)</b></p>

Sl. No.	Existing Provisions	New / Revised Provisions
	<p>The isolators shall comply to IEC 62271-102 in general. 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 400kV and 220kV shall be of extended mechanical endurance class-M2 and <b><u>all earth switches shall be class M0</u></b> as per IEC-62271-102. Main blades and earth blades shall be interlocked and interlock shall be fail safe type. 400kV and 220kV earth switch for line isolator shall be suitable for induced current switching duty as defined for Class-B.</p>	<p>The isolators shall comply to IEC 62271-102 in general. 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 400kV and 220kV shall be of extended mechanical endurance class-M2 and <b><u>suitable for bus transfer current switching duty</u></b> as per IEC-62271-102. Main blades and earth blades shall be interlocked and interlock shall be fail safe type. 400kV and 220kV earth switch for line isolator shall be suitable for induced current switching duty as defined for Class-B.</p>
21.	<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 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 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><u>(not more than 20VA for metering core)</u></b> for better sensitivity and accuracy. <b><u>Instrument security factor shall be less than 5.</u></b></p>
22.	<p><b>2.7 Capacitor Voltage Transformers (AIS)</b></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 400kV and 220kV shall be of 4400/8800 pF depending on PLCC requirements. The rated burden of cores shall be closer</p>	<p><b>2.7 Capacitor Voltage Transformers (AIS)</b></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 400kV and 220kV shall be of 4400/8800 pF depending on PLCC requirements. The rated burden of cores shall be closer to the maximum</p>

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	to the maximum burden requirement of metering & protection system for better sensitivity and accuracy.	burden requirement of metering & protection system <b><u>(not more than 50VA for metering core)</u></b> for better sensitivity and accuracy.
23.	<p><b>2.8 Surge Arresters (AIS)</b></p> <p>336kV &amp; 216kV Station class, <b>current limiting</b>, heavy duty gapless type Surge arresters conforming to IEC 60099-4 in general shall be provided for 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>336kV &amp; 216kV Station class, heavy duty gapless type Surge arresters conforming to IEC 60099-4 in general shall be provided for 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>
24.	<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, to obtain redundancy, and to take protection systems out for maintenance while the equipment remains in service.</u></b></p>
25.	<p><b>2.9 a) Transmission Lines Protection</b></p> <p>400kV and 220kV lines shall have Main-I numerical three zone distance protection scheme with carrier aided inter-tripping feature. 400kV and</p>	<p><b>2.9 a) Transmission Lines Protection</b></p> <p>400kV and 220kV lines shall have Main-I numerical three zone distance protection scheme with carrier aided inter-tripping feature. 400kV and</p>

Sl. No.	Existing Provisions	New / Revised Provisions
	<p>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 <u>&amp; manufacturing platform</u></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>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, manufacturing platform <b><u>or different principle of operation.</u></b></p> <p><b><u>However,</u></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>
26.	<p><b>2.9 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 and <b><u>open delta protection is required to</u></b> 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 the auxiliary system or in the control &amp; protection IEDs to be provided for autotransformer.</p>	<p><b>2.9 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 and <b><u>other necessary protection shall</u></b> 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 the auxiliary system or in the control &amp; protection IEDs to be provided for autotransformer.</p>
27.	<p><b>2.10 a) Substation Automation System</b></p> <p>a) .....</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>2.10 a) Substation Automation System</b></p> <p>a) .....</p> <p>The functions of control, annunciation, disturbance recording, event logging and measurement of electrical parameters shall be integrated in Substation Automation System.</p>

Sl. No.	Existing Provisions	New / Revised Provisions
	<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>At new substations, the Substation Automation System (SAS) shall be suitable for operation and monitoring of the complete substation including proposed future bays/elements. .....</p>	<p>At new substations, the Substation Automation System (SAS) shall be suitable for operation and monitoring of the complete substation including proposed future bays/elements. .....</p>
28.	<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> <p>Additionally, Active Energy Meters may be provided at the same point in the 33kV tertiary of Transformer by local SEB/DISCOM for energy <b><u>accounting.</u></b></p>
29.	<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</u></b> with minimum rating as specified here under shall be considered with duplicate supply:</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>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 no.</u></b></p> <p>(b) AC distribution board – <b><u>1 no.</u></b></p>

Sl. No.	Existing Provisions	New / Revised Provisions
	<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>(c) Main lighting distribution board – 1 no.  (d) Emergency lighting distribution board – 1 no.  (e) 220 Volt DC distribution board – 2 nos.  (f) 48 Volt DC distribution board – 2 nos.</p>
30.	<p><b>3.2 Fire Fighting System</b></p> <p>.....</p> <p>Beam type heat detection for GIS hall fire protection system shall be provided for all the GIS halls.</p> <p>.....</p>	<p><b>3.2 Fire Fighting System</b></p> <p>.....</p> <p><b><u>Optical</u></b> Beam type heat detection for GIS hall fire protection system shall be provided for all the GIS halls.</p> <p>.....</p>
31.	<p><b>3.8 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> <li>4. <b><u>All the gates of switchyard.</u></b></li> <li>5. <b><u>Main entrance Gate</u></b></li> </ol>	<p><b>3.8 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> <p><b><u>All camera recordings shall have Camera ID &amp; location/area of</u></b></p>

Sl. No.	Existing Provisions	New / Revised Provisions
	<p>6. <u>All other major AIS Equipment (such as CB, CT, CVT, SA etc. as applicable)</u></p>	<p><u>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, VMS, if available, shall be augmented as per existing or better specifications.</u></p>
32.	<p><b>4.0 e) General Facilities</b></p> <p>In 400kV switchyard, if spare bay of half diameter is identified as future, all the equipment for Tie &amp; Future bay shall be designed considering the current rating of line bay i.e. <u>3000A.</u></p>	<p><b>4.0 e) General Facilities</b></p> <p>In 400kV switchyard, if spare bay of half diameter is identified as future, all the equipment for Tie &amp; Future bay shall be designed considering the current rating of line bay i.e. <u>3150A.</u></p>
33.	<p><b><u>PLCC</u></b></p> <p><b><u>PLCC &amp; PBAX: 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:-</u></b></p> <p><b><u>Coupling device, line traps, carrier terminals, protection couplers, HF cables, PABX (if applicable) and maintenance and testing instruments.</u></b></p> <p><b><u>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.</u></b></p> <p><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</u></b></p>	<p><b>Deleted</b></p>

Sl. No.	Existing Provisions	New / Revised Provisions
	<p><u>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></p> <p><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></p> <p><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></p> <p><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. 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.</u></p> <p><u>TSP shall provide/undertake necessary addition/modification/shifting/re-commissioning etc. of PLCC equipment due to LILO of transmission lines (wherever applicable).</u></p> <p><u>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.</u></p>	
<u>TECHNICAL REQUIREMENTS FOR COMMUNICATION SYSTEM</u>		

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34.	<p>For Gadag PS-Narendra (New) PS 400 kV <b><u>(high capacity equivalent to quad moose)</u></b> D/C Line</p> <p>On Gadag PS - Narendra (New) PS 400 kV 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 Gadag PS up to gantry of Narendra (New) PS 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 Gadag PS – Narendra (New) PS, the OPGW (48F) connectivity from power line crossing point upto repeater station shall also be in the scope of TSP.</p>	<p>For Gadag PS-Narendra (New) PS 400 kV D/C Line <b><u>OPGW:</u></b></p> <p>On Gadag PS - Narendra (New) PS 400 kV 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 Gadag PS up to gantry of Narendra (New) PS 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 Gadag PS – Narendra (New) PS, 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>
35.	<p>New point to be inserted</p>	<p><b><u>2. For Gadag PS-Koppal PS 400 kV D/C Line OPGW:</u></b></p> <p><b><u>On Gadag PS – Koppal PS 400 kV 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 Gadag PS up to gantry of Koppal PS 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 Gadag PS – Koppal PS, the OPGW (48F) connectivity from power line crossing point upto repeater station shall also be in the scope of TSP.</u></b></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</u></b></p>

Sl. No.	Existing Provisions	New / Revised Provisions
	<p><b>2.</b> Establishment of 5x500MVA, 400/220kV s/s Pooling station in GADAG</p> <p>(i) TSP shall provide FODP( 96 F) and Approach Cable (24F) at Gadag Pooling Station, Narendra(New), Kopal Pooling station and repeater station(if any) which shall be connected with OPGW fibres to be installed on 400 kV Gadag PS – Narendra(New) T/L and on 400 kV Gadag PS –Kopal pooling station T/L</p> <p>(ii) TSP (Transmission Service Provider) shall provide STM-16 SDH equipment at Gadag Pooling Station, Narendra(New), Kopal Pooling station and at repeater stations (if any) along with necessary interfaces to meet the voice and data communication requirement and shall be integrated with the remote end wideband nodes i.e. Narendra(New) and Kopal Pooling station</p> <p>(iii) In case of repeater requirement, TSP shall provide Repeater shelter alongwith DG set, provisioning for AC and DC supply and other associated systems</p> <p>(iv) The integration of Communication equipment with centralized NMS at regional level shall be responsibility of TSP. Configuration work in centralized NMS for integration of new Communication equipment is not in scope of TSP, however all necessary support to integrate new Communication equipment in the Centralized NMS shall be ensured by TSP.</p> <p>(v) TSP shall install required no. of Phasor Measurement Units (PMUs) for all 400kV feeders (under the scope of this project) at Gadag Pooling Station, Narendra(New) &amp; Kopal Pooling station and PMUs shall support latest IEEE C-37.118 protocols. These PMUs shall be integrated with the PDC (Phasor Data Concentrator) located at</p>	<p><b><u>in addition to one channel for speech plus data for each direction.</u></b></p> <p><b>3.</b></p> <p><b><u>(a)</u></b> Establishment of 5x500MVA, 400/220kV s/s Pooling station in GADAG</p> <p><b><u>(b) 2 Nos. line bays at Narendra (New) GIS S/s for Gadag PS-Narendra (New) D/c line</u></b></p> <p><b><u>(c) 2 Nos. line bays at Koppal PS for Gadag PS-Koppal D/c line</u></b></p> <p>(i) TSP shall provide FODP( 96 F) and Approach Cable (24F) at Gadag Pooling Station, Narendra(New), Kopal Pooling station and repeater station(if any) which shall be connected with OPGW fibres to be installed on 400 kV Gadag PS – Narendra(New) T/L and on 400 kV Gadag PS –Kopal pooling station T/L</p> <p>(ii) TSP (Transmission Service Provider) shall provide STM-16 SDH equipment at Gadag Pooling Station, Narendra(New), Kopal Pooling station and at repeater stations (if any) along with necessary interfaces to meet the voice and data communication requirement and shall be integrated with the remote end wideband nodes i.e. Narendra(New) and Kopal Pooling station</p> <p>(iii) In case of repeater requirement, TSP shall provide Repeater shelter alongwith DG set, provisioning for AC and DC supply and other associated systems</p> <p>(iv) The integration of Communication equipment with centralized NMS at regional level shall be responsibility of TSP. Configuration work in centralized NMS for integration of new Communication equipment is not in scope of TSP, however all necessary support to integrate new Communication equipment in the Centralized NMS shall be ensured by TSP.</p> <p>(v) TSP shall install required no. of Phasor Measurement Units (PMUs)</p>

Sl. No.	Existing Provisions	New / Revised Provisions
	<p>respective RLDC/SLDC.</p> <p>(vi) TSP shall install RTU/SAS with necessary interfaces which shall be integrated with respective RLDC SCADA System on IEC 60870-5-101/104 protocol</p> <p>(vii) The maintenance of all the communication equipments including FODP and approach cable, PMUs, RTU/SAS &amp; repeater stations shall be the responsibility of TSP.</p>	<p>for all 400kV feeders (under the scope of this project) at Gadag Pooling Station, Narendra(New) &amp; Kopal Pooling station and PMUs shall support latest IEEE C-37.118 protocols. These PMUs shall be integrated with the PDC (Phasor Data Concentrator) located at respective RLDC/SLDC.</p> <p>(vi) TSP shall install RTU/SAS with necessary interfaces which shall be integrated with respective RLDC SCADA System on IEC 60870-5-101/104 protocol</p> <p>(vii) The maintenance of all the communication equipment including FODP and approach cable, PMUs, RTU/SAS &amp; repeater stations shall be the responsibility of TSP.</p>
36.	New point to be inserted	<p><b><u>PLCC:</u></b></p> <p><b><u>PLCC &amp; PBAX: 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:-</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 substations, a telephone exchange (PABX) of 24 lines shall be provided as means of effective communication among various buildings of the substation, remote end substations and with control centers (RLDC/SLDC) etc.</u></b></li> </ul>

Sl. No.	Existing Provisions	New / Revised Provisions
		<ul style="list-style-type: none"> <li data-bbox="1136 204 2024 423">- <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></li> <li data-bbox="1136 477 2024 696">- <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></li> <li data-bbox="1136 750 2024 889">- <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 data-bbox="1136 943 2024 1122">- <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 data-bbox="1136 1175 2024 1315">- <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 data-bbox="1136 1369 2024 1425">- <u>All other associated equipment like cabling, coupling device and HF cable shall also be provided by the TSP.</u></li> </ul>