Amendment – III dated 03.06.2020 on the Request for Proposal and Transmission Service Agreement issued for selection of bidder as Transmission Service Provider to establish "Transmission System for evacuation of power from RE Projects in Osmanabad area (1 GW) in Maharashtra" through tariff based competitive bidding process

<table>
<tr><th>Sl. No.</th><th>Existing Clause</th><th>New / Revised Clause</th></tr>
<tr><td></td><td colspan="2">SPECIFIC TECHNICAL REQUIREMENTS FOR TRANSMISSION LINE</td></tr>
<tr><td>1.</td><td>……..
2.0

Selection of tower type shall be made as per CEA Regulations, however in case lattice type towers are used, the following shall also be applicable:

a) Steel section of grade E 250 and/or grade E 350 as per IS 2062, <u>are only</u> 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
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61/3.55mm 31.95mm diameter; 604 sq.mm</td><td>Stranding details:

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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 & Electric Supply) Regulations as amended from time to time and IS:5613.</td><td>8.0

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<u>The minimum live metal clearances for 400 kV D/c transmission lines shall be considered as follows:</u>
(i) <u>Under stationary conditions</u>
<u>From tower body: 3.05m</u>

(ii) <u>Under Swing conditions</u>

<table>
<tr><th><u>Wind Pressure Condition</u></th><th><u>Minimum Electrical Clearance</u></th></tr>
<tr><td><u>a) Swing angle (22º)</u></td><td><u>3.05 mtrs</u></td></tr>
<tr><td><u>b) Swing angle (44º)</u></td><td><u>1.86 mtrs</u></td></tr>
</table>
</td></tr>
<tr><td>3.</td><td>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.</td><td>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. <u>If site condition demands, multiple earthing or use of earthing enhancement compound shall be used.</u></td></tr>
</table>

Sl. No.	Existing Clause	New / Revised Clause
4.	New point to be inserted	**13.0** **Multi-circuit (4 circuits) towers shall be used for the LILO portion.**
5.	New point to be inserted	**14.0** **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.**
6.	New point to be inserted	**15.0** **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.**
	SPECIFIC TECHNICAL REQUIREMENTS FOR SUBSTATION	
7.	General The proposed new substation shall be conventional AIS type generally conforming to the requirement **of CEA regulation for construction of substation.**	General The proposed new substation shall be conventional AIS 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.**
8.	**1.2. Switching Scheme** **……** ii. Transformers of same HV rating shall be placed in different diameters.	**1.2. Switching Scheme** …….. ii. Transformers **and Bus reactor** of same HV rating shall be placed in different diameters.
9.	**2.0 Substation Equipment and facilities:** The switchgear shall be designed and specified to withstand operating	**2.0 Substation Equipment and facilities:** The switchgear shall be designed and specified to withstand operating

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<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></td><td>conditions and duty requirements. All equipment shall be designed considering the transmission line capacity.

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Sl. No.	Existing Clause	New / Revised Clause
10.	**2.1. 400/220kV, 3-Phase Transformer** 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 **is not** considered **to be** connected to source. **……..** The transformer shall be complete with all required accessories, Bushing CTs, cooler control cabinet, individual and common marshalling box, **RTCC** etc. as required for satisfactory operations of transformer. **The transformer shall be provided with IEC 61850 compliant digital RTCC relay having automatic voltage regulating features 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.	**2.1. 400/220kV, 3-Phase Transformer** 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 **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 for at least 5 MVA capacity.** **……..** 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. **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 System.** Neutral of the transformer shall be solidly grounded.

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<tr><th>Sl. No.</th><th>Existing Clause</th><th>New / Revised Clause</th></tr>
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<u>HV, IV and LV bushing shall be RIP (resin impregnated paper condenser) with composite insulator type. 36kV Neutral bushing shall be solid porcelain or oil communicating type.</u>

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

<u>Technical Particulars / Parameters Autotransformer of 500MVA, 400/220/33kV, 3-Phase</u>
<table>
<tr><th>Sl. No.</th><th>Description</th><th>Unit</th><th>Technical Parameters</th></tr>
<tr><td>1.</td><td>Rated Capacity (Tertiary): HV/IV/LV</td><td>MVA</td><td>500/500/166.67</td></tr>
<tr><td>..</td><td>…</td><td>…</td><td>……</td></tr>
<tr><td>11</td><td>Tap Changer & Tappings</td><td></td><td>OLTC with range 10% for HV variation in the step of 1.25% on common end of series winding</td></tr>
<tr><td>..</td><td>…</td><td>…</td><td>……</td></tr>
<tr><td>15</td><td>Insulating Oil</td><td></td><td><u>Virgin high grade</u> inhibited, conforming to IEC-60296</td></tr>
</table>
</td><td>
<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>

The major technical particulars / parameters of <u>3-phase, 500MVA, 400/220/33 kV</u> transformer are given below:

<table>
<tr><th>Sl. No.</th><th>Description</th><th>Unit</th><th>Technical Parameters</th></tr>
<tr><td>1.</td><td>Rated Capacity (Tertiary): HV/IV/LV</td><td>MVA</td><td>500/500/166.67
<u>Tertiary active loading: 5MVA</u></td></tr>
<tr><td>..</td><td>…</td><td>…</td><td>……</td></tr>
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<tr><td>15</td><td>Insulating Oil</td><td></td><td><u>Unused</u> inhibited <u>or uninhibited transformer oil</u>, conforming to IEC-60296<u>:2012</u></td></tr>
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<tr><td>11.</td><td>

2.2 420kV, 3-Phase, Shunt Reactor

….

The reactor shall be of **either** gapped core type **or magnetically shielded air core type (shell 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. **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.** Core shall be constructed from non-ageing, cold rolled grain oriented silicon steel laminations with requisite BIS certification.

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 condenser)** with composite insulator type.

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

Sl. No.	Description	Unit	Parameter
1.	Rated Voltage, Ur (1p.u)	kV	420
2.	Rated Capacity at 420 kV	MVAR	125/50 (as
3.	Cooling System		ONAN
4.	Permissible current unbalance among different phases	%	± 2

</td><td>

2.2. 420kV, 3-Phase, Shunt Reactor

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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.

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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)/RIS (Resin Impregnated Synthetic)** with composite insulator type.

The Technical Particulars / Parameters of **3-phase, 125 MVAr, 420 kV and 3-phase 50 MVAr, 420 kV** Shunt Reactor are given below:

S. No	Description	Unit	Technical Parameters	
1.	Rated Capacity at 420kV	MVAr	125	50
2.	Rated Voltage (Ur) (1.0 pu)	kV	420	
3.	Number of phases		3 (three)	
4.	Connection		Star	
5.	Cooling type		ONAN	
6.	Frequency	Hz	50	

</td></tr>
</table>

Sl. No.	Existing Clause				New / Revised Clause			
	5.	Crest value of Third Harmonic content in phase current at rated voltage with	%	≤ 3% of the crest value of fundamental	7.	Reference standard		IEC 60076-6
	6.	Range of constant Impedance		Up to 1.5 p.u.	8.	Service		Outdoor
	7.	Tolerance on current	%	0 to +5%	9.	Permissible unbalance current among phases	%	±2%
	8.	Ratio of zero sequence reactance to positive reactance	Range	0.9 - 1.0	10.	Crest value of third harmonic content in phase current at rated voltage with sinusoidal wave form	%	≤ 3% of the crest value of fundamental
	9.	Max. Temperature rise over 50 deg C Ambient Temp at	Deg.C	To p	11.	Range of constant impedance		Up to 1.5 p.u voltage (However, complete saturation characteristics of the Reactors upto 2.5 p.u. Voltage shall be furnished)
	10.	(a) Maximum Permissible load Losses at rated Voltage, Frequency and at 75° C (kW) for 420kV, 125 MVAR, 3-Phase Reactor	kW	160	12.	Tolerance on current	%	0 to +5%
		(b) Maximum Permissible I2R Losses of Reactor at rated Voltage, Frequency and at 75° C for 420kV, 125 MVAR, 3-Phase	kW	90	13.	Ratio of zero sequence reactance to positive reactance (X0/X1)		Between 0.9 & 1.0.
		(c) Maximum Permissible load Losses at rated Voltage, Frequency and at 75° C (kW) for 420kV, 50 MVAR, 3-Phase Reactor	kW	85	14.	Temperature rise over 50 °C Ambient Temp. at 420 kV		
					i)	Top oil measured by thermometer	°C	40
					ii)	Average winding measured by resistance method	°C	45
					15.	Winding hot spot temperature rise over yearly weighted average temperature of 32 °C	°C	61
	11.	Windings						

Sl. No.	Existing Clause				New / Revised Clause			
	a)	Insulation level (LI/SI/PF)		kVp/ kVp/kVrms	16.	Max. tank surface temperature	°C	110
		HV		1300/1050/-	17.	Max design ambient temperature	°C	50
		Neutral		550/-/230	18.	Windings		
	b)	Tan delta of windings	%	< 0.5	i)	Lightning Impulse withstand Voltage		
	12.	Partial discharge (PD) level at 1.58 Ur/ √3	pC	< 100		Line end	kV_p	1300
	13.	Vibration & Tank stress level at rated voltage and frequency		≤ 200 microns peak to peak; Average: ≤60 microns peak to peak. Stress: <		Neutral	kV_p	550
	14.	Noise level at rated voltage and frequency	dB	< 80	ii)	Chopped Wave Lightning Impulse Withstand Voltage		
	15.	Bushing				Line end	kV_p	1430
	a)	Rated voltage : HV / Neutral	kV	420/145	iii)	Switching Impulse withstand Voltage at Line end	kV_p	1050
	b)	Rated current (Min.) HV /	A	800/800	iv)	One Minute Power Frequency withstand Voltage		
	c)	Insulation level (LI/SI/PF)		kVp/ kVp / kVrms		Neutral	kVrms	230
		HV		1425/1050/695	19.	Tan-delta of windings		< 0.005
		Neutral		650/-/305	20.	Neutral earthing		Solidly Earthed
	d)	Tan delta of bushings : HV /	%	< 0.5	21.	Whether neutral brought out		Yes (through 145kV class bushing)
	e)	PD of bushings at level Um	pC	<10	22.	Bushing		
	16.	Insulating Oil		virgin high grade inhibited,	i)	Rated voltage		
	….					Line bushing	kV	420
						Neutral bushing	kV	145
					ii)	Rated current		
						Line bushing	A	800

Sl. No.	Existing Clause	New / Revised Clause

	Neutral bushing	**A**	**800**
iii)	**Lightning Impulse withstand Voltage**		
	Line bushing	**kV_p**	**1425**
	Neutral bushing	**kV_p**	**650**
iv)	**Switching Impulse withstand Voltage of Line bushing**	**kV_p**	**1050**
v)	**1minute power frequency withstand of bushings (dry)**		
	Line bushing	**kV rms**	**695**
	Neutral bushing	**kV rms**	**305**
vi)	**Minimum creepage distance**		**(Specific Creepage Distance: of 25mm/kV corresponding to highest line to line voltage)**
	Line bushing	**mm**	**10500**
	Neutral bushing	**mm**	**3625**
vii)	**Partial discharge of bushings at Ur (line end and neutral)**	**pC**	**< 10**
23.	**Maximum partial discharge level at 1.58Ur/√3**	**pC**	**100**
24.	**Vibration and tank stress at rated voltage**		**Max ≤200microns peak to peak** **Average ≤ 60microns peak to peak** **Tank stress: ≤2.0kg/sq.mm at any point of tank**

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<td></td>
<td>Neutral Grounding Reactor (NGR) and Surge Arrester for 400kV Line Reactors <u>(as applicable)</u>

<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.</u> <u>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.</u> NGR shall be rated for continuous current of 10A and short time current of 60A r.m.s for 10 seconds. <u>It shall be solidly connected between neutral of shunt reactor and earth.</u>

The surge arresters (rated voltage 120kV) shall be of <u>heavy duty station class type. It shall be</u> physically located between the neutral of shunt reactor (brought out at 145kV class bushing) and neutral</td>
<td>
<table>
<tr><td>25.</td><td><u>Maximum noise pressure level at rated voltage & frequency</u></td><td><u>dB</u></td><td colspan="2"><u>80</u></td></tr>
<tr><td>26.</td><td><u>Maximum Permissible Losses of Reactor at rated current and frequency and at 75°C</u></td><td></td><td><u>Total loss</u></td><td><u>I^2R Loss</u></td></tr>
<tr><td><u>i)</u></td><td><u>125MVAr 420kV</u></td><td><u>kW</u></td><td><u>160</u></td><td><u>90</u></td></tr>
<tr><td><u>ii)</u></td><td><u>50MVAr 420 kV</u></td><td><u>kW</u></td><td><u>85</u></td><td><u>45</u></td></tr>
<tr><td><u>27.</u></td><td><u>Insulating oil</u></td><td></td><td colspan="2"><u>Unused inhibited or uninhibited transformer oil conforming to IEC-60296:2012</u></td></tr>
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<u>Neutral Grounding Reactor (NGR) and Surge Arrester for 400kV Line Reactors</u>

<u>NGR can be oil filled or air core type. 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 60 seconds. However, the air core 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 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>
</td>
</tr>
</table>

Sl. No.	Existing Clause	New / Revised Clause
	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.	**The surge arresters (rated voltage 120kV) shall be provided & 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.**
12.	**2.3 Circuit Breakers (AIS)** 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 & Tie bay circuit breakers of line with non-switchable line reactors, Bus reactors and **765/400kV** Transformers **(whenever applicable)**.	**2.3. Circuit Breakers (AIS)** The circuit breakers and accessories shall conform to IEC: 62271-100, IEC: 62271-1 and shall be of SF6 Type. **The circuit breakers shall be of class C2-M2 (as per IEC) with regard to restrike probability during capacitive current breaking and mechanical endurance.** 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 & Tie bay circuit breakers of line with non-switchable line reactors, Bus reactors and Transformers.
13.	**2.4 Isolators (AIS)** 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	**2.4 Isolators (AIS)** 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

Sl. No.	Existing Clause	New / Revised Clause
	220kV shall be of extended mechanical endurance class-M2 **and all earth switches shall be class M0 as per IEC-622/1-102**. 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.	220kV shall be of extended mechanical endurance class-M2 and **suitable for bus transfer current switching duty.** 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.
14.	**2.5 Current Transformers (AIS)** 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 & protection system for better sensitivity and accuracy.	**2.5 Current Transformers (AIS)** 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 & protection system **(not more than 20VA for metering core)** for better sensitivity and accuracy. **The Instrument security factor shall be less than 5.**
15.	**2.6 Capacitor Voltage Transformers (AIS)** 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 burden requirement of metering & protection system for better sensitivity and accuracy.	**2.6 Capacitor Voltage Transformers (AIS)** 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 burden requirement of metering & protection system **(not more than 50VA for metering core)** for better sensitivity and accuracy.

Sl. No.	Existing Clause	New / Revised Clause
16.	**2.7 Surge Arresters (AIS)** 336kV & 216kV Station class, **current limiting**, heavy duty gapless type Surge arresters conforming to IEC 60099-4 in general shall be provided for 420kV & 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 & 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.	**2.7 Surge Arresters (AIS)** 336kV & 216kV Station class, heavy duty gapless type Surge arresters conforming to IEC 60099-4 in general shall be provided for 420kV & 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 & 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.
17.	**2.8 Projection Relaying & Control System** 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.	**2.8 Projection Relaying & Control System** 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. **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.**
18.	**2.8 a) Transmission Lines Protection** 400kV and 220kV lines shall have Main-I numerical three zone distance protection scheme with carrier aided inter-tripping feature. 400kV and 220kV lines shall also have Main-II numerical distance protection	**2.8 a) Transmission Lines Protection** 400kV and 220kV lines shall have Main-I numerical three zone distance protection scheme with carrier aided inter-tripping feature. 400kV and 220kV lines shall also have Main-II numerical distance protection

Sl. No.	Existing Clause	New / Revised Clause
	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 **and** manufacturing platform. 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 & control cabling and integration with SAS at remote end shall be provided by respective bay owner **……..**	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 **or different principle of operation**. **However,** 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 & control cabling and integration with SAS at remote end shall be provided by respective bay owner **……..**
19.	**2.8 b) Auto Transformer Protection** **……..** Suitable monitoring, control (operation of associated circuit breaker & 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 **open delta protection is required 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 the auxiliary system or in the control & protection IEDs to be provided for autotransformer.	**2.8 b) Auto Transformer Protection** **……..** Suitable monitoring, control (operation of associated circuit breaker & 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 **other necessary protection shall** 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 & protection IEDs to be provided for autotransformer.
20.	**2.9 a)……..** The functions of control, annunciation, disturbance recording, event logging and measurement of electrical parameters shall be integrated in Substation Automation System. **The Automation System shall be provided with the facility of communication and control for remote end operation so that by**	**2.9 a)……..** The functions of control, annunciation, disturbance recording, event logging and measurement of electrical parameters shall be integrated in Substation Automation System.

Sl. No.	Existing Clause	New / Revised Clause
	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. At new substations, the Substation Automation System (SAS) shall be suitable for operation and monitoring of the complete substation including proposed future bays/elements	At new substations, the Substation Automation System (SAS) shall be suitable for operation and monitoring of the complete substation including proposed future bays/elements
21.	**3.1. AC & DC power supplies** For catering the requirements of three phase & single phase AC supply and DC supply for various substation equipment, the following arrangement is envisaged:- i) …….. Additionally, Active Energy Meters may be provided at the same point in the 33kV tertiary of Transformer by local SEB/DISCOM for energy …. **iii)** Suitable AC & DC distribution boards and associated LT Switchgear shall be provided at new substation. **For new substation, following switch boards with minimum rating as specified here under shall be considered with duplicate supply:** (a) 415V Main Switch board – **2** nos. **(two sections separated by**	**3.1. AC & DC power supplies** For catering the requirements of three phase & single phase AC supply and DC supply for various substation equipment, the following arrangement is envisaged:- i) …….. Additionally, Active Energy Meters may be provided at the same point in the 33kV tertiary of Transformer by local SEB/DISCOM for energy **accounting** …. **iii)** Suitable AC & DC distribution boards and associated LT Switchgear shall be provided at new substation. **Sizing of LT Switchgear shall be suitable to cater the requirement for all present and future bays. AC & DC distribution boards shall have modules for all the present and future feeders as specified.** **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:**

Sl. No.	Existing Clause	New / Revised Clause
	one bus coupler) (b) AC distribution board – **2** nos. **(two sections separated by one bus coupler)** (c) …. (f) 48 Volt DC distribution board – 2 nos. **Sizing of LT Switchgear shall be suitable to cater the requirement for all present and future bays. AC & DC distribution boards shall have modules for all the feeders (including future as specified).** ……	(a) 415V Main Switch board – **1** no. (b) AC distribution board – **1** no. (c) …. (f) 48 volt DC distribution board – 2 nos. ……
22.	**3.2 Fire Fighting System** …. 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. **Beam type heat detection for GIS hall fire protection system shall be provided for all the GIS halls.** At existing substations, the fire-fighting systems as available shall be extended to meet the additional requirements.	**3.2. Fire Fighting System** ….. 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. At existing substations, the fire-fighting systems as available shall be extended to meet the additional requirements.
23.	**3.7 Visual monitoring system for watch and ward of substation premises:** 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.**	**3.7 Visual monitoring system (VMS) for watch and ward of substation premises:** 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) panel room, all the gates of switchyard and all entry and exit points of control room building and accordingly the**

Sl. No.	Existing Clause	New / Revised Clause
	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: **1. The operation of each and every isolator pole of the complete yard in case of AIS Substation.** **2. The Operation of each bay bays of GIS Hall as applicable.** **3. All the Transformer and Reactors, all the Entrance doors of Control Room Building, GIS hall and any other building as applicable.** **4. All the gates of switchyard.** **5. Main entrance Gate** **6. All other major AIS Equipment (such as CB, CT, CVT, SA etc. as applicable)** **At existing substations, the visual monitoring system as available shall be augmented as required.**	**location of cameras shall be decided. The camera shall be high definition colour 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. **All camera recordings shall have Camera ID & 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.**
24.	**4.0. General Facilities** **....** **e)** In 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**. 3000A.**	**4.0. General Facilities** **...** **e)** In 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**. 3150A.**
25.	**PLCC** **PLCC & 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**	**Deleted**

Sl. No.	Existing Clause	New / Revised Clause
	equipment shall in brief include the following:- **Coupling device, line traps, carrier terminals, protection couplers, HF cables, PABX (if applicable) and maintenance and testing instruments.** **A telephone exchange (PABX) of 24 lines shall be provided at new substations as means of effective communication among various buildings of the substation, remote end substations and with control centers (RLDC/SLDC) etc.** **Coupling devices shall be suitable for phase to phase coupling for 765kV & 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.** **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.** **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.** **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**	

Sl. No.	Existing Clause	New / Revised Clause
	for both ends of transmission lines not covered under present scope shall be provided by developer of lines. However, CVT & Wave trap for all the line bays under present scope shall be provided by TSP. TSP shall provide/undertake necessary addition/modification/shifting/re-commissioning etc. of PLCC equipment due to LILO of transmission lines (wherever applicable). **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.**	
26.	**SPECIFIC TECHNICAL REQUIREMENTS FOR COMMUNICATION** In order to meet the requirement for grid management and operation of substations, Transmission Service Provider (TSP) shall conform to the following requirements. **LILO of both circuits of Parli(PG) – Pune(GIS) 400kV D/c line at Kallam PS** On LILO of both Ckt. of Parli(PG) – Pune(GIS) 400kV D/c line at Kallam PS, two (02) nos OPGW containing 24 Fibres is to be installed in LILO portion (1 no 24-F OPGW for Line-In and 1 No OPGW for Line-Out portion) by the TSP in place of conventional earth wire during the construction of line. The installation of OPGW shall be done from LILO IN and LILO Out Tapping Points of Parli (PG) – Pune (GIS) 400kV D/c line to gantry of at Kallam PS and shall be terminated in Joint Boxes to be provided by TSP at Kallam PS Gantry. In case of requirement of repeater to establish link between Parli -Kallam PS or Pune – Kallam PS, the OPGW (48F) connectivity from power line crossing point upto repeater station shall also be in the scope of TSP. **Maintenance of**	**SPECIFIC TECHNICAL REQUIREMENTS FOR COMMUNICATION** In order to meet the requirement for grid management and operation of substations, Transmission Service Provider (TSP) shall conform to the following requirements. **1. LILO of both circuits of Parli(PG) – Pune(GIS) 400kV D/c line at Kallam PS** **OPGW** On LILO of both Ckt. of Parli(PG) – Pune(GIS) 400kV D/c line at Kallam PS, two (02) nos OPGW containing 24 Fibres is to be installed in LILO portion (1 no 24-F OPGW for Line-In and 1 No OPGW for Line-Out portion) by the TSP in place of conventional earth wire during the construction of line. The installation of OPGW shall be done from LILO IN and LILO Out Tapping Points of Parli (PG) – Pune (GIS) 400kV D/c line to gantry of at Kallam PS and shall be terminated in Joint Boxes to be provided by TSP at Kallam PS Gantry. In case of requirement of repeater to establish link between Parli -Kallam PS or Pune – Kallam PS, the OPGW (48F) connectivity from power line crossing point upto repeater station shall also be in the scope of TSP. Since, there is no

Sl. No.	Existing Clause	New / Revised Clause
	OPGW shall be responsibility of TSP. Since, there is no OPGW in Parli (PG) – Pune (GIS) line, TSP to install, one OPGW containing 24 Fibres in place of one conventional earth wire of Parli(PG) – Pune(GIS) existing transmission line owned by M/s Adani in live line condition.	OPGW in Parli (PG) – Pune (GIS) line, TSP to install, one OPGW containing 24 Fibres in place of one conventional earth wire of Parli(PG) – Pune(GIS) existing transmission line owned by M/s Adani in live line condition. **Maintenance of OPGW shall be responsibility of TSP.** **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.** **PLCC** **PLCC & 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:-** • **Coupling device, line traps, carrier terminals, protection couplers, HF cables, PABX (if applicable) and maintenance and testing instruments.** • **A telephone exchange (PABX) of 24 lines shall be provided at new substations as means of effective communication among various buildings of the substation, remote end substations and with control centers (RLDC/SLDC) etc.** • **Coupling devices shall be suitable for phase to phase coupling for 765kV & 400kV Transmission lines. The pass band of**

Sl. No.	Existing Clause	New / Revised Clause
		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. • **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.** • **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.** • **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 & Wave trap for all the line bays under present scope shall be provided by TSP.** • **TSP shall provide/undertake necessary addition/modification/shifting/re-commissioning etc. of PLCC equipment at remote ends substations due to LILO of transmission lines (wherever applicable).** • **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**

Sl. No.	Existing Clause	New / Revised Clause
		<u>respective bay owner.</u>
	Establishment of 2x500MVA, 400/220kV s/s near Kallam PS …….	**Establishment of 2x500MVA, 400/220kV s/s near Kallam PS** **…….**