Amendment No. 1 dated 13.10.2023 to

RFP documents for Selection of Bidder as Transmission service provider for Establish Inter- State Transmission System for "Transmission Scheme for integration of Renewable Energy Zone (Phase-II) in Koppal-II (Phase-A & B) and Gadag-II (Phase- A) in Karnataka"

<table>
<tr><th>S no.</th><th>Existing Provisions</th><th>Revised Provisions</th></tr>
<tr><td>1.</td><td>
ANNEXURE- C1
SPECIFIC TECHNICAL REQUIREMENTS FOR TRANSMISSION SYSTEM

A.7.0 The relevant conductor configuration shall be as follows: -
<table>
<tr><th>Transmission line</th><th>ACSR Conductor specified</th><th>Equivalent AAAC conductor based on 53.5% conductivity of Al Alloy</th><th>Equivalent minimum size of AL59 conductor based on 59% conductivity of AL Alloy*</th><th>Sub-conductor Spacing</th></tr>
<tr><td>765kV D/C (Hexa Zebra) transmission lines</td><td>……</td><td>…….</td><td>……</td><td>..</td></tr>
</table>
Note:

1. *To Select any size above the minimum, the sizes mentioned in the relevant Indian standard i.e. IS-398(part-6) shall be followed.

2. 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.
</td><td>
ANNEXURE- C1
SPECIFIC TECHNICAL REQUIREMENTS FOR TRANSMISSION SYSTEM

A.7.0 The relevant conductor configuration shall be as follows: -
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<tr><th>Transmission line</th><th>ACSR Conductor specified</th><th>Equivalent AAAC conductor based on 53.5% conductivity of Al Alloy</th><th>Equivalent minimum size of AL59 conductor based on 59% conductivity of AL Alloy*</th><th>Sub-conductor Spacing</th></tr>
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<table>
<tr><td></td><td></td><td>
<table>
<tr><td>400kV D/C (Quad Moose) transmission lines</td><td>Moose: Stranding 54/3.53mm -Al + 7/3.53 mm- Steel, 31.77 mm diameter 528.5 sq. mm, Aluminium area,

Maximum DC Resistance at 20°C (Ω/km):0.05552
Minimum UTS: 161.20 kN</td><td>Stranding details: 61/3.55mm 31.95mm diameter; 604 sq. mm Aluminium alloy area

Maximum DC Resistance at 20°C (Ω/km): 0.05506
Minimum UTS: 159.80 kN</td><td>Stranding details: 61/3.31 mm 29.79 mm diameter;

525 sq. mm Aluminium alloy area

Maximum DC Resistance at 20°C (Ω/km): 0.0566
Minimum UTS: 124.70 kN</td><td>457 mm</td></tr>
</table>
Note:

1. *To Select any size above the minimum, the sizes mentioned in the relevant Indian standard i.e. IS-398(part-6) shall be followed.

2. The transmission lines shall have to be designed for a maximum operating conductor temperature of 85 deg C.</td></tr>
<tr><td>2.</td><td>ANNEXURE- C1
SPECIFIC TECHNICAL REQUIREMENTS FOR TRANSMISSION SYSTEM

A.8.0 The required phase to phase spacing and horizontal spacing</td><td>ANNEXURE- C1
SPECIFIC TECHNICAL REQUIREMENTS FOR TRANSMISSION SYSTEM

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</table>

	for 765kV line shall be governed by the tower design as well as minimum live metal clearances for 765kV voltage level under different insulator swing angles. However, the phase to phase spacing for 765kV line shall not be less than 15 m.	765kV **and 400 kV** line shall be governed by the tower design as well as minimum live metal clearances for 765kV **and 400 kV** voltage level under different insulator swing angles. However, the phase to phase spacing **shall not be less than 8 m for 400 kV line and 15 m for 765 kV line.**
	A.9.0 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. Since these clearances for 765kV are not included in CEA Regulation/ Indian Standard, following values shall be considered: a) Minimum live metal clearances for 765 kV line: (i) <u>Under stationary conditions</u> From tower body: For 765 kV D/C: 6.1 m For 765 kV S/C: 5.6 m (ii) <u>Under swing conditions</u>	A.9.0 **Electrical clearances including minimum live metal clearance, ground clearance and minimum mid span separation between earth wire and conductor, as given below shall be considered:** **I. For 400 kV lines:** **(a) <u>Minimum live metal clearances:</u>** **(i) Under stationary conditions:** **From tower body: 3.05m** **(ii) Under Swing conditions:**
		(b) Minimum ground clearance: 8.84 m **(c) Minimum mid span separation between earthwire and conductor: 9.0 m** **II. <u>For 765 kV line:</u>** **(a) <u>Minimum live metal clearances:</u>**

Wind pressure Condition	Minimum electrical clearance
a) Swing angle (25º)	4.4 mtrs

Wind Pressure Condition	Minimum Electrical Clearance
a) Swing angle (22º)	**3.05 m**
b) Swing angle (44º)	**1.86 m**

	b) Swing angle (55º)	1.3 mtrs

a) Minimum ground clearance: 18 m

b) Minimum mid span separation between earthwire and conductor: 9.0 m

A.10.0 **Shielding angle shall not exceed 20 deg for 765kV D/C Line transmission line.**

A.11.0 The Fault current for design of line shall be 50kA for 1 sec for 765kV.

A.12.0 In case of 765kV voltage class lines, at least one out of two earth wires shall be OPGW and second earth wire, if not OPGW, shall be either of galvanized standard steel (GSS) or AACSR or any other suitable conductor type depending upon span length and other technical consideration.

A.13.0 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. If site condition demands, multiple earthing or use of earthing enhancement compound shall be used.

(i) <u>Under stationary conditions</u>

From tower body: For 765 kV D/C: 6.1 m
For 765 kV S/C: 5.6 m

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

Wind pressure Condition	**Minimum electrical clearance**
a) Swing angle (25º)	**4.4 m**
b) Swing angle (55º)	**1.3 m**

(b) Minimum ground clearance: 18 m

(c) Minimum mid span separation between earthwire and conductor: 9.0 m

A.10.0 Shielding angle shall not exceed 20 deg for 400 kV D/C Line transmission line and 10 degree for 765 kV D/C Line transmission line.

A.11.0 The Fault current for design of line shall be 63 kA for 1 sec for 400kV and 50kA for 1 sec for 765kV.

A.12.0 In case of 400kV and 765kV voltage class lines, at least one out of two earth wires shall be OPGW and second earth wire, if not OPGW, shall be either of galvanized standard steel (GSS) or AACSR or any other suitable conductor type depending upon span length and other technical

<table>
<tr><td></td><td></td><td>consideration.

A.13.0 Each tower shall be earthed such that tower footing impedance does not exceed 10 ohm. Pipe type or Counterpoise type earthing shall be provided in accordance with relevant IS. Additional earthing shall be provided on every 7 to 8 km distance for direct earthing of both shield wires. If site condition demands, multiple earthing or use of earthing enhancement compound shall be used.</td></tr>
<tr><td>3.</td><td>SPECIFIC TECHNICAL REQUIREMENTS FOR SUBSTATION

The proposed 765/400/220kV Koppal-II PS & 400/220kV Gadag-II PS shall be conventional AIS type and 765kV Narendra extension shall be GIS type generally conforming to the requirements of CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022 & CEA (Safety requirements for construction, operation and maintenance of electrical plants and electric lines) Regulations 2011, as amended from time to time.</td><td>SPECIFIC TECHNICAL REQUIREMENTS FOR SUBSTATION

The proposed 765/400/220kV Koppal-II PS & 400/220kV Gadag-II PS shall be conventional AIS type and 765kV Narendra extension shall be GIS type generally conforming to the requirements of CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022 as amended from time to time. Other CEA Regulations and MoP guidelines, as applicable, shall also be followed</td></tr>
<tr><td>4.</td><td>SPECIFIC TECHNICAL REQUIREMENTS FOR SUBSTATION

B.1.1 Insulation Coordination

The system design parameters for substations/switchyards shall be as given below:
<table><tr><th>Sl. No</th><th>Description of parameters</th><th>765/400/220kV Koppal-II PS & 400/220kV Gadag-II PS</th><th>765 kV Nare</th></tr></table></td><td>SPECIFIC TECHNICAL REQUIREMENTS FOR SUBSTATION

B.1.1 Insulation Coordination

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</table>

					ndra New GIS Extn
		765 kV System	**400 kV System**	**220 kV System**	**765 kV System**
5.	Rated Insulation levels				
ii)	Switching impulse withstand voltage (250/2500 micro sec.) dry and wet	..	..	…	1550 kVp
iii)	One minute power frequency dry withstand voltage (rms)	960kV	..	…	..

B.1.2 Switching Scheme

…….

Notes: -

i) ….

.

		PS			**New GIS Extn**
		765 kV System	**400 kV System**	**220 kV System**	**765 kV System**
5.	Rated Insulation levels				
ii)	Switching impulse withstand voltage (250/2500 micro sec.) dry and wet	…	…	-	**1425kVp**
iii)	One minute power frequency dry withstandvoltage (rms)	**830 kV**	…	-	…

B.1.2 Switching Scheme

…….

<table>
<tr>
<td></td>
<td>.
.
x) Gadag-II PS:
…….
<table><tr><th>220kV Bus Section-1</th><th>220kV Bus Section-2</th><th>220kV Bus Section-3(F)</th><th>220kV Bus Section-4 (F)</th></tr><tr><td>.</td><td>..</td><td>…</td><td>…</td></tr></table>
xi) Narendra New GIS Extension: Koppal-II PS – Narendra New 765kV D/c line shall be terminated in the new diameters and the bay configuration shall be Line -Tie- Line (F) (with Switchable Line Reactor).</td>
<td>Notes: -
ii) ….
.
.
.
x) Gadag-II PS:
…….
<table><tr><th>220kV Bus Section-1</th><th>220kV Bus Section-2</th><th>220kV Bus Section-3(Future)</th><th>220kV Bus Section-4 (Future)</th></tr><tr><td>..</td><td>…</td><td>.</td><td>.</td></tr></table>
xi) Narendra New GIS Extension: Koppal-II PS – Narendra New 765kV D/c line shall be terminated in the new diameters and the bay configuration shall be Line -Tie- Line (Future) (with Switchable Line Reactor).</td>
</tr>
<tr>
<td>5.</td>
<td>SPECIFIC TECHNICAL REQUIREMENTS FOR SUBSTATION

B.2.1 (765/√3)/(400/√3)/33 kV, Single Phase Autotransformer

500 MVA, (765/√3)/(400/√3)/33kV, 1-phase Transformer (including arrangement for 3-phase bank formation of 1500 MVA) shall conform to CEA's "Standard Specifications and Technical Parameters for Transformers and Reactors (66 kV and above)" available on CEA website.

Spare 1-phase Transformer unit shall be placed and</td>
<td>SPECIFIC TECHNICAL REQUIREMENTS FOR SUBSTATION

B.2.1 (765/√3)/(400/√3)/33 kV, Single Phase Autotransformer

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Spare 1-phase Transformer unit shall be placed and connected in such</td>
</tr>
</table>

	connected in such a way that in case of fault in any unit of any of the transformer banks (including for future transformer banks) can be replaced by spare unit without physically moving it.	a way that **the spare unit can be utilized to replace** any unit of any of the transformer banks (including for future transformer banks) without physically moving it.
	B.2.2 (765/√3) kV, Single Phase Shunt Reactor 80MVAR, 765/√3 kV, 1-Phase Reactor (including arrangement for 3-phase bank formation of 240MVAR) & 110MVAR, 765/√3 kV, 1-Phase Reactor (including arrangement for 3-phase bank formation of 330MVAR) shall conform to CEA's "Standard Specifications and Technical Parameters for Transformers and Reactors (66 kV and above)" available on CEA website. …… **Neutral Grounding Reactor and Surge Arrester for 765 kV Line Reactors (as applicable):** The neutral of the line reactors (wherever provided) shall be grounded through adequately rated Neutral Grounding Reactors (NGR) to facilitate single phase auto-reclosure, provided that the NGR shall be provided with bypass arrangement **through a breaker** so that the line reactor can be used as Bus reactor as and when required. The neutral of bus reactor shall be solidly grounded. …….	**B.2.2 (765/√3) kV, Single Phase Shunt Reactor** **80 MVAR & 110MVAR, 765/√3 kV, 1-Phase Reactor (including arrangement for 3-phase bank formation of 240 MVAR and 330 MVAR respectively), shall conform to CEA's "Standard Specifications and Technical Parameters for Transformers and Reactors (66 kV and above voltage class)" as amended up to date available on CEA website.** …… **Neutral Grounding Reactor and Surge Arrester for 765 kV Line Reactors (as applicable):** The neutral of the line reactors (wherever provided) shall be grounded through adequately rated Neutral Grounding Reactors (NGR) to facilitate single phase auto-reclosure, provided that the NGR shall be provided with **suitable** bypass arrangement so that the line reactor can be used as Bus reactor as and when required. The neutral of bus reactor shall be solidly grounded. …….

	The Ohmic value of NGR for Line Reactors shall be as follows: Sl. No. | Line Name | NGR value 1. | Koppal-II PS – Narendra New 765kV D/c line with 240 MVAr SLR at Koppal-II PS end | ____ Ohms **B.2.3 400/220/33kV, 3-phase Autotransformer** 500 MVA 400/220/33kV, 3-phase Transformer shall conform to CEA's "Standard Specifications and Technical Parameters for Transformers and Reactors (66 kV and above)" as amended up to date available on CEA website. …. **B.2.5.1 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 40ms for 765kV & 400kV circuit breakers and 60ms for 220kV circuit breakers. The Circuit breakers controlling 765kV lines shall be provided with pre-insertion closing resistor of about 450 ohms maximum with 9 ms insertion time or Controlled Switching Device. The Circuit	The Ohmic value of NGR for Line Reactors shall be as follows: Sl. No. | Line Name | NGR value 1. | Koppal-II PS – Narendra New 765kV D/c line with 240 MVAr SLR at Koppal-II PS end | **600 Ohms** **B.2.3 400/220/33kV, 3-phase Autotransformer** 500 MVA 400/220/33kV, 3-phase **autotransformer** shall conform to CEA's "Standard Specifications and Technical Parameters for Transformers and Reactors (66 kV and above **voltage class**)" as amended up to date available on CEA website. ….. **B.2.5.1 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. **Each breaker shall have two sets of trip circuits which would be connected to separate DC supplies for greater reliability.** The rated break time shall

	breakers controlling 400kV lines 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. 765kV, 400kV and 220kV Circuit breakers shall be provided with single phase and three phase auto reclosing. 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 Circuit breakers of switchable line reactor and in Main & Tie circuit breakers of line with non-switchable line reactors and Bus reactors and 765/400kV Transformers. **B.2.5.2 Isolators (AIS)** The isolators shall comply to IEC 62271-102 in general.765kV Isolator design shall be double break or vertical break or knee-type. 400kV & 220kV shall be double break type. All Isolators and earth switches shall be motor operated. Earth switches shall be provided at various locations to facilitate maintenance. Isolator rated for 765kV, 400kV & 220kV shall be of extended mechanical endurance class - M2 and suitable for bus transfer current switching duty as per IEC-62271-102. Main blades and earth blades shall be interlocked and interlock shall be fail safe type. 765kV, 400kV & 220kV earth switches for line isolator shall be suitable for induced current switching duty as defined for Class-B.	not exceed 40 ms for 765 kV & 400 kV circuit breakers and 60 ms for 220 kV circuit breakers. The Circuit breakers controlling 765 kV lines shall be provided with pre-insertion closing resistor of about 450 ohms maximum with 9 ms insertion time or Controlled Switching Device. The Circuit breakers controlling 400kV lines 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. 765kV, 400kV and 220kV Circuit breakers shall be provided with single phase and three phase auto reclosing. 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 Circuit breakers 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. **B.2.5.2 Isolators (AIS)** The isolators shall comply to IEC 62271-102 in general. 765 kV isolator design shall be double break or vertical break or knee-type. 400 kV & 220 kV **isolator** shall be double break type. All isolators and earth switches shall be motor operated. Earth switches shall be provided at various locations to facilitate maintenance. Isolator rated for 765kV, 400kV & 220kV shall be of extended mechanical endurance class - M2 and suitable for bus transfer current switching duty as per IEC-62271-102. Main blades and earth blades shall be interlocked and interlock shall be fail safe type. 765kV, 400kV & 220kV earth switches for line isolator shall be suitable for induced current switching duty as defined

	B.2.5.3 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 765kV & 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. The instrument security factor shall be less than 5 for CTs upto 400kV and less than 10 for CTs of 765kV voltage class. B.2.5.4 Capacitor Voltage Transformers (AIS) ……..	for Class-B **B.2.5.3 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 765kV & 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 for CTs upto 400kV and less than 10 for CTs of 765kV voltage class. B.2.5.4 **Capacitive** Voltage Transformers (AIS) **…….**
	B.2.6.1 Circuit Breakers (GIS) 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	**B.2.6.1 Circuit Breakers (GIS)** 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 765kV.

	(milli second) for 765kV. Circuit breakers shall be provided with single phase and three phase auto reclosing. The Circuit breakers controlling 765kV lines shall be provided with pre-insertion closing resistor of about 450 ohms with 9 ms insertion time or Controlled Switching Device (CSD). 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 & Tie bay circuit breakers of line with non-switchable line reactors, Bus reactors and 765/400kV Transformers. **B.2.6.2 Isolators (GIS)** 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 isolators and earth switches shall be motor operated type. Isolator shall be of extended mechanical endurance class-M2 and 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 **& cable terminations** & 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	Circuit breakers shall be provided with single phase and three phase auto reclosing. **Each breaker shall have two sets of trip circuits which would be connected to separate DC supplies for greater reliability**. The Circuit breakers controlling 765kV lines shall be provided with pre-insertion closing resistor of about 450 ohms with 9 ms insertion time or Controlled Switching Device (CSD). 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 & Tie bay circuit breakers of line with non-switchable line reactors, Bus reactors and 765/400 kV Transformers. **B.2.6.2 Isolators (GIS)** 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 isolators and earth switches shall be motor operated type. Isolator shall be of extended mechanical endurance class-M2 and 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 & 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. ….. **B.2.6.4 Voltage Transformer (GIS)** The voltage transformers shall conform to IEC-61869. Voltage transformers shall be of electromagnetic type with SF_6 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 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-SF_6 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 & protection system (not more than 50VA for metering core) for better sensitivity and accuracy.	switching duty as defined for Class-B as per relevant standard. ….. **B.2.6.4 Voltage Transformer (GIS)** The voltage transformers shall conform to IEC-61869. Voltage transformers shall be of electromagnetic type with SF_6 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 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-SF_6 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 **out of which two shall be used for protection and one for metering**. 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 & protection system (not more than 50VA for metering core) for better sensitivity and accuracy. **The voltage transformer should be thermally and**

		dielectrically safe when the secondary terminals are loaded with the guaranteed thermal burdens.
	B.2.7 Protection Relaying & Control System ……. a)…… b) Auto Transformer Protection These shall have the following protections: i) ……. ii) …….. iii) Numerical Back-up Over-current and earth fault protection on HV & MV side iv) Numerical Over fluxing protection on HV & MV side v) …….. Further, Numerical Back-up Over-current and earth fault protection on HV & MV side of autotransformer shall not be combined with other protective functions **(except back up Impedance protection)** in the main relays and shall be independent relays. Besides these, power transformers shall also be provided with Buchholz relay, protection against high oil and winding temperature and pressure relief device etc.	**B.2.7 Protection Relaying & Control System** ……. a)…… b) Auto Transformer Protection These shall have the following protections: i) …….. ii) …… iii) Numerical Back-up Over-current and earth fault protection on HV & **IV** side iv) Numerical Over fluxing protection on HV & **IV** side v) …….. Further, Numerical Back-up Over-current and earth fault protection on HV & **IV** side of autotransformer shall not be combined with other protective functions in the main relays and shall be independent relays. Besides these, power transformers shall also be provided with Buchholz relay, protection against high oil and winding temperature

	…… **B.3.1 AC & DC power supplies** For catering the requirements of three phase & single phase AC supply and DC supply for various substation equipment (for present and future scope), the following arrangement is envisaged:- (i) For LT Supply at each new Substation, two (2) nos. of LT Transformers (minimum 800kVA for substations with highest voltage rating as 765kV & minimum 630kVA for substations with highest voltage rating as 400kV) shall be provided out of which one shall be **connected with SEB/DISCOM supply and other one shall be connected to tertiary of Transformer**. ……. **B.4.0 General Facilities** a) b) …… f) Boundary wall shall be brick masonry wall with RCC frame or	and pressure relief device etc. ……. **B.3.1 AC & DC power supplies** For catering the requirements of three phase & single phase AC supply and DC supply for various substation equipment (for present and future scope), the following arrangement is envisaged:- (ii) For LT Supply at each new Substation, two (2) nos. of LT Transformers (minimum 800kVA for substations with highest voltage rating as 765kV & minimum 630kVA for substations with highest voltage rating as 400kV) shall be provided which shall be **fed from two independent sources as per the CEA (Technical Standards for Connectivity to the Grid) Regulations, 2007.** …. **B.4.0 General Facilities** a) b) ……

	Stone masonry wall or Precast RCC wall under present scope along the property line of complete substation area including future switchyard area to prevent encroachment and unauthorized access. Minimum height of the boundary wall shall be of 1.8m from finished ground level (FGL) **as per CEA Measures Relating to Safety and Electric Supply Regulations.**	f) Boundary wall shall be brick masonry wall with RCC frame or Stone masonry wall or Precast RCC wall under present scope along the property line of complete substation area including future switchyard area to prevent encroachment and unauthorized access. Minimum height of the boundary wall shall be of 1.8 m from finished ground level (FGL).
6.	**Annexure C2** **Transmission Scheme for integration of Renewable Energy Zone (Phase-II) in Koppal-II (Phase-B) in Karnataka** **SPECIFIC TECHNICAL REQUIREMENTS FOR TRANSMISSION LINE** **……** A.7.0 The relevant conductor configuration shall be as follows: -	**Annexure C2** **Transmission Scheme for integration of Renewable Energy Zone (Phase-II) in Koppal-II (Phase-B) in Karnataka** **SPECIFIC TECHNICAL REQUIREMENTS FOR TRANSMISSION LINE** **……** A.7.0 The relevant conductor configuration shall be as follows: -

Transmission line	ACSR Conductor specified	Equivalent AAAC conductor based on 53.5% conductivity of Al Alloy	Equivalent minimum size of AL59 conductor based on 59% conductivity of AL Alloy*	Sub-conductor Spacing
….	……	….	…	……

Note:

1. *To Select any size above the minimum, the sizes mentioned in the relevant Indian standard i.e. IS-398(part-6) shall be followed.

2. 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.**

……

A.9.0 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**

Transmission line	ACSR Conductor specified	Equivalent AAAC conductor based on 53.5% conductivity of Al Alloy	Equivalent minimum size of AL59 conductor based on 59% conductivity of AL Alloy*	Sub-conductor Spacing
….	……	….	…	……

Note:

1. *To Select any size above the minimum, the sizes mentioned in the relevant Indian standard i.e. IS-398(part-6) shall be followed.

2. The transmission lines shall have to be designed for a maximum operating conductor temperature of 85 deg C.

……..

A.9.0 **Electrical** clearances including minimum live metal clearance, ground clearance and minimum mid span separation between earth wire and conductor as given below shall be considered:

……..

	and IS:5613. Since these clearances for 765kV are not included in CEA Regulation/ Indian Standard, following values shall be considered: …… A.10.0 Shielding angle shall not exceed 20 deg for 765kV D/C Line transmission line. ……. A.13.0 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. If site condition demands, multiple earthing or use of earthing enhancement compound shall be used. **……**	A.10.0 Shielding angle shall not exceed **10 degree** for 765 kV D/C Line transmission line. ……. A.13.0 Each tower shall be earthed such that tower footing impedance does not exceed 10 ohm. Pipe type or Counterpoise type earthing shall be provided in accordance with relevant IS. Additional earthing shall be provided on every 7 to 8 km distance for direct earthing of both shield wires. If site condition demands, multiple earthing or use of earthing enhancement compound shall be used. **…….**
7.	**SPECIFIC TECHNICAL REQUIREMENTS FOR SUBSTATION** The proposed extension of 765/400/220kV Koppal-II PS & extension of 765kV Raichur S/S shall be conventional AIS type generally conforming to the requirements of CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022	**SPECIFIC TECHNICAL REQUIREMENTS FOR SUBSTATION** The proposed extension of 765/400/220 kV Koppal-II PS & extension of 765 kV Raichur S/S shall be conventional AIS type generally conforming to the requirements of CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022 as amended from time to time.

<table>
<tr><td></td><td>& CEA (Safety requirements for construction, operation and maintenance of electrical plants and electric lines) Regulations 2011, as amended from time to time.</td><td>Other CEA Regulations and MoP guidelines, as applicable, shall also be followed</td></tr>
<tr><td>8.</td><td>SPECIFIC TECHNICAL REQUIREMENTS FOR SUBSTATION

B.1.1 Insulation Coordination

The system design parameters for substations/switchyards shall be as given below:
<table>
<tr><th rowspan="2">Sl. No</th><th rowspan="2">Description of parameters</th><th colspan="3">765 kV Koppal – II PS Extension</th><th>765 kV Raichur Extension</th></tr>
<tr><th>765 kV System</th><th>400 kV System</th><th>220 kV System</th><th>765 kV System</th></tr>
<tr><td>5.</td><td>Rated Insulation levels</td><td colspan="3"></td><td></td></tr>
<tr><td>ii)</td><td>Switching impulse withstand voltage (250/2500 micro sec.) dry and wet</td><td>….</td><td>..</td><td>…</td><td>…</td></tr>
<tr><td>iii)</td><td>One minute power frequency dry withstand</td><td>960kV</td><td>…</td><td>…</td><td>960 kV</td></tr>
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The system design parameters for substations/switchyards shall be as given below:
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<tr><td></td><td>……..</td><td></td><td></td><td></td><td></td></tr>
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</table>

	voltage (rms)				
	…….				

B.1.2 Switching Scheme

The switching schemes, as mentioned below, shall be adopted at various voltage levels of substation/switchyard:

Substation	765kV side	400kV side	220kV side
…	…..	……	…….
…..	….	…	…….

Notes: -

i. At 765kV & 400kV voltage level, any double circuit line consisting of two numbers feeders and originating from a transmission or generating switchyard shall not be terminated in one diameter.

ii. ……

……

B.2.1 (765/√3)/(400/√3)/33 kV, Single Phase Autotransformer

500 MVA, (765/√3)/(400/√3)/33kV, 1-phase Transformer (including arrangement for 3-phase bank formation of 1500 MVA) shall conform to CEA's "Standard Specifications and Technical Parameters for Transformers and Reactors (66 kV and above)" available on CEA website.

B.1.2 Switching Scheme

The switching schemes, as mentioned below, shall be adopted at various voltage levels of substation/switchyard:

Substation	765kV side	400kV side	220kV side
…	…..	……	…….
…..	….	…	…….

Notes: -

i) *At 765kV & 400kV voltage level, any double circuit line consisting of two numbers feeders and originating from* ***the same*** *transmission or generating switchyard shall not be terminated in one diameter.*

ii) *……*

……

B.2.1 (765/√3)/(400/√3)/33 kV, Single Phase Autotransformer

500 MVA, (765/√3)/(400/√3)/33kV, 1-phase **autotransformer** (including arrangement for 3-phase bank formation of 1500 MVA) shall conform to CEA's

	Spare 1-phase Transformer unit shall be placed and connected in such a way that in case of fault in any unit of any of the transformer banks (including for future transformer banks) can be replaced by spare unit without physically moving it. **B.2.2 (765/√3) kV, Single Phase Shunt Reactor** 110MVAR, 765/√3 kV, 1-Phase Reactor (including arrangement for 3-phase bank formation of 330MVAR) shall conform to CEA's "Standard Specifications and Technical Parameters for Transformers and Reactors (66 kV and above)" available on CEA website. …… **Neutral Grounding Reactor and Surge Arrester for 765kV Line Reactors (as applicable):** The neutral of the line reactors (wherever provided) shall be grounded through adequately rated Neutral Grounding Reactors (NGR) to facilitate single phase auto-reclosure, provided that the NGR shall be provided with bypass arrangement **through a breaker** so that the line reactor can be used as Bus reactor as and when required. The neutral of bus reactor shall be solidly grounded. …….. **B.2.3 400/220/33kV, 3-phase Autotransformer** 500 MVA 400/220/33kV, 3-phase Transformer shall conform to	"Standard Specifications and Technical Parameters for Transformers and Reactors (66 kV and above **Voltage Class**)" **as amended upto date** available on CEA website. Spare 1-phase Transformer unit shall be placed and connected in such a way that **the spare unit can be utilized to replace** any unit of any of the transformer banks (including for future transformer banks without physically moving it. **B.2.2 (765/√3) kV, Single Phase Shunt Reactor** 110 MVAR, 765/√3 kV, 1-Phase Reactor (including arrangement for 3-phase bank formation of 330 MVAR) shall conform to CEA's "Standard Specifications and Technical Parameters for Transformers and Reactors (66 kV and above **Voltage Class**)" **as amended upto date** available on CEA website. …….. **Neutral Grounding Reactor and Surge Arrester for 765kV Line Reactors (as applicable):** The neutral of the line reactors (wherever provided) shall be grounded through adequately rated Neutral Grounding Reactors (NGR) to facilitate single phase auto-reclosure, provided that the NGR shall be provided with **suitable** bypass arrangement so that the line reactor can be used as Bus reactor as and when required. The neutral of bus reactor shall be solidly grounded. ……

	CEA's "Standard Specifications and Technical Parameters for Transformers and Reactors (66 kV and above)" as amended up to date available on CEA website. …… **B.2.4.1 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 40ms for 765kV & 400kV circuit breakers and 60ms for 220kV circuit breakers. The Circuit breakers controlling 765kV lines shall be provided with pre-insertion closing resistor of about 450 ohms maximum with 9 ms insertion time or Controlled Switching Device. The Circuit breakers controlling 400kV lines 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. 765kV, 400kV and 220kV Circuit breakers shall be provided with single phase and three phase auto reclosing. 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 Circuit breakers of switchable line reactor and in Main & Tie circuit breakers of line with non-switchable line reactors and Bus reactors and 765/400kV Transformers. **B.2.4.2 Isolators (AIS)** The isolators shall comply to IEC 62271-102 in general.765kV Isolator design shall be double break or vertical break or knee-type. 400kV & 220kV shall be	**B.2.3 400/220/33kV, 3-phase Autotransformer** 500 MVA 400/220/33kV, 3-phase **autotransformer** shall conform to CEA's "Standard Specifications and Technical Parameters for Transformers and Reactors (66 kV and above **Voltage Class**)" as amended up to date available on CEA website. ……. **B.2.4.1 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. **Each breaker shall have two sets of trip circuits which would be connected to separate DC supplies for greater reliability**. The rated break time shall not exceed 40 ms for 765kV & 400kV circuit breakers and 60ms for 220kV circuit breakers. The Circuit breakers controlling 765kV lines shall be provided with pre-insertion closing resistor of about 450 ohms maximum with 9 ms insertion time or Controlled Switching Device. The Circuit breakers controlling 400 kV lines 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. 765 kV, 400 kV and 220 kV Circuit breakers shall be provided with single phase and three phase auto reclosing. 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 Circuit breakers 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.

	double break type. All Isolators and earth switches shall be motor operated. Earth switches shall be provided at various locations to facilitate maintenance. Isolator rated for 765kV, 400kV & 220kV shall be of extended mechanical endurance class - M2 and suitable for bus transfer current switching duty as per IEC-62271-102. Main blades and earth blades shall be interlocked and interlock shall be fail safe type. 765kV, 400kV & 220kV earth switches for line isolator shall be suitable for induced current switching duty as defined for Class-B. **B.2.4.3 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 765kV & 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. The instrument security factor shall be less than 5 for CTs upto 400kV and less than 10 for CTs of 765kV voltage class. **B.2.4.4 Capacitor Voltage Transformers (AIS)** ……	**B.2.4.2 Isolators (AIS)** The isolators shall comply to IEC 62271-102 in general.765 kV Isolator design shall be double break or vertical break or knee-type. 400 kV & 220 kV **isolator** 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 765 kV, 400 kV & 220 kV shall be of extended mechanical endurance class - M2 and suitable for bus transfer current switching duty as per IEC-62271-102. Main blades and earth blades shall be interlocked and interlock shall be fail safe type. 765 kV, 400 kV & 220 kV earth switches for line isolator shall be suitable for induced current switching duty as defined for Class-B. **B.2.4.3 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 765kV & 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 for CTs upto 400kV and less than 10 for CTs of 765kV voltage class. **B.2.4.4 Capacitive Voltage Transformers (AIS)** ……

	B.2.6 Protection Relaying & Control System **……** **Transmission Lines Protection** …… **b)Auto Transformer Protection** These shall have the following protections: i) …… ii) ……. iii) Numerical Back-up Over-current and earth fault protection on HV & MV side iv) Numerical Over fluxing protection on HV & MV side v) ….. vi) **Numerical Back up Impedance protection (HV Side)** Further, Numerical Back-up Over-current and earth fault protection on HV & MV side of autotransformer shall not be combined with other protective functions **(except back up Impedance protection)** in the main relays and shall be independent relays. Besides these, power transformers shall also be provided with Buchholz relay, protection against high oil and winding temperature and pressure relief device etc. Suitable monitoring, control (operation of associated circuit breaker &	**B.2.6 Protection Relaying & Control System** **……** **a) Transmission Lines Protection** …….. **b) Auto Transformer Protection** These shall have the following protections: i) ……. ii) …… iii) Numerical Back-up Over-current and earth fault protection on HV & **IV** side iv) Numerical Over fluxing protection on HV & **IV** side v) …….. Further, Numerical Back-up Over-current and earth fault protection on HV & **IV** side of autotransformer shall not be combined with other protective functions in the main relays and shall be independent relays. Besides these, power transformers shall also be provided with Buchholz relay, protection against high oil and winding temperature and pressure relief device etc. **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**

	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. **c)Reactor Protection** **……** **d)Bus bar Protection** **……** **e)Local Breaker Back up Protection** **…….** **B.3.1 AC & DC power supplies** For catering the requirements of three phase & single phase AC supply and DC supply for various substation equipment (for present and future scope), the following arrangement is envisaged:- **iii.** For LT Supply at each new Substation, two (2) nos. of LT Transformers (minimum 800kVA for substations with highest voltage rating as 765kV) shall be provided out of which one shall be **connected with SEB/DISCOM supply and other one shall be connected to tertiary of**	**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.** **c) Reactor Protection** **……** **d) Bus bar Protection** **……** **e) Local Breaker Back up Protection** **…….**

	Transformer. …… iv. 2 sets of 220V battery banks for control & protection and 2 sets of 48V battery banks for PLCC/ communication equipment shall be provided at each new Substation. Each battery bank shall have a float-cum-boost charger. At new substation, sizing of 220 V battery and battery charger shall be done based on the number of bays specified (including future bays**) as per CEA Regulations and relevant IS**. 2 sets of 48 V battery banks for PLCC and communication equipment for present and future scope shall be provided at each new Substation with at least 10-hour battery backup and extended backup, if required. ……. **B.3.6 Control Concept** All the EHV circuit breakers in substation/switching stations shall be controlled and synchronized from the switchyard control room/remote control center. **Each breaker would have two sets of trip circuits which would be connected to separate DC supplies for greater reliability**. All the isolators shall have control from remote/local whereas the earth switches shall have local control only. ……	**B.3.1 AC & DC power supplies** For catering the requirements of three phase & single phase AC supply and DC supply for various substation equipment (for present and future scope), the following arrangement is envisaged:- (i) For LT Supply at each new Substation, two (2) nos. of LT Transformers (minimum 800kVA for substations with highest voltage rating as 765kV) shall be provided which shall be **fed from two independent sources as per the CEA (Technical Standards for Connectivity to the Grid) Regulations, 2007.** …… (ii) 2 sets of 220 V battery banks for control & protection and 2 sets of 48V battery banks for PLCC/ communication equipment shall be provided at each new Substation. Each battery bank shall have a float-cum-boost charger. At new substation, sizing of 220 V battery and battery charger shall be done **as per CEA Regulations** and relevant IS based on the number of bays specified (including future bays). 2 sets of 48 V battery banks for PLCC and communication equipment for present and future scope shall be provided at each new Substation with at least 10-hour battery backup and extended backup, if required. ……..

	B.4.0 General Facilities a) ……. b) …… …… f) Boundary wall shall be brick masonry wall with RCC frame or Stone masonry wall or Precast RCC wall under present scope along the property line of complete substation area including future switchyard area to prevent encroachment and unauthorized access. Minimum height of the boundary wall shall be of 1.8m from finished ground level (FGL) **as per CEA Measures Relating to Safety and Electric Supply Regulations**. g) …..	**B.3.6 Control Concept** All the EHV circuit breakers in substation/switching stations shall be controlled and synchronized from the switchyard control room/remote control center. All the isolators shall have control from remote/local whereas the earth switches shall have local control only. …… **B.4.0 General Facilities** a) ……. b) …… …… **f)** Boundary wall shall be brick masonry wall with RCC frame or Stone masonry wall or Precast RCC wall under present scope along the property line of complete substation area including future switchyard area to prevent encroachment and unauthorized access. Minimum height of the boundary wall shall be of 1.8 m from finished ground level (FGL). **g)** …….

9.	**SPECIFIC TECHNICAL REQUIREMENTS FOR COMMUNICATION** The communication requirement shall be in accordance to CEA (Technical Standards for Communication System in Power System Operations) Regulations, 2020, CERC (Communication System for inter-State transmission of electricity) Regulations, 2017 and CEA (Cyber Security in Power Sector) Guidelines, 2021, all above documents as amended from time to time. The complete ISTS communication system commissioned by TSP under the RFP shall be the asset of ISTS and shall be available for usage of ISTS requirements as suggested by CTU from time to time. **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.** In order to meet the requirement for grid management and operation of substations, Transmission Service Provider (TSP) shall provide the following: ……..	**SPECIFIC TECHNICAL REQUIREMENTS FOR COMMUNICATION** The communication requirement shall be in accordance to CEA (Technical Standards for Communication System in Power System Operations) Regulations, 2020, CERC (Communication System for inter-State transmission of electricity) Regulations, 2017 and CEA (Cyber Security in Power Sector) Guidelines, 2021, all above documents as amended from time to time. The complete ISTS communication system commissioned by TSP under the RFP shall be the asset of ISTS and shall be available for usage of ISTS requirements as suggested by CTU from time to time. In order to meet the requirement for grid management and operation of substations, Transmission Service Provider (TSP) shall provide the following: ……