SPECIFIC REQUIREMENT'S (Section- Project)

C/ENGG/SPEC/SEC-PROJECT/SPECIFIC REQUIREMENT REV NO 08

Employer has standardized its Specific Requirement for various equipment and works for different voltage levels. Items or clauses, which are not applicable for the scope of this package as per schedule of quantities described in BPS or as per scope defined elsewhere in Section Project, the technical specification/clauses for the items specified below should not be referred to.

S.No.	Clause No.	Amended As (As per Specific Requirement Rev 08)
A.	**Section: GTR Rev 15**	
1.	Section GTR, Rev-15 Clause 2.1 (a)	"All equipment/materials/items, as per **Annexure-K (Rev 01),** as applicable under present scope of works, shall be procured and supplied from domestic manufacturers only with Minimum Local Content for individual items as listed in the above annexure. Any imported equipment/material/item/parts/component (comprising of embedded systems) to be supplied under the contract shall be tested in the certified laboratories to check for any kind of embedded malware/trojans/cyber threats and for adherence to Indian Standards as per the directions issued by Ministry of Power/Govt. of India from time to time. In case of such import from specified "prior reference" countries, the requirement of prior permission from the Govt. of India including protocol for testing in certified and designated laboratories by Ministry of Power/Govt. of India shall also be complied with by the contractor. The bidder/contractor shall list out the products and components producing Toxic e-waste under the contract and shall furnish to the Employer the procedure of safe disposal at the time of closing of the contract."
2.	**New Clause no 2.1 C**	Equipment/Material/Items from a Indian manufacture who have specified transfer of technology (TOT) arrangement with an entity from a country which shares land border with India shall be accepted only if the Indian Manufacturer is complying the requirement of prevailing Guideline by Government of India under Rule 144(xi) of the General financial Rule (GFR) 2017
3.	**New Clause No. 4.7**	**Planning and Designing in purview of Vulnerability Atlas of India** Vulnerability Atlas of India (VAI) is a comprehensive document which provides existing hazard scenario for the entire country and presents the digitized State/UT wise hazard, maps with respect to earthquakes, winds and floods for district wise identification of vulnerable areas. It also includes additional digitized maps for thunderstorms, cyclones and landslides. The main purpose of this Atlas is its use for disaster preparedness and mitigation at policy planning and project formulation stage. This Atlas is one of its kind single point source for the various stakeholders including policy makers, administrators, municipal commissioners, urban managers, engineers, architects, planners, public etc. to ascertain proneness of any city/ location/ site to multi-hazard which includes earthquakes, winds, floods thunderstorms, cyclones and landslides. While project formulation, approvals and implementation of various urban housing, buildings and infrastructures schemes, this Atlas provides necessary information for risk analysis and hazard assessment. The Vulnerability Atlas of India has been prepared by Building Materials and Technology Promotion Council under Ministry of Housing and Urban Affairs, Government of India and available at their website https://www.bmtpc.org/. It is mandatory for the bidders to refer Vulnerability Atlas of India for multi-hazard risk assessment and include the relevant hazard proneness specific to project location while planning and designing the project in terms of:

<table>
<tr><td></td><td></td><td>i) Seismic zone for earthquakes,
ii) Wind velocity
iii) Area liable to floods and Probable max. surge height
iv) Thunderstorms history
v) Number of cyclonic storms/ severe cyclonic storms and max sustained wind specific to coastal Region
vi) Landslides incidences with Annual rainfall normal
vii) District wise Probable Max. Precipitation</td></tr>
<tr><td>4.</td><td>New Para under Clause no. 8.3.2</td><td>Wherever references to SFQP is made in Technical Specifications, it shall be the latest edition/revision of the same uploaded up to seven (7) days prior to the actual date of bid opening.</td></tr>
<tr><td>5.</td><td>Clause no. 9.2</td><td>The reports for all type tests as per technical specification shall be furnished by the Contractor along with equipment / material drawings. However, type test reports of similar equipments/ material already accepted in POWERGRID shall be applicable for all projects with similar requirement. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited based on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by POWERGRID/representative authorized by POWERGRID/representative of Utility /representative of accredited test lab/ representative of The National Accreditation Board for Certification Bodies (NABCB) certified agency shall also be acceptable.

Unless otherwise specified elsewhere, the type test reports submitted shall be of the tests conducted within the years specified below from the date of NOA. In case the test reports are of the test conducted earlier than the years specified below from the date of NOA, the contractor shall repeat these test(s) at no extra cost to the Employer:-

<table>
<tr><th>S. No.</th><th>Name of Equipment</th><th>Validity of type test(in years)</th></tr>
<tr><td>1</td><td>Power Transformer</td><td>5</td></tr>
<tr><td>2</td><td>LT Transformer</td><td>5</td></tr>
<tr><td>3</td><td>Shunt Reactor</td><td>5</td></tr>
<tr><td>4</td><td>OLTC</td><td>10</td></tr>
<tr><td>5</td><td>Bushing of Power Transformers/Reactors</td><td>7</td></tr>
<tr><td>6</td><td>Fittings and accessories for Power transformers & Reactors</td><td>10</td></tr>
<tr><td>7</td><td>Circuit Breaker</td><td>10</td></tr>
<tr><td>8</td><td>Isolator</td><td>10</td></tr>
<tr><td>9</td><td>Lighting Arrester</td><td>10</td></tr>
<tr><td>10</td><td>Wave Trap</td><td>10</td></tr>
<tr><td>11</td><td>Instrument transformer</td><td>10</td></tr>
<tr><td>12</td><td>GIS & Hybrid GIS</td><td>15</td></tr>
<tr><td>13</td><td>LT Switchgear</td><td>10</td></tr>
<tr><td>14</td><td>Cable and associated accessories</td><td>10</td></tr>
<tr><td>15</td><td>Relays</td><td>7</td></tr>
<tr><td>16</td><td>Capacitors</td><td>10</td></tr>
<tr><td>17</td><td>Battery and Battery charger</td><td>10</td></tr>
<tr><td>18</td><td>Conductor & Earth wire</td><td>10</td></tr>
<tr><td>19</td><td>Insulators (Porcelain/Glass)</td><td>10</td></tr>
<tr><td>20</td><td>Composite Insulators</td><td>5</td></tr>
<tr><td>21</td><td>PLCC</td><td>5</td></tr>
</table>
</td></tr>
</table>

		Note:- For all other equipment's validity of type test shall be 10 years from date of NOA. Further, in the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes or due to non-compliance with the requirement stipulated in the Technical Specification or any/all type tests not carried out, same shall be carried out without any additional cost implication to the Employer. The Contractor shall intimate the Employer the detailed program about the type tests atleast two (2) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies**.**
6.	Section GTR Rev 15 Clause No 24.1	**Technical requirements for 765/400/220/132kV* Air Insulated Switchgear (AIS) Equipment*:** **A) Circuit Breaker** (i) The manufacturer(s) whose 765/400/220/132kV* Circuit Breaker(s) are offered, must have, manufactured, type tested (as per IEC/IS or equivalent standard) and supplied 715/345/220/132kV* or higher voltage class Circuit Breaker(s), which are in satisfactory operation# for atleast two (2) years as on the date of NOA. (ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India for the offered Circuit Breaker and not meeting the requirement stipulated in (i) above, can also be considered provided that a) 715/345/220/132kV* or higher Voltage class Circuit Breaker(s) must have been manufactured in the above Indian works & type tested (as per IEC/IS standard) and supplied as on the date of NOA. b) In case manufacturer meets the technical requirement through clause (ii) above, warranty obligations for additional warranty of two (2) years over & above the warranty period as specified in the bidding documents shall be applicable for the entire quantity of the offered Circuit Breaker(s) to be supplied under the contract. Further, contractor shall furnish performance guarantee for an amount of 10% of the ex-works cost of the Circuit Breaker(s)* for the additional warranty period in addition to the contract performance guarantee to be submitted by the contractor. **B) Isolator, Current Transformer, Capacitive Voltage transformer, Inductive Voltage transformer, Surge Arrester and Wave Trap)** (i) The manufacturer whose 765/400/220/132kV* equipment(s) are offered, must have manufactured, type tested (as per IS/IEC or equivalent standard) and supplied 715/345/220/132kV* or higher voltage class equipment(s), which are in satisfactory operation# for at least two (2) years as on the date of NOA.

		OR (ii) The manufacturer, who have established manufacturing and testing facilities in India for the offered equipment(s) and not meeting the requirement stipulated in (i) above, can also be considered provided that: a) 715/345/220/132kV* or higher Voltage class equipment(s) must have been manufactured in the above Indian works & type tested (as per IS/IEC standard) as on the date of NOA b) Manufacturer has manufactured, type tested (as per IS/IEC or equivalent standard) and supplied equipment(s) of 345kV or above voltage class (applicable for 765kV* Equipment)/220kV or above voltage class (applicable for 400kV* equipment) /132kV or above voltage class (applicable for 220kV* equipment) / 66kV or higher voltage class (applicable for 132kV* equipment), which are in satisfactory operation# for at least two (2) years as on the date of NOA. c) Warranty obligations for additional warranty of two (2) years over & above the warranty period as specified in the bidding documents shall be applicable for the entire quantity of the offered equipment(s) to be supplied under the contract. Further, contractor shall furnish performance guarantee for an amount of 10% of the ex-works cost of the equipment(s)* for the additional warranty period in addition to the contract Performance guarantee to be submitted by the contractor. OR (iii) The manufacturer, who have established manufacturing and testing facilities in India for the offered equipment(s) based on technological support of a parent company or collaborator and not meeting the requirement stipulated in (i) above, can also be considered provided that: a) 715/345/220/132kV* or higher Voltage class equipment(s) must have been manufactured in the above Indian works & type tested (as per IS/IEC standard) as on the date of NOA. b) The parent company or collaborator meets the qualifying requirements stipulated under (i) given above. A valid collaboration agreement for technology transfer / license to design, manufacture, test and supply the 765/400/220/132kV* Air Insulated Switchgear (AIS) Equipment(s)* in India, shall be submitted. c) The parent company/collaborator shall furnish performance guarantee for an amount of 10% of the ex-works cost of such equipment(s) and this performance guarantee shall be in

		addition to contract performance guarantee to be submitted by the contractor Legends: * : voltage class of respective equipment as applicable. # : satisfactory operation means certificate issued by the Employer/Utility certifying the operation without any adverse remark. NOA: Notification of Award
7.	**Clause No 24.2**	**Technical Requirement for 765kV class Transformer** (i) The Manufacturer whose 765kV Transformer(s) are offered must have designed, manufactured, tested & supplied 715 kV or higher voltage class one (1) number 1-phase Transformer of at least 500 MVA capacity or at least three (3) numbers 1-phase Transformers each having a capacity of at least 166 MVA, and the same transformer (s) should have been in satisfactory operation# for atleast two (2) years as on the date of NOA. (ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that a) 715 kV or higher voltage class either One (1) no. 1-phase Transformer of at least 166 MVA capacity or One (1) no. 1-phase Reactor of at least 80 MVAR capacity must have been manufactured in the above Indian works based on technological support of collaborator, type tested (as per IEC/IS standard) and same should have been supplied as on the date of NOA. b) The collaborator meets the requirements stipulated in (i) above. A valid collaboration agreement for technology transfer / license to design, manufacture, test and supply 765kV transformer in India, shall be submitted. c) the collaborator shall furnish performance guarantee for an amount of 10**%** of the ex-works cost of such equipment(s) and this performance guarantee shall be in addition to contract performance guarantee to be submitted by the contractor
8.	**Clause No 24.3**	**Technical Requirement for 765kV class Reactor** (i) The Manufacturer whose 765kV Reactor(s) are offered must have designed, manufactured, tested & supplied 715 kV or higher voltage class one (1) number 1-phase Reactor of at least 110 MVAR capacity or at least three (3) numbers 1-phase Reactors each having a capacity of at least 36.7 MVAR and the same Reactor(s) should have been in satisfactory operation# for atleast two (2) years as on the date of NOA. OR The Manufacturer must have designed, manufactured, tested & supplied 715 kV or higher voltage class one (1) number 1-phase Transformer of at least 500 MVA capacity or at least three (3) numbers 1-phase Transformers each having a capacity of at least 166 MVA and the bidder should have designed, manufactured, tested & supplied 345 kV or higher voltage class one (1) number 3-phase Reactor of at least 50 MVAR capacity or at least three (3) numbers 1-phase Reactors each having a capacity of at least 16.7 MVAR and the same Transformer(s) & Reactor(s) should have been in satisfactory operation# for atleast two (2) years as on the date of NOA.

<table>
<tr><td></td><td></td><td>(ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that

a) 715 kV or higher voltage class either One (1) no. 1-phase Reactor of at least 80 MVAR capacity or One (1) no. 1-phase Transformer of at least 166 MVA capacity must have been manufactured in the above Indian works based on technological support of collaborator, type tested (as per IEC/IS standard) and same should have been supplied as on the date of NOA.

b) The collaborator meets the requirements stipulated in (i) above. A valid collaboration agreement for technology transfer/license to design, manufacture, test and supply 765kV Reactor in India, shall be submitted.

c) the collaborator shall furnish performance guarantee for an amount of 10% of the ex-works cost of such equipment(s) and this performance guarantee shall be in addition to contract performance guarantee to be submitted by the contractor</td></tr>
<tr><td>9.</td><td>Clause No 24.4</td><td>Technical Requirement for 400kV, 220kV, 132kV class Transformer

(i) The manufacturer whose transformer(s) are offered must have designed, manufactured, tested and supplied transformers as per table below:

<table>
<tr><td>345kV or above class 3-phase transformers of at least 200 MVA or at least three (3) nos. 1-phase Transformers each having capacity of at least 66.7 MVA</td><td>applicable for supply of 400kV class Transformer</td></tr>
<tr><td>220kV or above class 3-phase transformers of at least 50 MVA or at least three (3) nos. 1-phase Transformers each having capacity of at least 16.7 MVA</td><td>applicable for supply of 220kV class Transformer</td></tr>
<tr><td>commissioned 132kV or above class 3-phase transformers of at least 20 MVA or at least three (3) nos. 1-phase Transformers each having capacity of at least 6.7 MVA</td><td>applicable for supply of 132kV class Transformer</td></tr>
</table>
These Transformer(s) must have been in satisfactory operation# for atleast two (2) years as on the date of NOA.

(ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that

a) 220kV (applicable for supply of 400kV class Transformer)/ 132kV (applicable for supply of 220kV class Transformer)/ 66kV (applicable for supply of 132kVclass Transformer)or higher voltage class transformers must have been designed, manufactured in the above Indian works based on technological support of collaborator, type tested (as per IEC/IS standard) and supplied as on the date of NOA.</td></tr>
</table>

<table>
<tr><td></td><td></td><td>b) The collaborator meets the requirements stipulated in (i) above. A valid collaboration agreement for technology transfer / license to design, manufacture, test and supply 400kV/220kV/132kV* transformer in India, shall be submitted.

c) The collaborator shall furnish performance guarantee for an amount of 10% of the ex-works cost of such equipment(s) and this performance guarantee shall be in addition to contract performance guarantee to be submitted by the contractor.</td></tr>
<tr><td>10.</td><td>Clause No 24.5</td><td>Technical Requirement for 400kV, 220kV and 132kV class Reactor

(i) The Manufacturer whose 400kV/220kV/132kV* Reactor(s) are offered must have designed, manufactured, tested & supplied Reactor as per table below:

<table>
<tr><td>345kVor above class 3-phase shunt reactor of at least 50 MVAR capacity or at least three (3) nos. 1-phase Shunt Reactors, each having capacity of at least 16.7 MVAR</td><td>applicable for supply of 400kV class Reactors</td></tr>
<tr><td>220kV or above class 3-phase shunt reactor of at least 20 MVAR capacity or at least three (3) nos. 1-phase Shunt Reactors each having capacity of at least 6.67 MVAR</td><td>applicable for supply of 220kV class Reactors</td></tr>
<tr><td>132kV or above class 3-phase shunt reactor of at least 15 MVAR capacity or at least three (3) nos. 1-phase Shunt Reactors each having capacity of at least 5 MVAR</td><td>applicable for supply of 132kV class Reactors</td></tr>
</table>
These Reactor(s) must have been in satisfactory operation# for atleast two (2) years as on the date of NOA.

(ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that

a) Such manufacturer has designed, manufactured based on technological support of collaborator, type tested (as per IEC/IS standard) and supplied 400kV class transformer or 220kV or above class shunt reactors (applicable for supply of 400kV class Reactors) / 220kV class transformer or 132kV or above class shunt reactors (applicable for supply of 220kV class Reactors)/ 132kV class transformer or 66kV or above class shunt reactors (applicable for supply of 132kV class Reactors) as on the date of NOA.

b) The collaborator meets the requirements stipulated in (i) above. A valid collaboration agreement for technology transfer/license to design, manufacture, test and supply the Reactor in India, shall be submitted.

c) the collaborator shall furnish performance guarantee for an amount of 10% of the ex-works cost of such equipment(s) and this performance guarantee shall be in addition to contract performance guarantee to be submitted by the contractor</td></tr>
</table>

11.	**Clause No 24.6**	**Technical Requirement for 400 kV Grade XLPE Power Cables** (i) The manufacturer(s) whose XLPE Power Cables are offered must have designed, manufactured, type tested and supplied in a single contract atleast 5 (five) km of single core, 400kV grade XLPE insulated cable which must be in operation for atleast 2 (two) years as on the date of NOA. (ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that a) The manufacturer must have designed, manufactured, type tested and supplied 400kV grade XLPE insulated cable and which must be in satisfactory operation# for atleast one (1) year as on the date of NOA. OR b) The manufacturer must have designed, manufactured, type tested and completed Pre-qualification (PQ) tests as per IEC for 400kV grade XLPE insulated Cable as on the date of NOA. Note: In case manufacturer meets the technical requirement through clause (ii) above, warranty obligations for additional warranty of two(2) years over & above the warranty period as specified in the bidding documents shall be applicable for the entire quantity of cable to supplied under the contract. Further, contractor shall furnish performance guarantee for an amount of 10% of the ex-works cost of the equipments(s)* and this performance guarantee shall be in addition to the contract performance guarantee to be submitted by the contractor
12.	**Clause No 24.7**	**Technical Requirement for 220KV,132kV,110kV Grade XLPE Power Cables** (i) The manufacturer(s) whose XLPE Power Cables are offered must have designed, manufactured, type tested and supplied in a single contract atleast 5 (five) km of single core, 220kV/132kV/110kV* or higher grade XLPE insulated cable which must be in operation for atleast 2 (two) years as on the date of NOA. (ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that a) The manufacturer must have designed, manufactured, type tested and supplied 220kV/132kV/110kV* or higher grade XLPE insulated cable and which must be in satisfactory operation# for atleast one (1) year as on the date of NOA. OR b) The manufacturer must have designed, manufactured, type tested and completed Pre-qualification (PQ) tests as per IEC for 220kV/132kV/110kV* or higher grade XLPE insulated Cable as on the date of NOA. Note: In case manufacturer meets the technical requirement through clause (ii) above, warranty obligations for additional warranty of two(2) years over & above the warranty period as specified in the bidding documents shall be applicable for the entire quantity of cable to supplied under the contract. Further, contractor shall furnish performance guarantee for an amount of 10% of the ex-works cost of the equipments(s)* and this performance guarantee

		shall be in addition to the contract performance guarantee to be submitted by the contractor
13.	**Clause No 24.15**	**Technical Requirements for LT Transformer** (i) The manufacturer, whose LT transformer(s) are offered, must have designed, manufactured, type tested including short circuit test as per IEC/IS or equivalent standards and supplied transformer(s) of atleast 33kV class of 315kVA or higher. The transformer must have been in satisfactory operation# for atleast two (2) years as on the date of NOA. (ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that At least 33kV class of 315kVA or higher rating LT transformer(s) must have been designed, manufactured in the above Indian works, type tested (as per IEC/IS standard) including short circuit test and supplied as on the date of NOA. Note In case manufacturer meets the technical requirement through clause (ii) above, warranty obligations for additional warranty of two(2) years over & above the warranty period as specified in the bidding documents shall be applicable for the entire quantity of the offered equipment to be supplied under the contract. Further, contractor shall furnish performance guarantee for an amount of **10%** of the ex-works cost of the equipments(s)* for the additional warranty period in addition to the contract performance guarantee to be submitted by the contractor.
14.	**Clause no 24.16**	**Technical Requirements for Composite Long Rod Polymer Insulator (765kV & 400kV)** (i) The manufacturer whose Composite Long rod Insulator are offered, must have designed, manufactured, tested and supplied Composite Long rod Insulator of 120KN or higher electro-mechanical strength for 765kV/400kV* or higher voltage class and the same must have been in satisfactory operation# for at least two (2) years as on the date of NOA. (ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that a) The manufacturer must have designed, manufactured, type tested and supplied Composite Long rod Insulator of 120KN or above electro-mechanical strength for 765kV/400kV* or higher voltage class and the same must have been in satisfactory operation# as on the date of NOA. b) Contractor shall furnish performance guarantee for an amount of 10% of the ex-works cost of the equipments(s)* and this performance guarantee shall be in addition to the contract performance guarantee to be submitted by the contractor. Note: In case manufacturer meets the technical requirement through clause (ii) above, warranty obligations for additional warranty of two(2) years over & above the warranty period as specified in the bidding documents shall be applicable for the entire quantity of the offered equipment to be supplied under the contract. Further, contractor shall furnish performance guarantee for an amount of 10% of the ex-works cost of the equipments(s)* for the additional warranty period in addition to the contract performance guarantee to be submitted by the contractor.

15.	**Clause No. 24.20**	**<u>Technical Requirement for 400kV GIS Equipment</u>** (i) The manufacturer whose 400kV GIS bays are offered must have designed, manufactured, type tested** (as per IEC or equivalent standard), supplied and supervised erection & commissioning of at least two (2) nos. Gas Insulated Switchgear (GIS) circuit breaker bays@ of 345kV or above voltage class in one (1) Substation or Switchyard during the last seven (7) years and these bays must be in satisfactory operation# for at least two (2) years as on the date of NOA. (ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that a) Atleast one no. 345kV or above voltage class GIS Circuit Breaker bay@ must have been manufactured in the above Indian works based on the technological support of the Collaborator(s) and either supplied or type tested the above CB bay (as per IEC or equivalent standard) as on the date of NOA. b) The collaborator(s) meets the requirements stipulated in (i) above. A valid collaboration agreement for technology transfer / license to design, manufacture, test and supply 400kV or above voltage level GIS equipment in India, shall be submitted. **c)** The Collaborator(s) shall furnish performance guarantee for an amount of 10% of the ex-works cost of such equipment(s) and this performance guarantee shall be in addition to Contract Performance Guarantee to be submitted by the bidder. Note :- (**) Type test reports of the collaborator/ parent company/ subsidiary company/ group company shall also be acceptable.
16.	**New Clause Clause No. 24.21**	**<u>Technical Requirement for 220/132/66 kV* level GIS/Hybrid GIS/MTS Equipment:</u>** (i) The manufacturer whose 220/132/66 kV* level GIS/Hybrid GIS/MTS bays are offered must have designed, manufactured, type tested** (as per IEC or equivalent standard), supplied and supervised erection & commissioning of at least two (2) nos. Gas Insulated Switchgear (GIS) circuit breaker bays@ of 220/110/66kV* or above voltage class in one (1) Substation or Switchyard during the last seven (7) years and these bays must be in satisfactory operation# for at least two (2) years as on the date of NOA. (ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that a) Atleast one no. 220/110/66kV* or above voltage level GIS Circuit Breaker bay@ must have been manufactured in the above Indian works based on the technological support of the Collaborator(s) and either supplied or type tested the above GIS bay (as per IEC or equivalent standard) as on the date of NOA.

b) The collaborator(s) meets the requirements stipulated in (i) above. A valid collaboration agreement for technology transfer/license to design, manufacture, test and supply 220/110/66*kV or above voltage level GIS equipment in India shall be submitted.

c) The Collaborator(s) shall furnish performance guarantee for an amount of 10% of the ex-works cost of such equipment(s) and this performance guarantee shall be in addition to Contract Performance Guarantee to be submitted by the bidder.

Note:

1. (*) voltage class of respective equipment as applicable

2. (@) For the purpose of technical requirement, one no. of circuit breaker bay shall be considered as a bay used for controlling a line or a transformer or a reactor or a bus section or a bus coupler and comprising of at least one circuit breaker, one disconnector and three nos. of single phase CTs / Bushing CTs. GIS means SF6 Gas insulated Switchgear.

3. Experience with combination of GIS CB Bay/Hybrid GIS CB Bay/MTS CB Bay is also acceptable if supply of only Hybrid/MTS equipment is envisaged. Hybrid GIS means outdoor SF6 Gas insulated switchgear connected to outdoor Air insulated bus-bar System (AIS bus-bars System), MTS means outdoor SF6 Gas insulated Mixed Technology Switchgear connected to outdoor AIS bus bar system.

4. (**) Type test reports of the collaborator/ parent company/ subsidiary company/ group company shall also be acceptable

17. **New Clause 27.0**

The technical parameters for 36kV & 12kV Horn gap fuse

1. 36kV Horn Gap Fuse

1.	Rated voltage	33 kV
2.	Maximum Continuous voltage	36 kV
3.	Rated current	50 Amps (min)
4.	Rated short time withstand (in KA)	25KA for 1 sec.
5.	Lighting Impulse voltage withstand	170 KV (Between Live and earth) 195 KV (Across open terminals)
6.	One minute Power frequency voltage withstand (Dry and Wet)	70 KV (Between Live and earth) 80 KV (Across open terminals)
7.	Creepage	900mm

2. 12kV Horn Gap Fuse

1.	Rated voltage	11 kV
2.	Maximum Continuous voltage	12 kV
3.	Rated current	50 Amps (min)
4.	Rated short time withstand (in KA)	12KA for 1 sec.
5.	Lighting Impulse voltage withstand	75 KV (Between Live and earth) 85 KV (Across open terminals)

		6. One minute Power frequency voltage withstand (Dry and Wet) — 28 KV (Between Live and earth) 32 KV (Across open terminals) Applicable standard: IS9385
B.	**Section GIS Rev 5A**	
1.	**New Para under Clause no.1**	GIS of all voltage levels above 52kV class envisaged in one substation under a single package, shall be supplied from one GIS manufacturer who shall be responsible for design, manufacturing, erection, testing and commissioning of complete GIS switchyard under the Contract and any other responsibilities stipulated in the contract with respect to GIS portion. GIS shall be accepted from manufacturer for which JDU is submitted along with the bidding documents.
2.	**Clause no. 5.31**	Alarm circuit shall not respond to faults for momentary conditions. The following indications including those required elsewhere in the specifications shall be generally provided in the alarm and indication circuits. **Gas Insulating System:** i) Loss of Gas Density **Operating System:** i) Low operating pressure ii)Loss of operating power iii)Loss of control supply iv) Pole Discordance.
3.	**New Clause no. 5.39.8**	Reference Guidelines for GIS Grounding shall be as per **Annexure-12 (Attached at Annexure-S10)**
4.	**Clause no. 5.40**	Adequate number of UHF sensors shall be provided in the offered GIS of voltage level 220kV and above for detection of Partial discharge (of 5pC and above) as per IEC 60270. The number and location of these sensors……..in close proximity to VT compartments. However, adequacy of number of sensors……. to complete the technical requirement. The calibration and frequency response…….couplers meeting this requirement.
5.	**New Clause no. 5.41(10)**	The price of Bus-duct inside the GIS hall shall be integral part of the respective bay module and it will not be paid separately. However, the payment of bus-duct for outside the GIS hall along with support structure shall be paid as per running meters in line with provision of Bid Price schedule.
6.	**New Para added under Clause no. 5.43.2**	The gas density monitoring devices shall have IP rating of IP65 or better and Suitable canopy shall be provided to prevent ingress of rain water for outdoor application.
7.	**New Clause no. 5.43.3**	**Requirement for Gas Zone Trip Scheme of GIS gas Tight Compartments**: a) Gas Zone tripping scheme is envisaged to isolate the GIS compartment when its gas level falls below gas zone trip level (i.e. minimum functional pressure) b) Density monitor Contact for gas zone tripping shall close when SF6 gas level falls below gas zone trip level in the respective compartment. c) Gas zone tripping shall be interlocked with the associated GIS disconnector so that tripping doesn't take place when a gas tight compartment is in electrically isolated condition from rest of the GIS (Disconnector open). Further, Gas zone tripping scheme should not mal-operate during control DC failure/changeover. Gas zone tripping scheme shall be coordinated with CRP scheme and shall be submitted for employer's approval during detailed engineering.

<table>
<tr><td>8.</td><td>Clause no. 6.8.2</td><td>The CSD shall be provided in following circuit breakers:
a) 765kV
• Main and Tie bay for Auto Transformer
• Main and Tie bay of Bus Reactor
• Switchable Line Reactor bay
b) 400kV
• Main and Tie bay for 765/400kV Auto Transformer
• Main and Tie bay of Bus Reactor
• Switchable Line Reactor bay
c) 220 & 132kV
• Bay for operation of Shunt reactor
The requirement of CSD shall be explicitly specified in price schedule.</td></tr>
<tr><td>9.</td><td>New Clause 6.8.3 (n)</td><td>For Circuit breaker with CSD controlling a Transformer following is applicable

“The limit for inrush current for switching of Transformer by CSD shall be 1.0 p.u. of rated current of transformer after fine tuning of CSD settings during pre-commissioning checks. For site acceptance of CSD, during online CSD test after fine tuning inrush current should be less than 1.0 P.U. of rated current in five consecutive operations”.</td></tr>
<tr><td>10.</td><td>New Clause no. 10.1.3(n)</td><td>For 400kV & above voltage class GIS bay module, CT cores shall be duly distributed on both side of circuit breaker. For 220 kV and below voltage level GIS bay module, CT on one side of the circuit breaker is also acceptable.</td></tr>
<tr><td>11.</td><td>New Clause no. 15.2.14</td><td>All 765kV & 400kV Circuit Breaker control schematics shall be finalized in such a way, that it may operate with or without CSD by using a suitable selector switch irrespective of whether circuit breakers to be supplied are envisaged along with CSD or not as per bid price schedules.</td></tr>
<tr><td>12.</td><td>Clause no. 17.1</td><td>One EOT Crane of suitable capacity shall be provided for erection & maintenance of largest/heaviest GIS component/assembly for each GIS hall. The crane shall consist of all special requirements for erection & maintenance of GIS equipment.</td></tr>
<tr><td>13.</td><td>New Para added under Clause no. 20</td><td>During detailed engineering, the type test reports of GIS equipment of the parent company/subsidiary company/group company shall also be acceptable provided that the design of offered GIS is same as that of type tested GIS equipment.</td></tr>
<tr><td>14.</td><td>Clause no 20, Sl. no. 14 of Table</td><td><table><tr><td>14</td><td>Reactor current switching test for Inductive Current switching capability as per IEC 62271-110. Further, the manufacturer whose circuit breakers tested with smaller current w.r.t current limits specified for Reactor current switching test duty-2, 3 & 4 in IEC 62271-110 shall also be acceptable.</td></tr></table></td></tr>
<tr><td>15.</td><td>Annexure-1 S.No. 20 (i)</td><td><table><tr><th>Parameter</th><th>765kV system</th><th>400kV system</th><th>220kV system</th><th>132 kV system</th></tr><tr><td>Pre-insertion resistor requirement</td><td>As per BPS</td><td>As per BPS</td><td>NA</td><td>NA</td></tr><tr><td>Rating (ohms)</td><td>Approx. 450 with tolerance as applicable</td><td>Approx. 400 with tolerance as applicable</td><td>NA</td><td>NA</td></tr></table></td></tr>
</table>

16.	**New Para under Clause no 26.**	Requirement for Mandatory spares for GIS a. Any equipment which is not supplied as main equipment or part of main equipment, mandatory spare for that is not applicable. b. It is recognized that the GIS manufacturer may have standardized the GIS design/equipment rating based on the manufacturer's standard practice. Alternate proposals, offering higher rating equipment (without additional cost implication), will also be considered provided such equipment meets the specified minimum designs rating, standard and performance requirements. c. In case contractor offers circuit breaker, dis-connector, current transformer, SF6/Air Bushing etc. under main equipment of higher rating than equipment rating specified in the specifications, the mandatory spare of same higher rating offered by contractor identical to main equipment offered in the package shall be required to be supplied against spares without any cost implication to POWERGRID.
17.	Annexure-10 Rev-1	Annexure-10 Rev-1 (Standard Mandatory Spares for Gas Insulated Switchgear) of stands deleted.
18.	New Annexure-13	Standard GIS Module Description **(Attached at Annexure-S11)**
C.	**Section Switchgear – CB Rev 11**	
1.	**Clause no. 2.6 Para 2**	The CSD shall be provided in following circuit breakers: d) 765kV • Main and Tie bay for Auto Transformer • Main and Tie bay of Bus Reactor • Switchable Line Reactor bay e) 400kV • Main and Tie bay for 765/400kV Auto Transformer • Main and Tie bay of Bus Reactor • Switchable Line Reactor bay f) 220 & 132kV • Bay for operation of Shunt reactor The requirement of CSD shall be explicitly specified in price schedule.
2.	**New Clause no. 2.6.1(n)**	For Circuit breaker with CSD controlling a Transformer following is applicable "The limit for inrush current for switching of Transformer by CSD shall be 1.0 p.u. of rated current of transformer after fine tuning of CSD settings during pre-commissioning checks. For site acceptance of CSD, during online CSD test after fine tuning inrush current should be less than 1.0 P.U. of rated current in five consecutive operations".
3.	**Clause No. 11.4**	Separate cables shall be used for AC, DC-I, DC-II and selected DC. **Each control cable shall include minimum 10% spare cores (subject to minimum 1 no. of spare core).**
4.	**Clause No. 11.5**	Requirement of Plug-In type connector for Inter-pole cabling is deleted
5.	**Clause No. 11.6**	Vertical run of cables to the operating mechanism box shall be properly supported by providing the perforated closed type galvanized cable tray (Cable tray also to be supplied along with the Circuit Breaker) to be fixed as an integral part of the structures. The load of the cable shall not be transferred to the mechanism box/terminal arrangement in any circumstances. Hanging or loose run of cable is not permitted. The drawing of cable tray including fixing arrangement shall be incorporated in the GA drawing of CB also.

<table>
<tr><td>6.</td><td>Clause No. 16.0
S.No. 20 (i)</td><td colspan="2">
<table>
<tr><th>Parameter</th><th>765kV system</th><th>400kV system</th><th>220kV system</th><th>132 kV system</th><th>66kV System</th></tr>
<tr><td>Pre-insertion resistor requirement</td><td>As per BPS</td><td>As per BPS</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td>Rating (ohms)</td><td>Approx. 450 with tolerance as applicable</td><td>Approx. 400 with tolerance as applicable</td><td>NA</td><td>NA</td><td>NA</td></tr>
</table>
</td></tr>
<tr><td>D.</td><td colspan="3">Section Switchgear-INST Rev 11</td></tr>
<tr><td>1.</td><td>Clause No. 6.2 (a)(iii)</td><td colspan="2">Seismic withstand test as per Annexure-B of Section-GTR or IEC62271-2 (with Seismic acceleration requirement as per Annexure-I of this specification/Section-Project) for 400kV and above voltage rating.</td></tr>
<tr><td>2.</td><td>Clause No. 6.2 (b)(iii) & (c)(iii)</td><td colspan="2">Seismic withstand test (as per Annexure-B of Section-GTR) or IEC-62271-2 (with Seismic acceleration requirement as per Annexure-II of this specification/Section-Project) for 400kV and above voltage class.</td></tr>
<tr><td>3.</td><td>Clause No. 9.2
Para 3 & 4</td><td colspan="2">CTs must have adequate provision for taking oil samples from the bottom of the CT without exposure to atmosphere. Manufacturer shall recommend the frequency at which oil samples should be taken and norms for various gases in oil after being in operation for different durations. Manufacturer should also indicate the total quantity of oil which can be withdrawn from CT for gas analysis before refilling or further treatment of CT becomes necessary.

Manufacturer/Contractor shall supply 2 nos. of oil sampling device for every 20 nos. of oil filled CT supplied with a minimum of 2 nos. of oil sampling device for each substation. The price of the above sampling bottles is deemed to be included in cost of equipment.</td></tr>
<tr><td>4.</td><td>Clause No. 9.3</td><td colspan="2">Voltage Transformers

a) Insulation Resistance test for primary (if applicable) and secondary winding
b) Polarity test
c) Ratio test
d) Dielectric test of oil (wherever applicable)
e) Tan delta and capacitance measurement of individual capacitor stacks
f) Secondary winding resistance measurement
g) DGA of oil (for IVT/PT)

Dissolved Gas Analysis (DGA) shall be carried out twice within the first year of service, first within the first month of commissioning/charging and second between six months to one year from the date of commissioning/charging.

IVTs/PTs must have adequate provision for taking oil samples from the bottom of the IVT/PT without exposure to atmosphere. Manufacturer shall recommend the frequency at which oil samples should be taken and norms for various gases in oil after being in operation for different durations. Manufacturer should also indicate the total quantity of oil which can be withdrawn from IVT/PT for gas analysis before refilling or further treatment of IVT becomes necessary.
Manufacturer/Contractor shall supply 2 nos. of oil sampling device for every 20 nos. of oil filled IVT/PT supplied with a minimum of 2 nos. of oil sampling device for each substation. The price of the above sampling bottles is deemed to be included in cost of equipment.</td></tr>
<tr><td>5.</td><td></td><td colspan="2">Defect Liability</td></tr>
</table>

<table>
<tr><td></td><td>Clause No. 10.0</td><td>The actions required to be taken by contractor in case of defects observed in CT/CVT/IVT/PT of ratings 145kV & above during the warranty period (defect liability period) shall be as per enclosed <u>Annexure-V (Revised)</u>of this specification. Further, the replaced/repaired/refurbished equipment (or part of equipment) shall have Two (2) years warranty without prejudice to contractual warranty period (defect liability period).</td></tr>
<tr><td>6.</td><td>New Table - II.C.1</td><td>
<table>
<tr><td colspan="9">REQUIREMENTS FOR 245 KV 2500A, 120% CURRENT TRANSFORMER</td></tr>
<tr><td>Nos of core</td><td>Core no.</td><td>Application</td><td>Current ratio</td><td>Output Burden</td><td>Accuracy Class</td><td>Min. knee pt. voltage (Vk)</td><td>Max CT Sec. Wdg-resistance (ohms)</td><td>Max Excitation Current at Vk (in mA)</td></tr>
<tr><td rowspan="5">5</td><td>1</td><td>BUS DIFF CHECK</td><td>2500-1600-800/1</td><td>-</td><td>PX</td><td>2500-1600-800 V</td><td>12.5/8/4</td><td>16 on 2500/1 tap; 25 1600/1 Tap; 50 on 800/1 Tap</td></tr>
<tr><td>2</td><td>BUS DIFF CHECK</td><td>2500-1600-800/1</td><td>-</td><td>PX</td><td>2500-1600-800 V</td><td>12.5/8/4</td><td>16 on 2500/1 tap; 25 1600/1 Tap; 50 on 800/1 Tap</td></tr>
<tr><td>3</td><td>METERING</td><td>2500-1600-800/1</td><td>20VA</td><td>0.2S</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>4</td><td>TRANS BACKUP/LINE PROTN</td><td>2500-1600-800/1</td><td>-</td><td>PX</td><td>2500-1600-800 V</td><td>12.5/8/4</td><td>16 on 2500/1 tap; 25 1600/1 Tap; 50 on 800/1 Tap</td></tr>
<tr><td>5</td><td>TRANS DIFF/LINE PROTN</td><td>2500-1600-800/1</td><td>-</td><td>PX</td><td>2500-1600-800 V</td><td>12.5/8/4</td><td>16 on 2500/1 tap; 25 1600/1 Tap; 50 on 800/1 Tap</td></tr>
</table>
Note:
1. Protection cores shall be of accuracy class PX as per IEC 61869.
2. Metering Core shall be of accuracy class 0.2S as per IEC: 61869
</td></tr>
<tr><td>7.</td><td>New Table -II G</td><td>
<table>
<tr><td colspan="9">REQUIREMENT FOR 36kV NCT 3000A (120% extended) (Outdoor type) for bank of 765kV, 1-Ph Transformer
Location: Common Neutral Side (for each three-phase bank)</td></tr>
<tr><td>Nos of core</td><td>Core no.</td><td>Application</td><td>Current ratio</td><td>Output Burden</td><td>Accuracy Class</td><td>Min. knee pt. voltage (Vk)</td><td>Max CT Sec. Wdg-resistance (ohms)</td><td>Max Excitation Current at Vk (in mA)</td></tr>
<tr><td>1</td><td>1</td><td>REF (Hig</td><td>3000/1</td><td>-</td><td>PX</td><td>3000 V</td><td>12</td><td>20 on 3000/1tap</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td></td><td></td><td>
<table>
<tr><td></td><td></td><td>h Impedance)</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
Note:
1. Protection cores shall be of accuracy class PX as per IEC 61869.
</td></tr>
<tr><td>8.</td><td>New Table -III H</td><td>
<table>
<tr><td colspan="9">REQUIREMENT FOR 36kV NCT 300A (200% extended) (Outdoor type) for bank of 765kV, 1-Ph Reactor
Location: Common Neutral Side (for each three-phase bank</td></tr>
<tr><td>Nos of core</td><td>Core no.</td><td>Application</td><td>Current ratio</td><td>Output Burden</td><td>Accuracy Class</td><td>Min. knee pt. voltage (Vk)</td><td>Max CT Sec. Wdg-resistance (ohms)</td><td>Max Excitation Current at Vk/4 (in mA)</td></tr>
<tr><td>1</td><td>1</td><td>Earth fault protection</td><td>300/1</td><td>-</td><td>PX</td><td>300 V</td><td>1</td><td>40 on 300/1tap</td></tr>
</table>
Note:
1. Protection cores shall be of accuracy class PX as per IEC 61869.
</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>E.</td><td colspan="2">Section Switchgear-ISOLATOR Rev 12</td></tr>
<tr><td>1.</td><td>New Clause No. 2.0. f)</td><td>The values of transfer current and recovery voltage of 220kV class bus isolators shall be specified by manufacturer & Bus Isolators shall be type tested for bus transfer current switching duty as per latest IEC62271-102. Test reports is to be submitted for the Employer’s review.”</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>F.</td><td colspan="2">Section Switchgear-Surge Arrester Rev 12</td></tr>
<tr><td>1.</td><td>New Clause No. 4.5</td><td>The Surge Arresters shall be provided with a common Junction box suitably for a set of three (3) Surge Arresters of each bay for extending the contact information of surge counter to SAS</td></tr>
<tr><td>G.</td><td colspan="2">Section: Lighting System Rev 07</td></tr>
<tr><td>1.</td><td>New Para under Clause No. 2.1</td><td>Wherever, Indoor Illumination of building is specified as LS/Lot/SET item in BPS, illumination shall be provided using fixture types as specified in Annexure-I of Section: Lighting System. However, contractor shall submit lighting design calculation for deciding the number of fixtures in each building/room. Following Average lux (at working plane of height 1.2Mtrs from floor level) levels to be maintained for design of illumination system:
<table>
<tr><td>Sl. No.</td><td>Building/Room Type</td><td>Average Lux Level to be maintained</td></tr>
<tr><td>1</td><td>Control Room /Station-In charge Room /Administrative Room/Conference Room / Switchyard Panel Room/ GIS Relay Panel Room</td><td>300 Lux</td></tr>
<tr><td>2</td><td>Electronic Test Lab</td><td>250 Lux</td></tr>
<tr><td>3</td><td>GIS Hall/ Battery Room/ACDC & DCDB Room</td><td>200 Lux</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td></td><td></td><td>
<table>
<tr><td>4</td><td>AHU Room/GIS Store Room/ Pantry /Reception/ FFPH Building</td><td>150 Lux</td></tr>
<tr><td>5</td><td>Corridor/ Toilets</td><td>100 Lux</td></tr>
<tr><td>6</td><td>Periphery of the Building</td><td>50 Lux</td></tr>
<tr><td>7</td><td>Any other room/building</td><td>200 Lux</td></tr>
</table>
The minimum lux level to average lux level ratio should not be less than 0.6 (i.e Emin/Eav> 0.6). The maintenance factor for indoor illumination design shall be considered as 0.8.
All required items /equipment /fixtures/ panels/ receptacles/ switches/ switchboards/ fans etc. for Illumination of Control Room Building, GIS Building, FFPH, SPR, Security Hut etc. (as applicable) are deemed to be included under corresponding LS/Lot/SET item of BPS.
</td></tr>
<tr><td>2.</td><td>Clause no. 6.2.1(ii)</td><td>All Outdoor Lighting Panels shall be Stainless sheet steel of Grade 304 and shall be dust, weather and vermin proof. Panels shall be of thickness not less than 1.5 mm smoothly finished, leveled and free from flaws. Stiffeners shall be provided wherever necessary.
Alternatively, outdoor lighting panels of Aluminum shall also be acceptable as per provisions stipulated in Section GTR.</td></tr>
<tr><td>3.</td><td>Clause no. 6.6(i) (b)</td><td>The outdoor junction boxes shall be complete with conduit knockouts/threaded nuts and provided with terminal strips. The junction boxes shall be suitable for termination of Cable glands of required size. The junction boxes shall be provided with 4 way knockouts suitable for street lighting/switchyard lighting terminals suitable for 2 numbers 4C x 16 Sq.mm Al. cable or as per requirement. All Outdoor Junction boxes shall be of Stainless Steel of thickness 1.5mm of grade 304. Outdoor Junction Boxes shall be suitable for mounting on columns, structures etc. for Outdoor Lighting. The outdoor Junction shall have IP 55 protection. Alternatively, outdoor junction boxes of Aluminum shall also be acceptable as per provisions stipulated in Section GTR.</td></tr>
<tr><td>4.</td><td>New para under Clause no 5.1</td><td>EXTERNAL ELECTRIFICATION WORKS
Para-1
Para-2
Para-3
Townships DB’s shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness not less than 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness not less than 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary. Gland plate shall be cold rolled sheet steel having thickness not less than 3 mm in all cases. However, in case of termination of single core power cables, gland plate shall be of non-magnetic material of at least 4mm thickness.
Township DB shall be provided with a degree of protection of IP: 55.</td></tr>
<tr><td>H.</td><td colspan="2">Section: LT Switchgear Rev 05</td></tr>
<tr><td>1.</td><td>Clause no. 1.21.2</td><td>Contractor shall submit type test reports for the Lighting transformers as per IS:2026 for which test conducted once are acceptable (i.e. The requirement of test conducted within last ten years shall not be applicable)</td></tr>
<tr><td>2.</td><td>Clause no. 1.6.1</td><td>MCCB shall in general conform to IS: 13947 Part-2. All MCCB offered shall have Ics = 100% Icu rating.</td></tr>
<tr><td>I.</td><td colspan="2">Section DG Set Rev 05</td></tr>
</table>

<table>
<tr><td>1.</td><td>New para added under Clause no. 7.1(a)</td><td>Alternatively, AMF Panel for DG Set may be installed outside the acoustic enclosure near the DG Set. In such cases, AMF panel with or without additional enclosure shall meet IP-55 degree of protection.</td></tr>
<tr><td>J.</td><td colspan="2">Section: Battery and Battery Charger Rev 06</td></tr>
<tr><td>1.</td><td>Clause no. 1.2.12</td><td>The battery shall be capable of giving 1200 or more charge/discharge cycles at 80% Depth of discharge (DOD) at an average temperature of 27º Celsius.
DOD (Depth of Discharge) is defined as the ratio of the quantity of electricity (in Ampere-hour) removed from a cell or battery on discharge to its rated capacity.</td></tr>
<tr><td>2.</td><td>Clause no 1.1.4 table -2 (48V)</td><td>Bidder shall select number of cells, float and Boost voltage to achieve following system requirement:-
…….
…….
<table>
<tr><td rowspan="4">220V DC system</td><td>Load</td><td>Duration</td><td>Type Of Loads</td></tr>
<tr><td>…..</td><td>…..</td><td>……</td></tr>
<tr><td>…..</td><td>……</td><td>……</td></tr>
<tr><td>…….</td><td>…….</td><td>……</td></tr>
<tr><td rowspan="2">48V DC System</td><td>Continuous Load</td><td>10 hours Continuous</td><td>load associated with PLCs.(when speech is not working)</td></tr>
<tr><td>Momentary Load</td><td>15 minute</td><td>Loads associated with PLCs (when speech is working)</td></tr>
</table>
</td></tr>
<tr><td>K.</td><td colspan="2">Section Fire Protection Rev 06</td></tr>
<tr><td>1.</td><td>New para added at Clause no.2.03.00</td><td>Fire detection and alarm system shall also be provided in the GIS Hall using beam type smoke detectors to be installed at suitable mounting height, and in the Relay Panel room with ionization/optical type smoke detectors to be installed on the ceiling.</td></tr>
<tr><td>2.</td><td>New Clause no.2.01.02</td><td>Hydrant posts and Fire extinguishers (CO2 and DCP type) shall also be provided for GIS Building also.</td></tr>
<tr><td>3.</td><td>Clause No. 2.04.02 & 10.00.00</td><td>Mechanical foam type fire extinguishers wherever specified as 50 litre capacity, conforming to IS:13386, shall be read as 60 litre capacity conforming to IS 16018

Further in case of non-availability of any type of fire extinguisher (i.e. water, CO2, DPC, foam type) of a particular size as specified in BPS or technical specification, next available higher size conforming to IS shall be supplied.</td></tr>
<tr><td>4.</td><td>New Clause No. 2.06.05</td><td>For new substation, Fire Fighting LT Boards (AC & DC) and Annunciation panels (for FFPH & Control Room Building), shall have number of feeders, annunciation windows, zone-alarm modules (as applicable) required for entire present & specified future scope of the substation.</td></tr>
<tr><td>5.</td><td>Clause No.9.01.00(c) & Appendix-V</td><td>Deleted</td></tr>
<tr><td>6.</td><td>Appendix-I</td><td>Appendix-I (Rev 4) stand replaced by following <u>Appendix-I (Rev 5)</u></td></tr>
<tr><td>7.</td><td>Appendix-IV</td><td>Revised Appendix-IV Page1 of 13 is replaced by <u>Annexure-IV rev 01</u> Page1 of 13.</td></tr>
<tr><td>L.</td><td colspan="2">Section: Power & Control Cable Rev 06</td></tr>
<tr><td>1.</td><td>Clause no 1.1.4</td><td>Refer <u>Annexure-S1</u> for METHODOLOGY FOR SUPPLY, INSTALLATION & SIZING OF CABLES</td></tr>
<tr><td>2.</td><td>Clause no 1.2.2</td><td>1.2.2. XLPE Power Cables

1.2.2.1. The XLPE (90°C) insulated cables shall be of FRLSH type, C2 category conforming to IS: 7098 (Part-I) and its amendments read alongwith this specification. The conductor shall be stranded aluminium</td></tr>
</table>

		circular/sector shaped and compacted. In multicore cables, the core shall be identified by red, yellow, blue and black coloured strips or colouring of insulation. A distinct inner sheath shall be provided in all multicore cables. For XLPE cables, the inner sheath shall be of extruded PVC of type ST-2 of IS:5831. All cables shall be of armoured type. For single core cables, the armouring shall consist of aluminium wires/strips. The outer sheath shall be extruded PVC of Type ST-2 of IS:5831 for all XLPE cables
3.	**Clause no 1.2.3**	1.2.3. PVC Power Cables 1.2.3.1. The PVC (70°C) insulated power cables shall be of FRLSH type, C2 category, conforming to IS: 1554 (Part-I) and its amendments read alongwith this specification and shall be suitable for a steady conductor temperature of 70°C. The conductor shall be stranded aluminium. The Insulation shall be extruded PVC to type-A of IS: 5831. A distinct inner sheath shall be provided in all multicore cables. All cables shall be of armoured type. For multicore armoured cables, the inner sheath shall be of extruded PVC. The outer sheath shall be extruded PVC to Type ST-1 of IS: 5831 for all cables.
4.	**Clause no 1.2.4**	1.2.4. PVC Control Cables 1.2.4.1. The PVC (70°C) insulated control cables shall be of FRLSH type C2 category conforming to IS: 1554 (Part-1) and its amendments, read alongwith this specification. The conductor shall be stranded copper. The insulation shall be extruded PVC to type A of IS: 5831. A distinct inner sheath shall be provided in all cables. All cables shall be of armoured type. The over sheath shall be extruded PVC to type ST-1 of IS: 5831 and shall be grey in colour.
5.	**Clause No. 4.2**	Standard lengths for each size of power and control cables shall be 500/1000 meters. However, to avoid cable wastage and cable jointing at site, non-standard lengths of each size of Power & Control cable may also be acceptable subject to maximum length of 1000meters (+ 5% tolerance)
6.	**Clause No. 5**	5 TYPE TESTS 5.1 All cables shall conform to all type, routine and acceptance tests listed in the relevant IS. 5.2 XLPE INSULATED POWER CABLES (For working voltages up to and including 1100V):- 5.2.1 Following type tests (on one size in a contract) as per IS: 7098 (Part 1) – 1988 including its amendments shall be carried out as a part of acceptance tests on XLPE insulated power cables for working voltages up to and including 1100 V: a) Physical tests for insulation i) Hot set test ii) Shrinkage test b) Physical tests for outer sheath i) Shrinkage test ii) Hot deformation iii) Heat shock test iv) Thermal stability c) Test for Smoke density (as per relevant IS/IEC standard) d) Test for halogen acid gas evolution. e) Flame Retardant on Single cable. f) Flame Retardant on bunched cable. 5.2.2 Contractor shall submit type test reports as per clause no. 9.2 of Technical Specification, Section: GTR for the following tests

		a) Water absorption (gravimetric) test. b) Ageing in air oven c) Loss of mass in air oven d) Short time current test on power cables of sizes 240 sqmm and above on i) Conductors. ii) Armours. e) Test for armouring wires/strips. f) Oxygen and Temperature Index test. g) Flammability test. h) Smoke density test (on sheathing material) (as per relevant IS/IEC standard)
7.		5.3 PVC INSULATED POWER & CONTROL CABLES (For working voltages up to and including 1100V)- 5.3.1 Following type tests (on one size in a contract) as per IS: 1554 (Part 1) -1988 including its amendments shall be carried out as a part of acceptance tests on PVC insulated power & control cables for working voltages up to and including 1100 V: a) Physical tests for insulation and outer sheath i) Shrinkage test ii) Hot deformation iii) Heat shock test iv) Thermal stability b) High voltage test (water immersion test only a.c. test as per clause no. 16.3.1). c) Test for Smoke density (as per relevant IS/IEC standard) d) Test for halogen acid gas evolution. e) Flame Retardant on Single cable 5.3.2 Contractor shall submit type test reports as per clause no. 9.2 of Technical Specification, Section: GTR for the following a) High voltage test (water immersion d.c. test as per clause no. 16.3.2 of IS: 1554 (Part 1) - 1988). b) Ageing in air oven. c) Loss of mass in air oven. d) Short time current test on power cables of sizes 240 sqmm and above on i) Conductors. ii) Armours. e) Test for armouring wires/strips. f) Oxygen and Temperature Index test. g) Flammability test h) Flame Retardant on bunched cable i) Test for Specific optical density of smoke (as per relevant IS/IEC standard)
8.		Note:- In technical data sheet for 1.1kV XLPE/PVC Power cable & PVC control cable, wherever Type & Category of Cable is written FR & C1 shall be read as FR-LSH & C2, other details kept the same.
M.	**Section-Air Conditioning Rev-04**	
1.	**Clause No. 2.3.2.3**	Cooling capacity of 3TR AC units shall not be less than 36000btu/hr. and shall have minimum energy efficiency rating of 4 star as on the date of NOA.
2.	**Clause No. 2.3.3.4**	Cooling capacity of 2TR AC units shall not be less than 22000btu/hr. and shall have minimum energy efficiency rating of 4 star as on the date of NOA.
3.	Clause no. 2.4	Clause no. 2.4 of Section-Air Conditioning Rev-04 of Technical Specification Void

<table>
<tr><td>4.</td><td>New Annexure-S2</td><td><u>Annexure S2</u> – Air Conditioning & Ventilation System for GIS Building</td></tr>
<tr><td>N.</td><td colspan="2">Section Switchyard Erection Rev 10</td></tr>
<tr><td>1.</td><td>New Clause No. 2.5</td><td>Transmission line side insulator string along with hardware for line termination shall be in the scope of substation contractor. The erection of same shall be done by associated TL contactor.</td></tr>
<tr><td>2.</td><td>Clause No. 9.4(j) & (k)</td><td>
<table>
<tr><th>S.No</th><th>Item</th><th>Size</th><th>Material</th></tr>
<tr><td>j)</td><td>Isolator MOM Box</td><td>50X6 mm GS flat & Flexible copper braid</td><td>Galvanised steel and copper braid</td></tr>
<tr><td>k)</td><td>Insulator Guy Arrangemen</td><td>75x12mm G.S. flat</td><td>Galvanised Steel</td></tr>
</table>
</td></tr>
<tr><td>3.</td><td>New Clause No. 9.5.8</td><td>For estimation of riser of new substation/switchyard, maximum spacing of Main Earthmat shall be considered as 30 M x 30 M, 24 M x 24 M, 16 M x 16 M & 12 M x 12 M for 765kV, 400kV, 220kV & 132kV switchyard respectively.

Actual spacing for main earthmat shall be finalized during detailed engineering based on soil resistivity data and payment shall be made as per actual executed quantity at site. However, no cost compensation shall be considered in case of actual spacing of main earthmat finalized during detailed engineering is less than that mentioned above.

For switchyard extensions, main earthmat spacing shall be considered same as that in the existing switchyard.</td></tr>
<tr><td>4.</td><td>Clause no 9.10.3</td><td>Auxiliary earthing mat comprising of minimum 32mm dia M.S. rods closely spaced (300 mm x 300 mm) conductors shall be provided at depth of 300mm from ground level below the operating handles of the M.O.M. Box of the isolators. M.O.M. boxes shall be directly connected to the auxiliary earthing mat. Flexible copper braid connection to be provided between MOM box and GI flat to take care of soil sagging. The size of auxiliary earthing mat shall be of 1500mmx1500mm size for 220kV and above voltage class isolators and 900mmx900mm size for 132kV and below voltage class isolators. Factory welded auxiliary earthmat is preferable.</td></tr>
<tr><td>5.</td><td>New Clause No. 10.2</td><td>Following type of conductor for Flexible or Rigid Bus bars/Switchyard Equipment Jumpers/Interconnections shall be provided subject to suitability of conductor as per specified/applicable current ratings:

<table>
<tr><th>Voltage Level</th><th>Conductor / Al .Tube Type</th></tr>
<tr><td>Voltage Level: 765kV</td><td>AAC Bull / 4.5’’ IPS Al. Tube</td></tr>
<tr><td>Voltage Level: 400kV</td><td>ACSR Bersimis / 4.5’’ IPS Al. Tube</td></tr>
<tr><td>Voltage Level: 220kV</td><td>ACSR Moose / 4.0’’ IPS Al. Tube</td></tr>
<tr><td>Voltage Level: 132kV</td><td>ACSR Moose / 3.0’’ IPS Al. Tube</td></tr>
</table>

For substation extension works, suitable clamps & connectors for interconnection with existing buses as per drawings shall be provided by the contractor under present scope.

Conductor type with higher current rating than that specified above shall also be acceptable without any additional price implication.
Note: For existing substation, existing conductor configuration may preferably be adopted in extn. S/s package.</td></tr>
</table>

6.	**New Clause no. 20.1**	**<u>Neutral formation for Transformer(s), DELTA formation and making connection arrangement to connect spare unit in place of any unit of the bank without physical shifting and Earthing Arrangement :</u>** For Spare Unit connection to form 3-ph bank of 765kV Class Transformers with isolator based switching arrangement without physical shifting of spare unit along with necessary Neutral Formation, Earthing Arrangement & Tertiary (DELTA) formation for 3-ph bank formation with 1-ph units shall be under present scope as per the details mentioned below: **i. <u>Neutral Formation including Neutral auxiliary bus and Earthing Arrangement</u>** The contractor shall connect the neutrals of three (3) 1-phase transformers by overhead connection using 3" IPS Al tube. The neutral formation shall be such that neutral winding of single-phase spare transformer can be disconnected or connected to the three phase banks. The connection from the neutral bushing to neutral bus shall be through 3" IPS Al tube and wherever flexible jumper needs to be provided, same shall be through twin conductor. All material like Bus post insulator, Aluminium tube, conductor, clamps & connectors, earthing materials, support structure, **foundation bolts,** hardware etc. required for neutral formation and connection with neutral CT and earthing of neutral shall be provided by contractor. **ii. <u>Tertiary Delta Formation including Tertiary auxiliary bus(Insulation level 52 kV) .</u>** The contractor shall connect 33kV tertiary of single-phase auto-transformers in DELTA configuration by overhead connection to operate in 3-Ph Bank. The Delta shall be formed by 3" IPS Al tube, which shall be insulated with heat shrinkage insulating sleeve of at least 52kV class and shall be supported by structure mounted bus post insulators at suitable intervals. Jumpers (twin conductors) wherever provided shall also be insulated using suitable insulation tape or sleeve at least 52kV class at site. The minimum phase to phase horizontal spacing for delta formation shall be 1.5meter. All associated materials like bus post insulators, Aluminium tube, conductor, clamps & connectors, support structures, **foundation bolts,** hardware, earthing materials etc. required for tertiary delta formation shall be provided by the contractor. **iii. <u>HV & IV Auxiliary Buses (Applicable for AIS Substation)</u>** Formation of HV & IV auxiliary buses for connection of transformer 3-Phase bank with 1-Phase Spare transformer unit is under the present scope of the bidder. All associated materials like Bus post insulators, Aluminium tube, conductors, clamps & connectors, insulator strings, hardware, earthing materials, support structures, **foundation bolts,** required for the above-mentioned arrangement shall be provided by the contractor.
7.	**New Clause no. 20.2**	**<u>Neutral formation for Reactor banks, connection to neutral grounding reactor through 132kV Surge arrester, connection to ground through neutral CTs and connection arrangement to connect spare reactor unit in place of any other units of the bank without physical shifting and Earthing Arrangement :</u>** For Spare Unit connection to 3-ph bank of 765kV Class Reactors with isolator based switching arrangement without physical shifting of spare unit along with necessary Neutral Formation, Earthing Arrangement for 3-ph bank formation with 1-ph units shall be under present scope as per the details mentioned below:

		i. <u>Neutral Formation including Neutral auxiliary bus and Earthing Arrangement</u> The contractor shall connect the neutrals of three (3) 1-phase reactors by overhead connection using 3" IPS Al tube. The neutral formation shall be such that neutral winding of single-phase spare reactor can be disconnected or connected to the three phase banks. Neutral Connections of spare unit shall be extended upto the other unit(s) by forming Neutral auxiliary bus. The connection from the neutral bushing to neutral bus shall be through 3" IPS Al tube and wherever flexible jumper needs to be provided, same shall be through twin conductor. All material like Bus post insulator, Aluminum tube, conductor, clamps & connectors, earthing materials, support structure, **foundation bolts,** hardware etc. required for neutral formation and connection with neutral CT and earthing of neutral shall be provided by contractor. Required Insulation level is 145 kV from individual reactor neutral to point of neutral formation. However after neutral formation, the insulation level is 36kV. Connection of each Line reactor bank formed under present scope to Neutral grounding reactor through 132kV Surge Arrester including NGR by passing arrangement is also under present scope. **ii.<u>HV Auxiliary Bus (Applicable for AIS Substation)</u>** Formation of HV auxiliary bus for connection of reactor 3-Phase bank with 1-Phase Spare reactor unit is under the present scope of the bidder. All associated materials like Bus post insulators, Aluminium tube, conductors, clamps & connectors, insulator strings, hardware, earthing materials, support structures, **foundation bolts,** required for the above-mentioned arrangement shall be provided by the contractor.
8.	**New Clause no. 20.3**	Supply & Laying of Power, Control Cables & Special Cables (if any) (including all cabling works for spare unit of transformer/reactor) along with accessories for power supply, alarm, trip, control & indication, status and monitoring signals & contacts made available at MB/CMB of Transformers/Reactors upto Control & Relay Panels and BCUs located in the Switchyard Panel Room/Control Room and successful integration of same with Station Control, Protection & SAS System is in the scope of the contractor.
9.	**New Clause no. 20.4**	3½Cx300 Sq. mm XLPE power cable for oil filtration units of reactors & transformers shall be provided. The cable shall be terminated at 250A receptacle near Reactor & Transformer in the switchyard. XLPE Power cables shall be looped in & out for 250A Power receptacles.
10.	**New Clause no. 20.5**	Neutral of spare transformer/reactor is to be connected to station grounding system through a jumper/copper flat. This shall be applicable for single phase transformer/reactor wherever spare unit have been provided.
11.	**New Clause no. 20.6**	Tertiary connections made for tertiary loading of LT Transformer shall be insulated using suitable insulation tape or sleeve of at least 52kV class at site
12.	**New Clause no. 20.7**	The earthing risers from terminal of Neutral Current Transformer (NCT) of bank of 1-Phase Transformer/Reactor (as applicable) shall be brought down for connection with pipe electrodes by providing suitable insulators mounted on NCT support structure (minimum 2 nos. per support). Necessary provisions on NCT support structure for mounting of insulator shall be provided. These

		insulators shall deemed to be included in corresponding Erection Hardware item for Transformer/Reactor bay (as applicable) of BPS
13.	**New Clause No. 21**	Connection arrangement of 765kV equipment's shall be done as per the conceptual drawing (Drawing No. C/ENGG/SS/CONCEPTUAL 765KV BAY CONNECTIONS, Rev-01) enclosed as **Annexure-S3** of this Section.
14.	**New Clause No. 22**	For connection to HV bushing of LT Transformer, insulated copper rod/strip of at least 75 sq.mm cross sectional area shall be used.
15.	New annexure	Refer **Annexure-S4** for SHORT CIRCUIT FORCES & SPACER SPAN FOR 765kV & 400kV GANTRY STRUCTURE
O.	**Section: Structure Rev 06**	
1.	**New Clause No. 3.2.4 Added**	POWERGRID will issue the fabrication drawings of the standard structures to the successful bidder. The contractor shall do the proto assembly of the structures as per the issued fabricated drawings. Employer may opt to witness such proto assembly. The bidder shall follow the fabrication drawing for preparing the proto assembly and do the minor adjustments, if necessary, without affecting the strength of the structure. In case of equipment support structure, the attachment of stool and fixing of MOM box etc. shall be taken care by the contractor as per the requirement of the equipment. The proto to be witnessed and Proto corrected drawings along with BOM shall be certified by the contractor. Certified drawings and BOM shall be submitted to POWERGRID for information only. The arrangement shall however not absolve the contractor from the responsibility of supply and erection of safe sound and durable structure.
2.	**New Clause no. 3.4**	Nuts, Bolts and washers for all non-standard structures shall be payable as per BPS.
P.	**Section Civil Works Rev 11A**	
1.	**New Clause No. 21.0**	The dewatering pump shall be Portable, Self Priming, Non clog, horizontal type monobloc pump. The Pump shall be driven by electric motor suitable for outdoor application with IP-55 degree of protection. Following are the major technical parameters for the pumps to be supplied as per BPS: (A) Pump Rating : 2 HP Flow Rate : 200-400 LPM Minimum Total Head : 12 Mtrs Voltage Range : 415 ± 10% Volts (Three Phase) (B) Pump Rating : 5 HP Flow Rate : 1000-1400 LPM Minimum Total Head : 10 Mtrs Voltage Range : 415 ± 10% Volts (Three Phase)
2.	**Clause 10.5.3 of Section-Civil works Rev 11A & Clause 2.8 (b) of Section-Structures Rev 06**	**Factor of safety for design of tower and equipment structures and foundations:** a. Factor of safety for design of tower, equipment structures shall be 1.5 under normal condition and 1.2 under short-circuit condition. b. Factor of safety for design of tower, equipment foundation shall be 1.5 in both normal and short circuit condition as per IS 456. c. Factor of safety for stability of tower, equipment foundation like overturning shall be 2 (without wind or seismic), 1.5 (with wind or seismic) for normal and short circuit condition as per IS 1904.
3.	**New Clause No. 22.0**	**Slope Protection Works & Retaining Walls:** Design & Drawings pertaining to slope protection works & retaining walls (if required) shall be developed by the contractor during detailed engineering for

		Employer's approval. The work shall be measured under respective line items of BPS.
4.	New Clause of Copy right in Civil Rev 11A & Structure Rev 06	a. The copyright in all drawings, documents and other materials containing data and information for such design(s) to be developed by the Contractor or through any third party under this Contract shall remain vested in the Employer for a period of 5 years from the date of Completion of the Contract. In case the Contractor intends to use these design(s) for any purpose other than for project(s) to be executed by POWERGRID prior to the period of 5 years as above, the Contractor shall obtain a written permission from POWERGRID to this effect. The permission shall be granted or otherwise by POWERGRID keeping in view the specifics of the case and POWERGRID shall be sole judge in this regard. In case any breach of the aforesaid provisions of copyright during the copyright retention period comes to the notice, POWERGRID shall take the action as deemed fit keeping inter-alia under the provisions of the Integrity Pact. b. The Contractor may also use previous structure designs and associated foundation designs meeting specification requirements, which have been designed by them for any other project of POWERGRID, having copyright retained thereof with POWERGRID, without any financial implication and without any written permission from POWERGRID as per para (a) above. c. In case the Contractor uses previously designed structure and associated foundation designs meeting specification requirements, developed by the Contractor for any other utility/developer, POWERGRID shall be free to use designs and reproduce all drawings, documents and other material for the purpose of the Contract including, if required, in its any other project and for operation and maintenance, without any financial implication. The contractor shall ensure to submit only those documents for which they hold copyright. d. Also, all the drawings indicated at (a) & (b) above shall carry the following statement and shall be displayed conspicuously on the drawing: "WARNING: THIS IS PROPRIETORY ITEM AND DESIGN RIGHT IS STRICTLY RESERVED WITH POWERGRID UNDER NO CIRCUMSTANCES THIS DRAWING SHALL BE USED BY ANYBODY WITHOUT PRIOR PERMISSION FROM POWERGRID IN WRITING"
Q.	**Section CRP Rev 09**	
1.	**New Para added under Clause No.5.1**	Requirement of Shrouding shall not be applicable to TB's where live parts are concealed.
2.	**New para added under Clause no.18.8**	Line Differential relays used as both Main –I & Main-II protection of a line, shall be of either different make & model or shall be on different hardware platform.
3.	**New para added under**	Directional Earth Fault Relay/Function provided shall have Carrier Aided scheme feature which shall be suitable for single phase auto re-closure schemes

<table>
<tr><td></td><td>Clause no.18.9(s)</td><td></td></tr>
<tr><td>4.</td><td>Clause no. 19.1. (a), (b) and (d)</td><td>a) have single phase & 3 phase reclosing facilities.
b) have a continuously variable dead time range of 0.1-2 seconds.
(d) Auto reclose scheme shall have provision of selection of the following modes:-
i. Single phase.
ii. Three Phase.
iii. Single & three phase.
iv. Non-Auto
The necessary provision in the scheme shall be provided to select the A/R mode from both local and remote</td></tr>
<tr><td>5.</td><td>New Para added under Clause No. 20.4</td><td>Wherever, scope for NGR by passing is envisaged, necessary equipment, wiring etc. required for control & monitoring of 145kV Circuit Breaker for NGR by-passing arrangement shall be under contractor’s scope of work. The same may be located in respective line/reactor protection panel.</td></tr>
<tr><td>6.</td><td>Clause No. 21.1 (e)</td><td>be suitable for individual input from associated CTs with rated CT secondary current of 1 Amp.</td></tr>
<tr><td>7.</td><td>New Clause No. 21.8</td><td>Back-up Impedance protection function shall be provided for 765kV & 400kV sides of 765/400/33kV ICT and for 400kV side of 400kV class ICT. This protection function can be clubbed with any other protection IED’s except of Differential Protection IDC.</td></tr>
<tr><td>8.</td><td>Clause No. 32.9</td><td>The equipment offered shall have six (6) output ports. Various combinations of output ports shall be selected by the customer, during detailed engineering, from the following :
• Potential free contact (Minimum pulse duration of 50 milli seconds.)
• IRIG-B
• RS232C
• SNTP Port (at least 4 ports)
• IEEE 1588 PTP (Applicable only for Process bus automation station)</td></tr>
<tr><td>9.</td><td>New clause 24.3 q)</td><td>In case of extension substation with distributed bus bar protection, if Bay unit is envisaged under scope of the contract, it shall be compatible with the existing central unit. In such case type test for the bay unit once conducted shall hold good. The requirement of type test conducted within last seven years, shall not be applicable for the bay unit.</td></tr>
<tr><td>10.</td><td>Clause no 37. IV Breaker Relay Panel</td><td>BREAKER RELAY PANEL: The breaker relay panel shall consist of the following:
<table>
<tr><th>Sl. No.</th><th>Description</th><th>Qty</th></tr>
<tr><td>1.</td><td>Breaker failure Protection Scheme*</td><td>1no.</td></tr>
<tr><td>2.</td><td>DC supply Supervision relay</td><td>2nos.</td></tr>
<tr><td>3.</td><td>Trip Circuit supervision relays#</td><td>6nos.</td></tr>
<tr><td>4.</td><td>Auto-reclose scheme (##)</td><td>1No.</td></tr>
<tr><td>5.</td><td>Flag relays, aux relays, timers, trip relays as per scheme requirements</td><td>As required</td></tr>
<tr><td>Note-1)</td><td colspan="2"># Trip supervision relays shall be 2 or 6 numbers as per no. of trip coils for each 132KV Circuit breaker</td></tr>
<tr><td>Note- 2)</td><td colspan="2">Equipment/relays to be provided under CB Relay Panel may be accommodated in the Protection Panels to be provided for Transmission Line/Transformer/Reactor as applicable</td></tr>
<tr><td>Note- 3)</td><td colspan="2">* In case of bay extension in existing half diameter, breaker failure relay for main CB / Tie CB shall be supplied only if BFR built-in Bus Bar protection bay unit is not available or Tie CB standalone BFR relay is not available in the existing protection scheme.</td></tr>
</table></td></tr>
</table>

		Note-3)	## Auto reclose scheme shall also be acceptable as a part of BCU. All Circuit Breaker Relay Panel shall be provided with Auto-reclose function. However, during execution stage Auto-reclose function shall be enabled/ disabled based on requirement
R.	**Section SAS Rev 04**		
1.	**Typical Architectural Drawing of SAS (Without Process Bus)**	TYPICAL ARCHITECTURAL DRAWING OF SUBSTATION AUTOMATION SYSTEM (Without Process Bus) stands replaced by **Annexure-S5**	
2.	**Para 2 under Clause No. 3.3.1**	The Substation Automation System shall have communication ports on each gateway (two gateways per station) as follows: (a) Three ports for Remote Control Centres on Secure IEC60870-5-104 protocol. **(b) Two port on IEC 60870-5-104 for Regional System Coordination Centre (RSCC)**	
3.	**New Para Added Under Clause No.4.1.5**	The bidder shall also provide 2 Nos. managed Ethernet switches with at least 16 copper RJ45 ports on each switch to form managed "Redundant System LAN" for connecting different NTAMC sub-systems devices (SCADA Gateways, VMS, VOIP etc.) as per revised system architecture **(attached as Annexure S5)**. The specification of the switches is enclosed at **Annexure-S6.**	
4.	Para 2 Under Clause No.4.1.6	Contractor shall provide 2 nos. Next Generation Firewalls (NGFW); one No. Main & one No. Standby having electrical ethernet interfaces/ports and placed between FOTE & SAS gateways, NTAMC switch etc. at the substation. All ethernet based applications (e.g. PMU, AMR, VOIP, SAS/SCADA etc.) shall be terminated in the firewall ports directly. Each port of firewall shall work as a separate zone. Firewall shall be hardware based with functionality of Block/Allow/drop and IPSec VPN (network encryption). Minimum 16 Nos. of ports/interfaces shall be provided in each firewall (i.e. Main & Standby) Contractor can use either single firewall or multiple firewalls to meet this interfaces requirement, each for main as well as standby firewall. Minimum throughput of firewall shall be 300 Mbps. The Firewall shall be managed/ configured as standalone at present and shall also have compatibility to manage/configure through Centralized Management Console (CMC) remotely in future. OEM Support on 24x7 basis for 7 years shall be provided for all the functions & features of the Firewall. Firewall shall be tested and certified for ISO15408 Common Criteria for least EAL4+. Further, the OEM must certify that it conforms to Secure Product Development Life Cycle requirements as per IEC62443-4-1. The firewall shall generate reports for NERC-CIP Compliance. The specifications for the firewalls are attached at **Annexure-S7.**	
5.	**Para 3 Under Clause No.4.1.6**	The substation routers shall have the following features: - Routing protocols such as OSPF and support for IPv4 and IPv6 **- 8 Ethernet interfaces of 10/100 Mbps** - 2 E1 interfaces - Hot standby operation with a similar router - Support IEEE 802.3u, 802.1p, 802.1Q, 802.1d, 802.1w, - Traffic prioritization for routed IP flows/ports	
6.	**Bullet no.4 under Clause No. 4.2.1**	Each BCU shall be equipped with Local HMI (display) facilities, enabling control of each particular bay from BCU whenever required. The Local HMI facilities shall be accomplished by means of Graphical LCD display embedded into the front panel of the BCU. Display will show the SLD (with device identification number) showing status of bay switching equipment (such as circuit breaker, isolators, earth switches) and enabling issuance of switching controls. Other display type will be multiple displays of analog values readings / reports, displays for controls other than switching, Alarm panel displays,	

		Diagnostic/ online configuration displays etc. **Bay control unit shall have inbuilt metering CVT supervision function. It shall have feature to give alarm in case of CVT/PT metering core fuse fail.**
7.	Clause 4.2.2 New bullet	Bay Control Units for Main System and Auxiliary system at a station shall be classified as below based on it's application and Contractor shall supply following types of BCU applicable under the subject package: Bay control Unit (IED) of Main System (a). Main Bay BCU (b). Tie Bay BCU (c). Switchable Line Reactor Bay BCU Bay control Unit (IED) of Auxiliary System (a) Auxiliary BCU
8.	**New Clause 15.4**	Mandatory spares: a. Mandatory Spares for Substation Automation shall be supplied as per BPS. b. The offered "Bay control Unit (IED) of Main System" as spare, shall be sufficient to replace all types of Bay control Units supplied under Main system without addition of any hardware/module etc. Further any additional I/O module and/or hardware supplied under Main system to meet the functional requirement of Bay control Unit in any bay, shall be considered part of Bay control Unit (IED) of Main System. The offered "Bay control Unit (IED) of Auxiliary System" as spare, shall be sufficient to replace all types of Auxiliary BCU supplied under Auxiliary system without addition of any hardware/module etc. Further any additional I/O module and/or hardware supplied under Auxiliary system to meet the functional requirement of Bay control Unit shall be considered part of Bay control Unit (IED) of Auxiliary System
9.	**Clause No. 16.0 (v)**	**LIST OF EQUIPMENTS** v) **Two nos. Disturbance Recorder/Engineering Workstation where atleast one workstation shall have Linux based operating system.**
S.	**Section PLCC Rev 05**	
1.	**New Clause No. 6.12.4**	For 765 kV Wave Trap, cantilever strength of BPIs used for Wave Trap shall be 10 kN.
2.	**New Clause no. 10.4.13**	All protection couplers (Analog protection coupler, digital protection coupler) shall be equipped with direct reading type counter facility for all the codes (Tx & Rx).
3.	**New Clause no.10.5**	Digital protection coupler (DPC) shall be used as one of the two tele-protection channel on the lines between the stations having Optical Fiber link alongwith SDH Equipment. Specification of digital protection coupler is enclosed as **Annexure-S8.** The DPC can be housed either in offered Control & Protection Panel / PLCC Panel or in separate panel. Generally SDH Equipment are placed in communication room of Control room where as DPC is placed in panel room. The connection between SDH equipment and each DPC shall be through Optical fiber. Necessary cables, converter(s) for converting E1 signal to optical fiber at both ends (at Panel Room as well as at Control room) along with FODP shall be in the scope of the contractor. Further sharing of additional spare ports of converter for DPC placed in other Panel Room or in same Panel Room is also permitted. Necessary optical fiber for interconnection of DPC is to be provided by the contractor. Further any copper wiring for ensuring the protection signaling/data/speech shall be in the scope of the contractor.
T.	**VISUAL MONITORING SYSTEM** (if specified in BPS)	
1.		Technical Specification for Visual Monitoring System for watch and ward of substation premises is attached at **Annexure-S9**

<table>
<tr><th>U.</th><th colspan="2">Section –400KV Transformer Rev 13</th></tr>
<tr><td>1.</td><td>Clause no 4 (b)</td><td>The concentration of any fault gas is more than respective values as per Table-1 of IEEE-C57.104-2019, which are as detailed below
<table>
<tr><th>Fault GAS</th><th>O2/N2 Ratio ≤0.2</th><th>O2/N2 Ratio >0.2</th></tr>
<tr><td>Hydrogen (H2)</td><td>75</td><td>40</td></tr>
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<tr><td>Ethylene (C2H4)</td><td>20</td><td>25</td></tr>
<tr><td>Acetylene (C2H2)</td><td>01</td><td>02</td></tr>
<tr><td>Carbon Monoxide (CO)</td><td>900</td><td>500</td></tr>
<tr><td>Carbon dioxide (CO2)</td><td>5000</td><td>3500</td></tr>
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<tr><td>2.</td><td>Clause No. 6.5.1</td><td>Conservator shall have air cell type constant oil pressure system to prevent oxidation and contamination of oil due to contact with moisture.
Conservator Protection Relay (CPR)/Air cell puncture detection relay shall be installed to give alarm in the event of lowering of oil in the conservator due to puncture of air cell in service.

Conservator shall be fitted with magnetic oil level gauge (Plug & socket type arrangement) with potential free high and low oil level alarm contacts and prismatic oil level gauge and Conservator Protection Relay.

Plug & socket type arrangement with factory fitted cable of adequate length shall be supplied by OEM. Connection of plug and socket with cable at site is not acceptable.</td></tr>
<tr><td>3.</td><td>Annexure-H</td><td>ANNEXURE - H
1.1 KV GRADE POWER & CONTROL CABLES
…
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STANDARD TECHNICAL DATA SHEET (1.1kV GRADE XLPE POWER CABLES)
– VOID (Parameters of Standard Technical Data Sheet shall not be referred to)

STANDARD TECHNICAL DATA SHEET (1.1kV GRADE PVC POWER CABLES)
– VOID (Parameters of Standard Technical Data Sheet shall not be referred to)

STANDARD TECHNICAL DATA SHEET (1.1kV GRADE PVC CONTROL CABLES)
– VOID (Parameters of Standard Technical Data Sheet shall not be referred to)</td></tr>
<tr><td>4.</td><td>Clause no 9.1</td><td>Particles in the oil
The particle analysis shall be carried out in an oil sample taken before carrying out FAT at manufacturer’s works and after completion of the oil filtration at site. The procedure and interpretation shall be in accordance with the recommendation of CIGRE report WG-12.17- “Effect of particles on transformer dielectric strength”. Particle limit as shown below shall be ensured by manufacturer, implying low contamination, as per CIGRE Brochure 157, Table 8.
Limiting value for the particle count are 1000 particle/100 ml with size ≥ 5 µm; 130 particle/100 ml with size ≥ 15 µm.</td></tr>
</table>

<table>
<tr><td>V.</td><td colspan="2">Section 400kV Shunt Reactor Rev. 11</td></tr>
<tr><td>1.</td><td>Clause No. 7.5.1</td><td>Conservator shall have air cell type constant oil pressure system to prevent oxidation and contamination of oil due to contact with moisture.
Conservator Protection Relay (CPR)/Air cell puncture detection relay shall be installed to give alarm in the event of lowering of oil in the conservator due to puncture of air cell in service.

Conservator shall be fitted with magnetic oil level gauge (Plug & socket type arrangement) with potential free high and low oil level alarm contacts and prismatic oil level gauge and Conservator Protection Relay.

Plug & socket type arrangement with factory fitted cable of adequate length shall be supplied by OEM. Connection of plug and socket with cable at site is not acceptable.</td></tr>
<tr><td>2.</td><td>Clause no. 5(b)</td><td>The concentration of any fault gas is more than respective values as per Table-1 of IEEE-C57.104-2019, which are as detailed below
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<tr><th>Fault GAS</th><th>O2/N2 Ratio ≤0.2</th><th>O2/N2 Ratio >0.2</th></tr>
<tr><td>Hydrogen (H2)</td><td>75</td><td>40</td></tr>
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Limiting value for the particle count are 1000 particle/100 ml with size ≥ 5µm; 130 particle/100 ml with size ≥ 15µm.</td></tr>
<tr><td>5.</td><td>Annexure-D</td><td>Sl. nos. (i) and (iv) of Reference Drawings mentioned at Annexure-D stands deleted.</td></tr>
<tr><td>W.</td><td colspan="2">Section- 765kV Auto-transformer Rev 08</td></tr>
</table>

<table>
<tr><td>1.</td><td>Clause no. 4(b)</td><td>The concentration of any fault gas is more than respective values as per Table-1 of IEEE-C57.104-2019, which are as detailed below
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<tr><td>2.</td><td>Clause 6.5.1</td><td>Conservator shall have air cell type constant oil pressure system to prevent oxidation and contamination of oil due to contact with moisture.
Conservator Protection Relay (CPR)/Air cell puncture detection relay shall be installed to give alarm in the event of lowering of oil in the conservator due to puncture of air cell in service.

Conservator shall be fitted with magnetic oil level gauge (Plug & socket type arrangement) with potential free high and low oil level alarm contacts and prismatic oil level gauge and Conservator Protection Relay.

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<tr><td>4.</td><td>Clause no 8.1</td><td>Particles in the oil
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<tr><td>X.</td><td colspan="2">Section-765kV Shunt Reactor, Rev. 08</td></tr>
<tr><td>1.</td><td>Clause no. 5(b)</td><td>The concentration of any fault gas is more than respective values as per Table-1 of IEEE-C57.104-2019, which are as detailed below
<table>
<tr><th>Fault GAS</th><th>O2/N2 Ratio ≤0.2</th><th>O2/N2 Ratio >0.2</th></tr>
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2.	Clause No. 7.5.1	Conservator shall have air cell type constant oil pressure system to prevent oxidation and contamination of oil due to contact with moisture. Conservator Protection Relay (CPR)/Air cell puncture detection relay shall be installed to give alarm in the event of lowering of oil in the conservator due to puncture of air cell in service. Conservator shall be fitted with magnetic oil level gauge (Plug & socket type arrangement) with potential free high and low oil level alarm contacts and prismatic oil level gauge and Conservator Protection Relay. **Plug & socket type arrangement with factory fitted cable of adequate length shall be supplied by OEM. Connection of plug and socket with cable at site is not acceptable.**
3.	Annexure-I	**ANNEXURE - I** **1.1 KV GRADE POWER & CONTROL CABLES** **…** **…** **STANDARD TECHNICAL DATA SHEET (1.1kV GRADE XLPE POWER CABLES)** **– VOID (Parameters of Standard Technical Data Sheet shall not be referred to)** **STANDARD TECHNICAL DATA SHEET (1.1kV GRADE PVC POWER CABLES)** **– VOID (Parameters of Standard Technical Data Sheet shall not be referred to)** **STANDARD TECHNICAL DATA SHEET (1.1kV GRADE PVC CONTROL CABLES)** **– VOID (Parameters of Standard Technical Data Sheet shall not be referred to)**
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5.	Annexure-C	Sl. nos. (i) and (iii) of Reference Drawings mentioned at Annexure-C stands deleted.
Y	LT transformer Rev-5	
1.	Clause no 5.2.5 b)	**Clause no 5.2.5 b) Stand Deleted.**

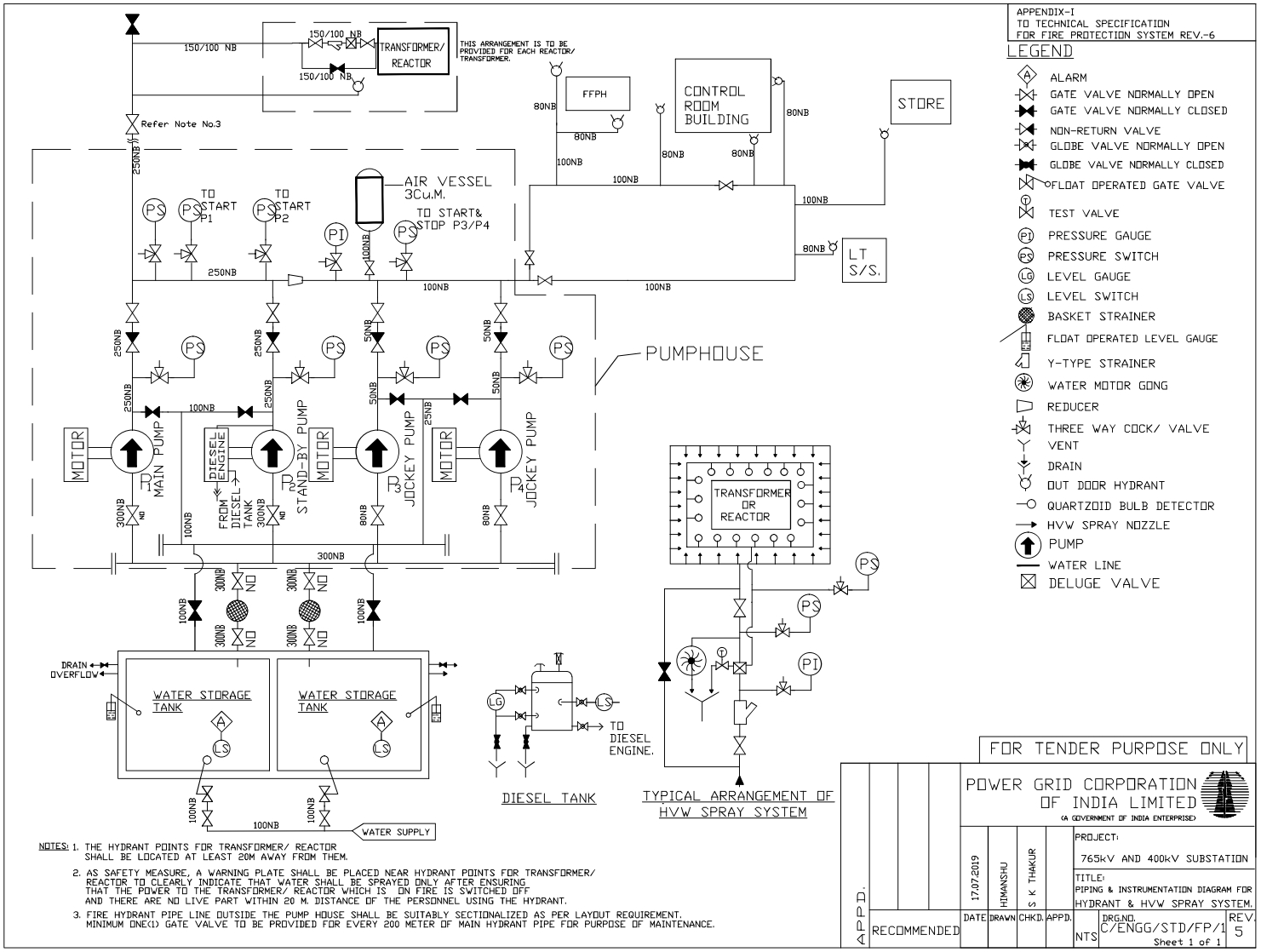
Sl. No.	Power System Equipment	Minimum Local Content (%)
1	Power Transformers (up to 765 kV, including Generator Transformers)	60
2	Instrument Transformer (up to 765 kV)	60
3	Transformer Oil Dry Out System (TODOS)	60
4	Reactors up to 765 kV	60
5	Oil Impregnated Bushing (Up to 400kV)	60
6	Resin Insulated Paper (RIP) bushings (up to 145 kV)	50
7	Circuit Breakers (up to 765kV AC-Alternating Current)	60
8	Disconnectors, Isolators (up to 765kV AC)	60
9	Wave Trap (up to 765kV AC)	60
10	Oil Filled Distribution Transformers up to & including 33kV [Cold Rolled Grain Oriented (CRGO)/Amorphous, Aluminium/Copper wound]	60
11	Dry type Distribution Transformers up to & including 33kV (CRGO/Amorphous, Aluminium/Copper wound)	60
12	Conventional conductor	60
13	Accessories for conventional conductors	60
14	High Temperature/High Temperature Low Sag (HTLS) conductors (such as Composite core, GAP, ACSS, INVAR, AL59) and accessories	60
15	Optical ground wire (OPGW)- all designs	60
16	Fiber Optic Terminal Equipment (FOTE) for OPGW	50
17	OPGW related Hardware and accessories	60
18	Remote Terminal Unit (RTU)	50
19	Power Cables and accessories up to 33kV	60
20	Control cables including accessories	60
21	XLPE cables up to 220kV	60
22	Substation Structures	60
23	Transmission Line Towers	60
24	Porcelain (Disc/Long Rod) Insulators	60
25	Bus Post Insulators (Porcelain)	60
26	Porcelain Disc Insulators with Room Temperature Vulcanisation (RTV) coating	50
27	Porcelain Long Rod Insulators with Room temperature Vulcanisation (RTV) coating	50
28	Hardware Fittings for porcelain Insulators	60
29	Composite/Polymeric Long Rod Insulators	60
30	Hardware Fittings for Polymer Insulators	60
31	Bird Flight Diverter (BFD)	60
32	Power Line Carrier Communication (PLCC) system (up to 800kV)	60
33	Gas Insulated Switchgear (up to 400kV AC)	60
34	Gas Insulated Switchgear (above 400kV AC)	50
35	Surge/Lightning Arrester (up to 765kV AC)	60
36	Power Capacitors	60
37	Packaged Sub-station (6.6kV to 33kV)	60
38	Ring Main Unit (RMU) (up to 33kV)	60

39	Medium Voltage (MV) GIS panels (up to 33kV)	60
40	Automation and Control system/Supervisory Control and Data Acquisition (SCADA) system in Power system	50
41	Control and Relay panel (including Digital/Numerical relays)	50
42	Electrical motors 0.37kW to 1MW	60
43	Energy meters excluding smart meters	50
44	Control and Power cables and accessories (up to 1.1kV)	60
45	Diesel Generating (DG) set	60
46	DC system (DC Battery & Battery Charger)	60
47	AC and DC Distribution board	60
48	Indoor Air Insulated Switchgear (AIS) up to 33kV	60
49	Poles (PCC, PSCC, Rolled Steel Joist, Rail Pole, Spun, Steel Tubular)	60
50	Material for Grounding/earthing system	60
51	Illumination system	60
52	Overhead Fault Sensing Indicator (FSI)	50
53	Power Quality Meters	50
54	Auxiliary Relays	50
55	Load Break Switch	50
56	Cranes, EOT cranes, gantry crane & chain pulley blocks, etc	60
57	Elevator	60
Fire Protection and Detection system		
58	Motor driven fire water pumps	60
59	Diesel engine driven fire water pumps	60
60	Hydrant system	60
61	High velocity water spray system	60
62	Medium velocity water spray system	60
63	Foam Protection system	60
64	Inert gas flooding system	60
65	Fire tenders	60
66	Portable fire-extinguishers	60

Annexure-V (Revised): Actions required in case of defects observed during warrantee period

Equipment	Nature of problem	Corrective measures to be taken by contractor
CT**/IVT/PT** (Oil filled)	**DGA Violation** H2 > 300 ppm C2H2> 2 ppm	Refurbished or replaced
CT**/IVT/PT** (SF_6 filled)	a) SF6 gas leakage b) High Dew point of SF6 gas (> -36 deg C at atm press)	a)Repair/ replacement b)Re-processing of gas and replacement of Gas in case of no improvement
CT**/IVT/PT** (Oil filled)	**Violation of Tan delta** Tan Delta: >0.5%(during pre-commisioning) >0.7% (in operation) or change w.r.t. to previous **year** value > 0.1%	Replacement
CT, **IVT/PT** & CVT	- Oil leakage - Low Oil level -Sec winding problem leading to open/ short circuit, saturation etc	Replacement or repair as per repair procedure approved by QA.
CVT	Secondary voltage drift: Upto ± 0.5 volts Healthy a) ± 0.5 **or beyond**	a) CVT to be replaced

***Replaced/Repaired/Refurbished Equipment (or part of equipment) shall have 2 years warranty without prejudice to contractual warranty period.**



NOTES:
1. THE HYDRANT POINTS FOR TRANSFORMER/ REACTOR SHALL BE LOCATED AT LEAST 20M AWAY FROM THEM.
2. AS SAFETY MEASURE, A WARNING PLATE SHALL BE PLACED NEAR HYDRANT POINTS FOR TRANSFORMER/ REACTOR TO CLEARLY INDICATE THAT WATER SHALL BE SPRAYED ONLY AFTER ENSURING THAT THE POWER TO THE TRANSFORMER/ REACTOR WHICH IS ON FIRE IS SWITCHED OFF AND THERE ARE NO LIVE PART WITHIN 20 M. DISTANCE OF THE PERSONNEL USING THE HYDRANT.
3. FIRE HYDRANT PIPE LINE OUTSIDE THE PUMP HOUSE SHALL BE SUITABLY SECTIONALIZED AS PER LAYOUT REQUIREMENT. MINIMUM ONE(1) GATE VALVE TO BE PROVIDED FOR EVERY 200 METER OF MAIN HYDRANT PIPE FOR PURPOSE OF MAINTENANCE.

FOR TENDER PURPOSE ONLY

POWER GRID CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

	DATE	DRAWN	CHKD.	APPD.
RECOMMENDED	17.07.2019	HIMANSHU	S K THAKUR	
APPD.				

PROJECT: 765kV AND 400kV SUBSTATION

TITLE: PIPING & INSTRUMENTATION DIAGRAM FOR HYDRANT & HVW SPRAY SYSTEM.

NTS | DRG.NO. C/ENGG/STD/FP/1 | REV. 5

Sheet 1 of 1

TECHNICAL DATA SHEETS

DATA SHEET FOR DELUGE VALVE

1.0	Manufacturer	POWERGRID Approved make
2.0	Number & size	As per approved system drawings.
3.0	Type	Differential Diaphragm type
4.0	Rating	
4.1	Flow in M^3/hr. 1. 150 mm ø 2. 100 mm ø	170 to 650 50 to 225
4.2	Pressure	Working Pressure – 12.3 kg/cm^2 Test Pressure - 25 kg/cm^2
4.3	Pressure drop in equivalent length 1. 150 mm ø 2. 100 mm ø	 19M 11M
5.0	**Material of construction**	
5.1	Body	CI IS:210 Gr. FG 260
5.2	Valve internal	Cast Bronze – IS:318-LTB 2 / Ductile Iron ASTM A536 65-45-12
5.3	Seat Seal	EPDM/ Neoprene Rubber
5.4	Diaphragm	EPDM/ Neoprene Rubber
6.0	Differential pressure required for operation	Differential Ratio – 50%
7.0	Water Motor Gong provided	Yes
7.1	Type	Hydraulic type
7.2	**Material of Construction:**	
7.2.1	Housing	Al. Alloy-IS:617
7.2.2	Cover/Rotor./Gong	Aluminium to IS:737
7.2.3	Manual actuation lever provided?	Yes
8.0	Remote actuation with Solenoid Valve provided?	Yes
9.0	Resetting type	Manual resetting type
10.0	Deluge valve complete with test and drain valves, manual operation arrangement, supporting structures and all necessary accessories	Yes
11.0	Approval of Deluge Valve.	FM of USA, UL of USA, LPCB of U.K. or VDS of Germany

METHODOLOGY FOR SUPPLY, INSTALLATION & SIZING OF CABLES

Supply of 1.1kV grade Cables:

- The quantities of various type of 1.1kV grade power and control cables shall be assessed by POWERGRID. The Sizes of 1.1 kV grade Control cables to be adopted for installation is enclosed at Appendix I . For Sizes of Power Cable, Clause 1.1.4 of Section Power and control Cable rev 06 is amended at Appendix-II

  For Applications in addition to those specified, appropriate cable size shall be considered by the contractor with prior approval of Employer during execution stage

- Supply of 1.1kV grade power and control cables of various sizes shall be as per unit quantities mentioned in BPS.

- The Cables from Control Room/SPR/ACDB/DCDB/BMK to Equipment Marshalling box (MB)/Local control Cubical (LCC) shall be considered under the BPS item for supply of cables.

- The Interpole cables between AIS Instrument Transformer (CT/CVT), Surge Arrester and associated Junction Box shall be as per unit quantities mentioned in BPS.

- The Interpole cables between Circuit Breaker, Isolator and associated Marshalling box shall be deemed to be included in price of Equipment.

Installation of 1.1kV grade Cables:

- The quantity of Installation of cables is to be assessed by the contractor for the complete scope of work specified in Section project.

- The installation of 1.1kV grade power and control cables (including interpole cable of Equipment & illumination cables) shall be quoted in "LOT" basis.

- Supply and installation of Cable accessories like lugs, glands etc. for entire cabling work shall be deemed to be included in Installation charges of cables quoted by contractor in Bid price schedule.

- No variation shall be admissible on account of Installation of Cables/supply and installation of associated accessories, irrespective of variation (either positive or negative) in supply quantity of Cable specified in BPS.

Extra Consumption of 1.1 kV Power and control cables.

The Contractor shall make every effort to minimise wastage of the cables during installation. The Permitted Overall scarp/wastage shall be limited to 0.50% of actual supplied quantity for each size of cables. Any wastage more than the above limit shall be recovered from the contractor. All balance unused cables shall be returned to the employer by rewinding in separate drums for each size with discrete markings on drums.

Cut pieces of Cables having length less than following shall be considered for Scrap. The Contractor shall dispose of the scrap (if any), at their own cost :

1.) **Length less than 20 M**
   - **a)** Control Cable (3C, 5C, 7C & 10 Core)
   - **b)** Power Cable(2CX 6Sqmm,4CX6Sqmm, 4CX16Sqmm)

2.) **Length less than 50 M**
   - **a)** Control Cable having more than 10 Cores
   - **b)** Power Cable of sizes above 16 Sq mm

For Illumination purpose, ACP's shall be supplied as per BPS. From ACP to luminous all the required cables, accessories(including lugs and gland for cables between MLDB & ACP) , SLP/JB etc as required shall be assessed and supplied by the contractor. The price of these items shall be deemed to be included in price of luminaries.

Appendix-I: Control Cable Sizes

S.No.	From	To	Proposed Cable size
1.	CB MB	CRP panels	i) 10CX2.5Sq mm ii) 19CX1.5 Sq mm iii) 27CX 1.5 Sq mm
2.	CB MB	Earth switch MB	i) 3CX 2.5 Sqmm ii) 5C X2.5 Sq mm
3.	Isolator MB	Earth switch MB	10CX2.5Sq mm
4.	Isolator MB	CRP panels	19CX1.5 Sq mm
5.	CT	CT JB	i) 5C X2.5 Sq mm ii) 10C X2.5 Sq mm
6.	CT JB	CRP panels	i) 5C X2.5 Sq mm ii) 10C X2.5 Sq mm
7.	CVT	CVT JB	i) 5C X2.5 Sq mm ii) 10C X2.5 Sq mm
8.	CVT JB	CRP panels	i) 5C X2.5 Sq mm ii) 10C X2.5 Sq mm
9.	LA	LA JB	3C X2.5 Sq mm
10.	LA JB	CRP panels	5C X2.5 Sq mm
11.	Reactor MB/CMB (for 1-Ph)	CRP panels	i) 3CX2.5Sq mm ii) 5CX2.5 Sq mm iii) 19CX 1.5 Sq mm iv) 27CX 1.5 Sq mm v) Paired Cables
12.	ICT MB/CMB (for 1-Ph)	CRP panels	i) 3CX2.5Sq mm ii) 5CX2.5 Sq mm iii) 19CX 1.5 Sq mm iv) 27CX 1.5 Sq mm v) Paired Cables

Note:

i) For Applications in addition to those specified, appropriate cable size shall be considered by the contractor with prior approval of Employer during execution stage.

ii) GTP of 1.5 Sq mm Cable shall be submitted during detailed engineering stage for employers approval.

iii) In case, more nos. of runs or larger sizes of cables are required between two points based on design calculations, same shall deemed to be included in the scope of bidder.

Appendix-II Power cable sizes.

S.No.	From	To	Existing Cable size	Cable type
1.	Main Switch Board	LT Transformer	2-1C X 630 mm^2 :For each phase 1-1C X 630 mm^2 : for neutral	XLPE
2.	Main Switch Board	AC Distribution Board	2-3½C X 300 mm^2	XLPE
3.	Main Switch Board	Oil Filtration Unit	1-3½C X 300 mm^2	XLPE
4.	Main Switch Board	Colony Lighting	1-3½C X 300 mm2	XLPE
5.	Main Switch Board	HVW pump LCP	1-3½C X 300 mm2	XLPE
6.	Main Switch Board	Main Lighting distribution board	2-3½C X 300 mm2	XLPE
7.	AC Distribution Board	D.G. Set AMF Panel	For 500 kVA DG set: 2-3½C X 300 mm2 For 250 kVA DG set: 1-3½C X 300 mm2	XLPE
8.	AC Distribution Board	Emergency Lighting distribution board	3½C X 70mm2 :For 765/400kV S/s 3½C X 35mm2 :For 400/220kV S/s	PVC
9.	AC Distribution Board	ICT MB	3½C X 70mm2 :For 765/400kV S/s 3½C X 35mm2 :For 400/220kV S/s	PVC
10.	AC Distribution Board	Bay MB	3½C X 70mm2 :For 765/400kV S/s 3½C X 35mm2 For 400/220kV S/s	PVC
11.	Bay MB	AC Kiosk	1-4C X 16 mm2	PVC
12.	AC Distribution Board	Battery Charger 220 V	1-3½C X 70 mm2	PVC

13.	AC Distribution Board	Battery Charger 48 V	1-3½C X 35 mm	PVC
14.	DCDB	Battery	2-1C X 150 mm2	PVC
15.	DCDB	Battery Charger	2-1C X 150 mm2	PVC
16.	DCDB	Protection/PLCC panel	1-4C X 16 mm2 : 765/400kV S/s 1-4C X 6 mm2: 400/220kV S/s	PVC
17.	Main Lighting DB	Lighting panels(Indoor)	1-3½C X 35 mm2	PVC
18.	Main Lighting DB	Lighting panels (outdoor)	1-3½C X 70 mm2	PVC
19.	Main Lighting DB	Receptacles (Indoor)	1-3½C X 35 mm2	PVC
20.	Main Lighting DB	Receptacles (Outdoor)	1-3½C X 70 mm2	PVC
21.	Lighting Panel	Sub lighting panels	These Cables shall be included in Price of item for Lighting fixture	PVC
22.	Lighting Panel	Street Lighting Poles	These Cables shall be included in Price of item for Lighting fixture	PVC
23.	Lighting Panel/ Sub lighting panels	Lighting Fixtures (Outdoor)	These Cables shall be included in Price of item for Lighting fixture	PVC
24.	Bay MB	Equipment	1-4C X 16 mm^2 : For CB 1-4C X 6 $mm^{2:}$ For Isolator/earths switch 1-2C X 6 : For CT/CVT	PVC
25.	ELDB	Lighting panel	3½C X 70mm^2 :For 765/400kV S/s 3½C X 35mm2 :For 400/220kV S/s	

AIR CONDITIONING & VENTILATION SYSTEM FOR GIS BUILDING

AIR CONDITIONING SYSTEM FOR GIS

1. GENERAL

1.1. This specification covers supply, installation, testing and commissioning and handing over to POWERGRID of Air conditioning system for the Local Control rooms & Maintenance Room in the GIS halls.

1.2. Air conditioning system shall be designed to maintain the inside DBT below 24oC. Bidder shall submit necessary design calculations for employer's approval.

1.3. At least 50% spare Air-Conditioning capacity shall be provided for Local Control rooms in the GIS halls.

1.4. Controllers shall be provided in Local Control room inside GIS hall for controlling and monitoring the AC units in these rooms as detailed in clause no.2.6.

1.5. Each Local Control room inside GIS hall shall be provided with temperature transducer to monitor the temperature of the Local Control rooms in the GIS halls. The Temperature transducer shall have the following specification.

Sensor : Air temperature sensor (indoor use)
Output : 4 to 20mA
Temperature range : -5^{o}C to 60^{o}C
Resolution : 0.1^{o}C
Accuracy : 0.5^{o}C or better.

2. AIR CONDITIONING SYSTEM REQUIREMENTS.

2.1. Air conditioning requirement of the buildings shall be met using a combination of following types Air Conditioning units as required.

a) Cassette type split AC units of 3TR.
b) High wall type split AC units of 2TR

2.2. Type & Capacity of air conditioners shall be so chosen such that quantity of air conditioners in the room is optimized keeping the necessary air flow.

2.3. SCOPE

The scope of the equipment to be furnished and services to be provided under the contract are outlined hereinafter and the same is to be read in conjunction with the provision contained in other sections/ clauses. The scope of the work under the contract shall be deemed to include all such items, which although are not specifically mentioned in the bid documents and/or in Bidder's proposal, but are required to make the equipment/system complete for its safe, efficient, reliable and trouble free operation.

2.3.1. Required number of Cassette type split AC units of 3TR capacity each complete with air cooled outdoor condensing unit having hermetically sealed compressor unit with cordless remote controller.

2.3.2. Required number of High wall type split AC units of 2TR capacity each complete with air cooled outdoor condensing unit having hermetically sealed compressor and high wall type indoor evaporator unit with cordless remote controller.

2.3.3. Copper refrigerant piping complete with insulation between the indoor and outdoor units as required.

2.3.4. First charge of refrigerant and oil shall be supplied with the unit.

2.3.5. GSS/Aluminium sheet air distribution ducting for distributing conditioned dehumidified air along with supply air diffusers and return air grilles with volume control dampers and necessary splitters etc., suitable fixtures for grilles/diffusers and supports for ducting complete with insulation.

2.3.6. Local start/stop facility for local starting/ stopping of all electrical equipment/ drives.

2.3.7. All instruments and local control panels alongwith controls and interlock arrangements and accessories as required for safe and trouble free operation of the units.

2.3.8. PVC drain piping from the indoor units upto the nearest drain point.

2.3.9. Supply and erection of Power and control cable and earthing.

2.3.10. MS Brackets for outdoor condensing units, condensers as required.

2.4. Technical specifications

2.4.1. Cassette type split AC units

The Cassette type AC units shall be complete with indoor evaporator unit, outdoor condensing units and cordless remote control units.

2.4.1.1. Outdoor unit shall comprise of hermetically/ semi hermetically sealed compressors mounted on vibration isolators, fans and copper tube aluminium finned coils all assembled in a sheet metal casing. The casing and the total unit shall be properly treated and shall be weatherproof type. They shall be compact in size and shall have horizontal discharge of air.

2.4.1.2. Indoor units shall be of 4-way, ceiling mounted cassette type. The indoor unit shall be compact and shall have elegant appearance. They shall have low noise centrifugal blowers driven by suitable motors and copper tube aluminium finned cooling coils. Removable and washable polypropylene filters shall be provided. They shall be complete with multi function cordless remote control unit with special features like programmable timer, sleep mode etc.

2.4.1.3. Cooling capacity of 3TR AC units shall not be less than 36000btu/hr. and shall have energy efficiency rating of 4 star as on the date of NOA.

2.4.2. **High wall type split AC units.**
The split AC units shall be complete with indoor evaporator unit, outdoor condensing units and cordless remote control units.

2.4.2.1. Outdoor unit shall comprise of hermetically/semi hermetically sealed compressors mounted on vibration isolators, propeller type axial flow fans and copper tube aluminium finned coils all assembled in a sheet metal casing. The casing and the total unit shall be properly treated and shall be weatherproof type. They shall be compact in size and shall have horizontal discharge of air.

2.4.2.2. The indoor units shall be high wall type. The indoor unit shall be compact and shall have elegant appearance. They shall have low noise centrifugal blowers driven by suitable motors and copper tube aluminium finned cooling coils. Removable and washable polypropylene filters shall be provided. They shall be complete with multi function cordless remote control unit with special features like programmable timer, sleep mode and soft dry mode etc.

2.4.2.3. Cooling capacity of 2TR AC units shall not be less than 22000btu/hr. and shall have energy efficiency rating of 4 star as on the date of NOA

2.5. Controllers shall be provided in Local Control room inside GIS hall, one controller for each room, to control and monitoring of AC units and shall have the following facilities.

- Standby units shall come in to operation automatically when the running main unit fails.
- Main and standby units shall be changed over periodically which shall be finalised during detailed engineering.
- Following alarms shall be provided:

a. Compressor On/OFF condition of each unit
b. Compressor failure of each unit
c. Power OFF to AC unit
d. High temperature in room

2.6. Warranty
All compressors shall have minimum 5 years Warranty from the date of commissioning.

Ventilation system for GIS Hall

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

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

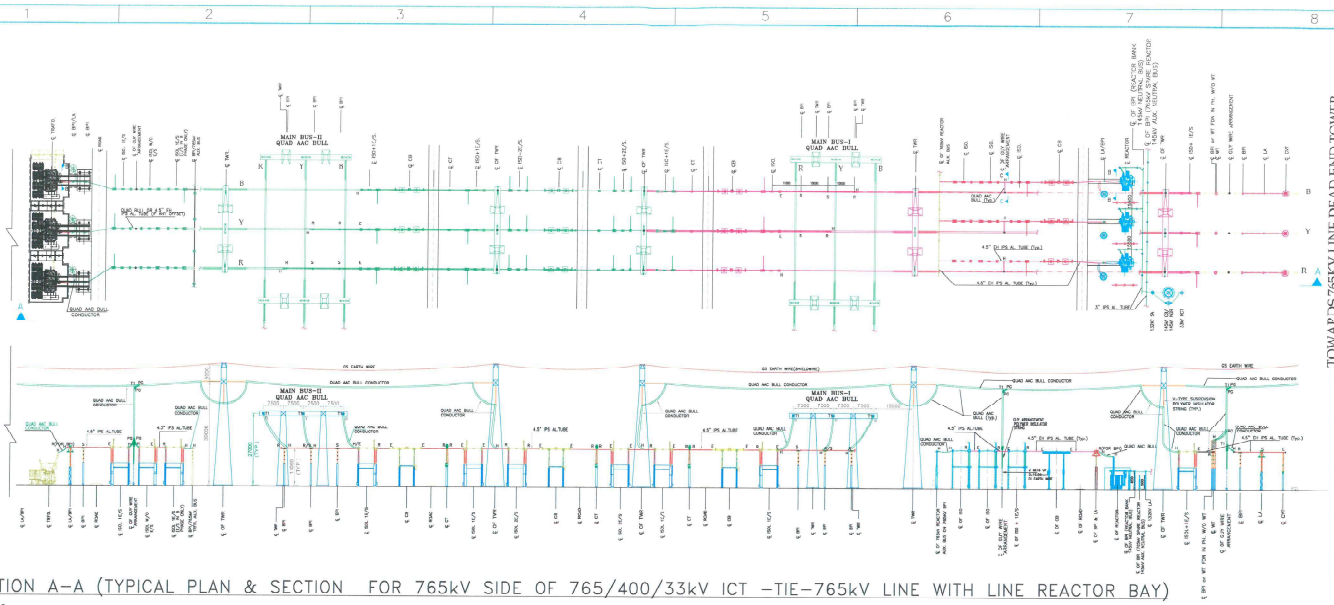
1. Pre Filters: To remove dust particles down to 10 micron in size with at least 95% efficiency.

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

All the filters shall be panel type. Easy access should be available to the filters for replacement/cleaning.

The ventilation of the GIS hall shall be of a positive pressure type with minimum 2 air changes per hour. The pressure inside the GIS hall shall be maintained 5 mm of water above the atmospheric pressure. Fresh outdoor air shall be filtered before being blown into the GIS hall by the air fans to avoid dust accumulation on components present in the GIS hall. GIS hall shall be provided with motorized exhaust dampers with local control.

ANNEXURE_S3



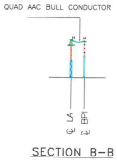
SECTION A–A (TYPICAL PLAN & SECTION FOR 765kV SIDE OF 765/400/33kV ICT –TIE–765kV LINE WITH LINE REACTOR BAY)

LEGENDS:

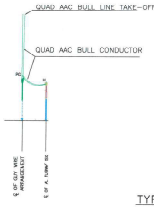
R– RIGID CONNECTION
E– EXPANSION TYPE CONNECTION
S– SLIDING TYPE CONNECTION
PG–PARALLEL GROOVE CONNECTION
T1– T1 TYPE CONNECTION (EACH T CONNECTOR SHALL BE OF TWIN TO TWIN CONDUCTOR TYPE FOR QUAD TO QUAD CONNECTION)
H– HORIZONTAL TYPE CONNECTION

NOTES:

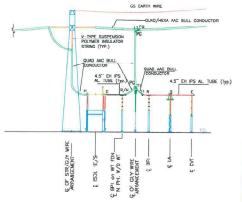
1) TWIN–TWIN CONNECTOR SHALL BE USED FOR QUAD–QUAD DROPPER CONNECTION.
2) AUXILIARY BUS ARRANGEMENT FOR 765kV TRANSFORMERS & REACTOR NEUTRALS, SPARE TRANSFORMER/REACTOR CONNECTION, TERTIARY ARRANGEMENT OF TRANSFORMERS ARE NOT SHOWN COMPLETELY.
3) CANTILEVER STRENGTH OF 765KV INSULATORS/BPI USED FOR 765KV ISOLATORS/WT SHALL BE OF 10KN AND FOR OTHER BPI IN SWITCHYARD SHALL BE OF 8KN MINIMUM.
4) HORIZONTAL TAKE–OFF OF JUMPERS AT EQUIPMENT LEVELS WITH ADEQUATE SAG SHALL BE PROVIDED



SECTION B–B



SECTION C C



TYPICAL SECTION FOR 765KV LINE SIDE FUIPMENT CONNECTION ARRANGEMENT IN PHASE WITHOUT WT

GAUTAM SHARMA	D.OJHA	A.SAMBAIAH	ABHAY KUMAR	P.K. DAS	RAJIL SRIVASTAVA	R.N. SINGH
CDE (ENGG–S/S)	DGM (ENGG–S/S)	DGM (ENGG–S/S)	Sr. GM (ENGG–S/S)	Sr.GM (ENGG–S/S)	CGM (ENGG–S/S)	ED (ENGG.–S/S,T/L & Civil)
PREPARED BY			REVIEWED BY			APPROVED BY

POWER GRID CORPORATION OF INDIA LIMITED
(A Government of India Enterprise)

TITLE: CONCEPTUAL CONNECTION ARRANMENT OF 765KV TRANSFORMER BAY–TIE BAY– LINE WITH LINE REACTOR BAYS

DRAWING NO. C/ENGG/ES/CONCEPTUAL 765KV BAY CONNECTIONS

REV.1

SH.1OF1

ANNEXURE- S4

SHORT CIRCUIT FORCES & SPACER SPAN FOR 765kV & 400kV GANTRY STRUCTURE

For new 765kV and 400 kV AIS switchyard with one & a half breaker switching scheme, three gantry type arrangement (i.e. arrangement having single gantry in Tie bay) shall be considered. Further, Short-Circuit Forces (SCF) for the design of Gantry Structure and spacer spans shall be as mentioned below:

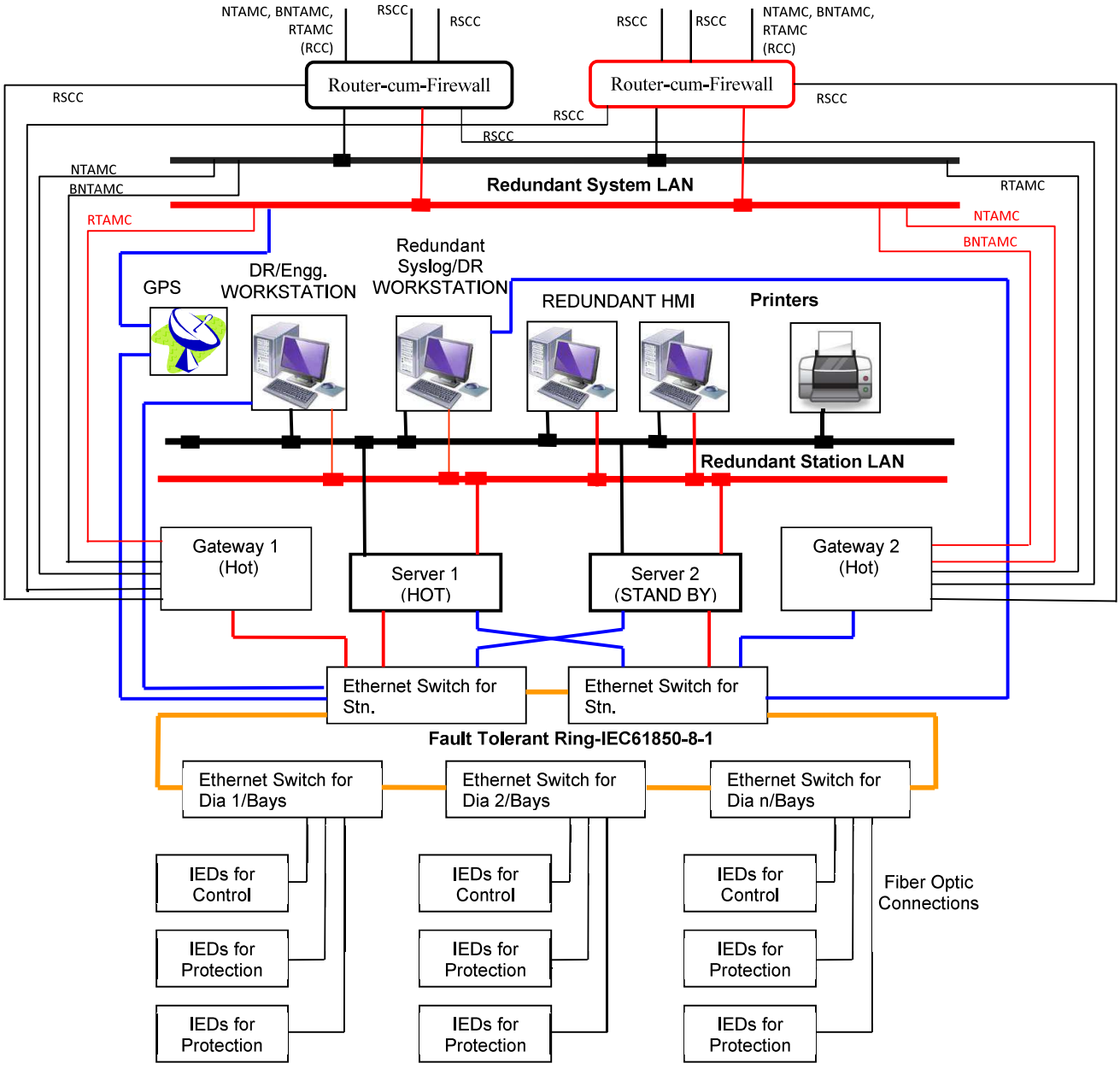
Voltage Level: 765kV, Fault Level: up to 50kA for 1 sec								
Bus Type	**Height of Bus (from FGL)**	**Max Span**	**Bus Conductor Configuration**	**Ph-Ph Spacing**	**Normal Tension per phase**	**SCF per phase**	**Spacer Span**	**Applicable Wind Speed**
Main Bus	27 Mtr	108 Mtr	Quad Bull	15Mtr	8T	9.75T	6Mtr	Upto 50m/s
Jack Bus	40 Mtr	140 Mtr		15Mtr	9.5T	11.26T	6Mtr	Upto 50m/s
Jack Bus	40 Mtr	114 Mtr		15Mtr	9.5T	11.10T	6Mtr	Upto 50m/s
Voltage Level: 400kV, Fault Level: up to 63kA for 1 sec, Bay Width : 24 Mtr								
Bus Type	**Height of Bus (from FGL)**	**Max Span**	**Bus Conductor Configuration**	**Ph-Ph Spacing**	**Normal Tension per phase**	**SCF per phase**	**Spacer Span**	**Applicable Wind Speed**
Main Bus	15mtr	72.0Mtr	Quad Bersimis	6.5mtr	5T	7.32T	4Mtr	Upto 50m/s
Jack Bus	23Mtr	75.0Mtr		6.5mtr	5T	7.36T	4Mtr	Upto 47m/s
Jack Bus	23Mtr	75.0Mtr		6.5mtr	5T	7.36T	3.5Mtr	Upto 50m/s
Jack Bus	23Mtr	59.0Mtr		6.5mtr	5T	7.12T	4Mtr	Upto 50m/s
Jack Bus	23Mtr	46.0Mtr		6.5mtr	4T	6.20T	4Mtr	Upto 50m/s

Above shall also be applicable for following cases unless otherwise specified elsewhere:

(i) Extension of 765kV switchyard with existing three gantry type arrangement
(ii) Extension of 400kV switchyard with existing three gantry type arrangement and having bus heights matching with above.

For design of gantry structures with spans, wind speed or conductor configurations other than that mentioned above, conductor tension shall be considered based on actual requirement of present & future scope of work. Relevant design calculations for such cases shall be submitted by the contractor for employer's approval.

TYPICAL ARCHITECTURAL DRAWING OF SUBSTATION AUTOMATION SYSTEM (Without Process Bus) for New Substation



Note:

1. The redundant managed bus (station LAN) shall be realized by high speed optical bus using industrial grade components and shall be as per IEC 61850.
2. Inside the sub-station, all connections shall be realized as per IEC 61850 protocol.
3. For gateway, it shall communicate with Remote Supervisory Control Centre (RSCC) on IEC 60870-104 protocol. The number of ports required shall be as per clause no. 1.1 and 3.3 of this specification.
4. The printer as required shall be connected to station bus directly and can be managed either from station HMI, HMI view node or disturbance recorder work stations.
5. The above layout is typical. However if any contractor offers slightly modified architecture based on their standard practice without compromising the working, the same shall be subject to approval during detailed engineering.
6. RCC means NTAMC/RTAMC. Similarly, RSCC could be SLDC for state owned substations/bays.
7. Syslog server to be Linux based. However DR/Engg. PC workstation can be other Operating System.

SPECIFICATION FOR SWITCHES

Substation System LAN:

2 (two) nos. managed Ethernet switches with 16 copper 10/100 Mbps RJ45 ports on each switch shall be supplied to form redundant system LAN as shown in typical architecture drawing. These switches shall be different from IEC 61850 LAN and specifically used for the purpose of connecting various devices of different sub-systems (SCADA, VMS, VOIP etc.) for integration with NTAMC/RTAMC. These switches shall be suitable for substation environment and shall comply with the requirements of IEC 61850-3 standard for EMI/EMC.

These LAN switches shall have the following compliance and functional features:

(a) Compliance as per NERC-CIP-3, NERC-CIP-5. NERC-CIP-7 standard for cyber security
(b) Support SNMPv3 (Full SNMP support including Traps)
(c) Web based GUI or CLI based with HTTPS/HTTP and SSH/ Telnet support
(d) Support for IPv4 and IPv6 switching simultaneously
(e) Layer 3 Static routing functionality
(f) Syslog facility for local as well as remote server
(g) Support for remote management
(h) LED indication for port status/supply etc.
(i) Shall support VLAN IEEE 802.1Q
(j) IGMP snooping
(k) Spanning tree protocol IEEE 802.1d or RSTP IEEE 802.1w
(l) Shall support SNTP
(m) Port based Network Access Control (IEEE 802.1x)
(n) Quality of Service (IEEE 802.1p)
(o) Shall support unicast as well as multicast IP traffic
(p) SNTP time synchronization
(q) Shall support Mac Binding
(r) Fanless design

Annexure-S7

Technical Specification for Next Generation Firewalls (NGFW)

1. NGFW shall have following features including but not limited to:
   Encryption through IPSec VPN (Virtual Private Network), Deep Packet Inspection (DPI), Denial of service (DoS) & Distributed Denial of Service (DDoS) prevention, Port Block/ Allow, rules/ policies for block/allow, IP (Internet Protocol) & Media Access Control (MAC) spoofing protection, threat detection, Intrusion Prevention System (IPS), Anti-Virus, Anti-Spyware, Man In The Middle (MITM) attack prevention.

2. The proposed firewall shall be able to handle (alert, block or allow) unknown /unidentified applications e.g. unknown TCP & UDP packets. It shall have the provision to define application control list based on application group and/or list.

3. Firewall shall have feature and also have capability to update the definition/ Signatures of Anti-Virus online as well as offline. Firewall shall also be compatible to update the definitions/signatures through CMC. There shall be a defined process for security patching and firmware up-gradation. There shall be a feature to field validate firmware checksum. The same shall also be validated before using the OEM provided file/binary in the process of firmware up-gradation and security patching

4. Firewall shall have Management Console port to configure remotely.

5. Firewall shall be EMI/EMC compliant in Substation environment as per IEC 61850-3.

6. Firewall shall be rack mounted in existing standard equipment cabinets.

7. Firewall shall have support of SCADA applications (IEC-60870-5-104), ICCP, PMU (IEEE C37.118), Sub-Station Automation System (IEC 61850), Ethernet and other substation environment protocols.

8. Client based Encryption/ VPN must support different Operating System platforms e.g. Windows, Linux & Mac.

9. The solution must have content and comprehensive file detection policies, blocking the files as function of their types, protocols and directions.

10. Firewall shall have logging facility as per standard logs/events format. Firewall shall have features to export the generated/stored logs/events in csv (Comma Separated Value) and also any other standard formats for offline usage, analysis and compliance. Firewall shall have suitable memory architecture and solution to store and be enable to export all logs/events for a period of last 90 days at any given time.

11. Firewall shall have features and be compatible with local as well as central authentication system (RADIUS, LDAP, or TACACS+) for user account and access right management. It shall also have Role Based User management feature.

12. Firewall shall have the capability to configure sufficient number of VLANs.

13. Firewall shall have the capability to support sufficient number of sessions.

14. Firewall shall have provision to configure multiple IP Sec VPNs, at least 100 nos., (one-to-many or many-to-one). Shall support redundant operation with a similar router after creation of all the IP Sec VPN. IPSec VPN shall be with encryption protocols as AES128, AES256 and hashing algorithms as MD5 and SHA1. IPSec VPN throughput shall be at least 300 Mbps.

15. Firewall shall be capable of SNMP v3 for monitoring from Network Management system. It shall also have SNMPv3 encrypted authentication and access security.

16. Firewall shall operate in Active/Passive or Active-Active mode with High Availability features like load balancing, failover for firewall and IPsec VPN without losing the session connectivity.

17. Firewall should have integrated traffic shaping (bandwidth, allocation, prioritisation, etc.) functionality.

18. Shall support simultaneous operation with both IPv4 and IPv6 traffic.

19. Firewall shall be compatible with SNTP/NTP or any other standards for clock synchronization.

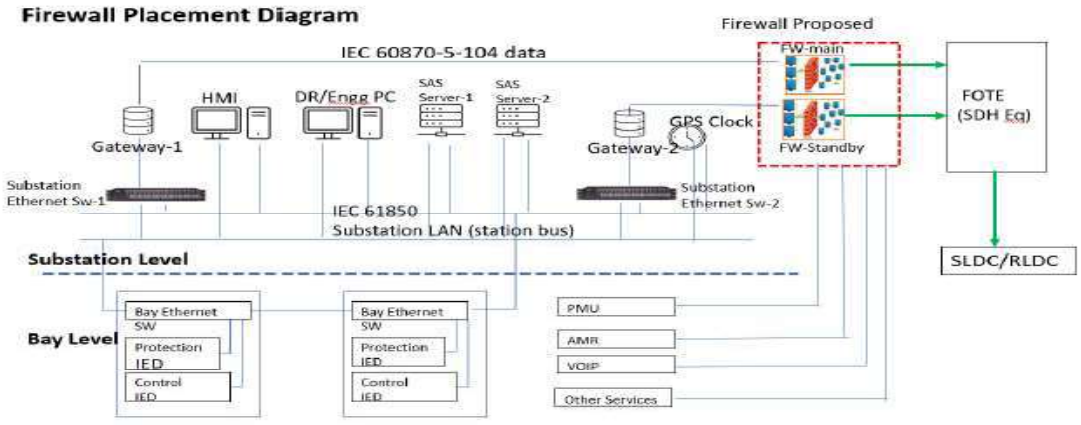
20. Firewall shall have the features of port as well as MAC based security.

21. Firewall shall support exporting of logs to a centralized log management system (e.g. syslog) for security event and information management.

22. Firewall time shall be kept synchronised to official Indian Timekeeping agency, time.nplindia.org.

23. Firewall product shall be provided with all applicable updates at least until 36 months since the applicable date of product shipping to the concerned utility.

Figure-I



SPECIFICATION FOR DIGITIAL PROTECTION COUPLER

1.0 Digital protection coupler for protection signalling through optical fibre cablesystem

1.1 The Digital protection signalling equipment is required to transfer the trip commands from one end of the line to the other end in the shortest possible time with adequate security and dependability. It shall also monitor the healthiness of the link from one end to the other and give alarms in case of any abnormality. The protection signalling equipment shall have a proven operating record in similar application over EHV systems and shall operate on 48V DC (+15%/-20%). It shall provide minimum four commands. These commands shall be suitable for Direct tripping, Intertripping and Blocking protection schemes of EHV lines.

The protection signalling equipment shall communicate to the remote end interfacing with SDH terminal equipment at its 2Mbps port. It shall provide suitable interfaces for protective relays, which operate at 220V DC. Power supply points shall be immune to electromagnetic interface

1.2 Principle of operation

During normal operation, protection signalling equipment shall transmit a guard signal/code. In case Protection signalling equipment is actuated by protective relays for transmission of commands, it shall interrupt the guard signal/code and shall transmit the command code to the remote end. The receiver shall recognize the command code and absence of the guard code and will generate the command to the protective relays.

All signal processing i.e. generation of tripping signal and the evaluation of the signals being received shall be performed completely digital using Digital Signal Processing techniques.

1.3 Loop testing

An automatic loop testing routine shall check the teleprotection channel.

It shall also be possible to initiate a loop test manually at any station by pressing a buttonon the front of the equipment.

Internal test routine shall continuously monitor the availability of the protection signaling equipment.

Proper tripping signal shall always take the priority over the test procedure.

The high speed digital protection signalling equipment shall be designed and provided with following feature.

- Shall work in conjunction with SDH terminal equipment.
- It shall communicate on G 703 (E1,2 Mbps)
- Full Duplex operation
- Auto loop facility shall be provided
- Shall meet IEC 60834-1 standard
- Shall be able to transmit upto 4 commands with trip counter simultaneouslyor sequentially in one 2Mbps channel

Bidder shall quote for protection signalling equipment suitable for 4 commands with separate trip counters for transmit and receive. With regard to trip counters alternate arrangement .i.e. Laptop along with software & all accessories to download eventsincluding carrier receipt and transmit shall be acceptable. Laptop for the above shall be supplied at each substation under substation package.

High security and dependability shall be ensured by the manufacturer. Probability of false tripping and failure to trip shall be minimum. Statistical curves/figures indicating above mentioned measures shall be submitted along with the bid.

The DPC can be either housed in offered Control & Protection Panel / PLCC Panel or in separate panel.

Reports of the following tests as per clause 9.2 of Section-GTR shall be submitted for approval for protection signalling equipment and relays associated with the protection signalling equipment and interface unit with protective relay units, if any.

i) **General equipment interface tests:-**

a) Insulated voltage withstand tests
b) Damped oscillatory waves disturbance test
c) Fast transient bursts disturbance test
d) Electrostatic discharge disturbance test
e) Radiated electromagnetic field test
f) RF Disturbance emission test

ii) **Specific power supply test**

a) Specific power supply test
b) Power supply variations
c) Interruptions
d) LF disturbance emission
e) Reverse polarity

iii) **Tele-protection system performance test:-**

a) Security
b) Dependability
c) Jitter
d) Recovery time
e) Transmission time
f) Alarm functions
g) Temperature and Humidity tests (As per IEC 68-2)

- Dry heat test (50°C for 8 hours
- Low temperature test (-5°C for 8 hours)
- Damp heat test (40°C/95%RH for 8 hours

All the above tests at i, ii & iii (except temperature & humidity tests) shall be as per IEC

60834-1 and the standards mentioned therein.

iv) **Relays**

a) Impulse voltage withstand test as per clause 6.1 of IS:8686 (for a test voltage appropriate to clause III as per clause 3.2 of IS:8686

b) High frequency disturbance test as per clause 5.2 of IS:8686 (for a test voltage appropriate to clause III as per clause 3.2 of IS:8686).

The protection signalling equipment shall be of modular construction and preferably mounted in the Relay panels. Cabling between the protection signalling equipment & Protection relays and between protection signalling equipment & Communication equipment shall be in the scope of bidder.

The input/output interface to the protection equipment shall be achieved by means of relays and the input/output rack wiring shall be carefully segregated from other shelf/cubicle wiring.

The isolation requirements of the protection interface shall be for 2kV rms.

1.4 Major technical Particulars

The major technical particulars of protection signalling equipment shall be as follow.

i) Power supply 48V DC +15% /-20%

ii) Number of commands 4 (four)

iii) Operating time <7 ms

iv) Back to back operate time without propagation delay ≤ 8 ms

v) Interface to Protection relays

Input: Contact Rating:

Rated voltage : 250 volts DC

Maximum current rating: 5 amps

Output: Contact Rating:

Rated voltage : 250 volts DC

Rated current : 0.1 A DC

Other parameters : As per IEC-255-0-20

vi) Alarm contact

Rated voltage : 250 volts DC

Rated current : 0.1 A DC

Other parameters : As per IEC-255- 0-20

vii) Digital communication interface: G 703(E1

Technical Specification for Visual monitoring system for watch and ward of Substation premises:

Visual monitoring system (VMS) for effective watch and ward of sub station premises covering the areas of entire switchyard, Control Room cum Administrative building, Fire fighting pump house, stores and main gate, shall be provided. The contractor shall design, supply, erect, test and commission the complete system including cameras, Digital video recorder system, mounting arrangement for cameras, cables, LAN Switches, UPS and any other items/accessories required to complete the system. To provide all the necessary licenses to run the system successfully shall be in the scope of contractor.

System with Color IP Cameras for VMS surveillance would be located at various locations including indoor areas and outdoor switchyard and as per the direction of Engineer-In-Charge. The VMS data partly/completely shall be recorded (minimum for 15 days) and stored on network video recorder.

The number of cameras and their locations shall be decided in such a way that any location covered in the 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 Sub-station.
2. The Operation of each bay(s) of GIS Hall as Applicable.
3. All the Transformer and Reactors All the Entrance doors of Control Room Building and Fire-fighting Pump House, GIS Hall and Switchyard Panel room 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)

   The cameras can be mounted on structures, buildings or any other suitable mounting arrangement to be provided by the contractor.

1.1 Technical requirements of major equipment of Visual Monitoring System.

1.1.1 The Video Monitoring system shall be an integrated system with IP network centric functional and management architecture aimed at providing high-speed manual/automatic operation for best performance.

1.1.2 The system should facilitate viewing of live and recorded images and controlling of all cameras by the authorized users.

1.1.3 The system shall use video signals from various types of indoor/outdoor CCD colour cameras installed at different locations, process them for viewing on workstations/monitors in the control Room and simultaneously record all the cameras after compression using **H 264**/MPEG 4 or better standard. Mouse/Joystick-Keyboard controllers shall be used for Pan, Tilt, Zoom, and other functions of desired cameras.

1.1.4 The System shall provide sufficient storage of all the camera recordings for a period of 15 days or more

@ 25 FPS, at 4 CIF or better quality using necessary compression techniques for all cameras. It shall be ensured that data once recorded shall not be altered by any means. The recording resolution and frame rate for each camera shall be user programmable.

1.1.5 The surveillance VMS System shall operate on 230 V, 50 Hz single-phase power supply. System shall have back up UPS power supply meeting the power supply need of all the cameras in the stations including those which are installed at gate for a period of 2 hours. The bidder shall submit the sizing calculation for the UPS considering the total load requirement of Video Monitoring System.

1.2 System requirements:

a) System must provide built-in facility of watermarking or Digital certificate to ensure tamperproof recording.

b) All cameras may be connected through a suitable LAN which shall be able to perform in 765kV class sub-station environment without fail.

c) All camera recordings shall have Camera ID & location/area of recording as well as date/time stamp. Camera ID, Location/Area of recording & date/time shall be programmable by the system administrator with User ID & Password.

d) Facility of camera recording in real-time mode (25 FPS)/15/12.5/10 or lower FPS as well as in any desired combination must be available in the system.

e) Facility of Camera recording in HD (1280X720p), D1 , 4CIF , CIF, VGA, as well as in any combination i.e. any camera can be recorded in any quality.

f) System to have facility of **100%** additional camera installation beyond the originally planned capacity.

g) In order to optimize the memory, while recording, video shall be compressed using H **264**/MPEG-4 or better standard and streamed over the IP network.

h) System shall be triplex i.e. it should provide facility of Viewing, Recording & Replay simultaneously.

i) The offered system shall have facility to export the desired portion of clipping (from a specific date/time to another specific date/time) on CD or DVD. Viewing of this recording shall be possible on standard PC using standard software like windows media player etc.

j) System shall have provision of WAN connectivity for remote monitoring.

k) The equipment should generally conform to Electro magnetic compatibility requirements for outdoor equipment in EHV switchyards. The major EMC required for Cameras and other equipment shall be as under:

1. Electrical Fast Transient (Level 4) – As per IEC 61000-4-4
2. Damped Oscillatory (1 MHz and 100 KHz) (level 3) – As per IEC 61000-4-18
3. AC Voltage Dips & Interruption/Variation (class 3) – As per IEC 61000-4-11
4. Electrostatic Discharge (Level 4) – As per IEC 61000-4-2
5. Power Frequency Magnetic Field (level 4) – As per IEC 61000-4-8
6. Ripple on DC input Power Supply Port immunity test(level 4) - As per IEC 61000-4-17

Type test reports to establish compliance with the above requirement shall be submitted during detailed engineering.

1.2.1 VIDEO SURVEILLANCE APPLICATION SOFTWARE

a) Digital video surveillance control software should be capable to display and manage the entire surveillance system. It should be capable of supporting variety of devices such as cameras, video encoder, Servers, NAS boxes/Raid backup device etc.

b) The software should have inbuilt facility to store configuration of encoders and cameras.

c) The software should Support flexible 1/2/4/8/16/32 Windows Split screen display mode and scroll mode on the PC monitor.

d) The software should be able to control all cameras i.e. PTZ control, Iris control, auto / manual focus, and color balance of camera, Selection of presets, Video tour selection etc.

e) The software should have user access authority configurable on per device or per device group basis. The system shall provide user activity log with user ID, time stamp, action performed, etc.

f) The users should be on a hierarchical basis as assigned by the administrator. The higher priority person can take control of cameras, which are already being controlled by a lower priority user.

g) It should have recording modes viz. continuous, manual, or programmed modes on date, time and camera-wise. All modes should be disabled and enabled using scheduled configuration. It should also be possible to search and replay the recorded images on date, time and camera-wise. It should provide onscreen controls for remote operation of PTZ cameras. It should have the facility for scheduled recording. Different recording speeds (fps) and resolution for each recording mode for each camera should be possible.

h) The software for clients should also be working on a browser based system for remote users. This will allow any authorized user to display the video of any desired camera on the monitor with full PTZ and associated controls.

i) Retrieval: The VMS application should allow retrieval of data instantaneously or any date / time interval chosen through search functionality of the application software. In case data is older than 15 days and available, the retrieval should be possible. The system should also allow for backup of specific data on any drives like DVD's or any other device in a format which can be replayed through a standard PC based software. Log of any such activity should be maintained by the system.

j) VMS shall provide the full functionality reporting tool which can provide reports for user login/logoff, camera accessibility report, server health check reports etc.

1.2.2 Network video recorder

The Network Video recorder shall include at least Server (min 3.0 GHZ, 4GB RAM, 3000GB HDD(min)), RAID 5 ,with suitable configuration along with Colored TFT 22" High resolution monitor, and Internal DVD writer. Windows XP/Vista/7 Prof. or VMS compatible operating system latest version with hardware like graphic cards, licensed Anti-virus etc.

Further the digital video recorder shall conform to the following requirements:

1.	Server Spec	Intel Quad Core (or better) 3.0 Ghz (min.) , 8 MB Cache , 4 GB memory , with suitable NVIDIA graphics card,3 TB HDD , Raid 5
2.	Recording and Display Frame Rate	Real-time 25 frames per second per channel , manual select

3.	Recording Resolution	(PAL): 1280X720 , 704(H) x 586(V) It should be possible to select lower resolutions
4.	Compression Method	H.264/MPEG-4 or better and latest
5.	Video Motion Detection Capable	Standard and built-in (selectable in menu)
6.	Monitoring Options	Split screen 1, 2, 4 , 8, 16, 32 or more cameras
7.	Playback Options	Search, still image capture
8.	Alarm/Event Recording Capable	To be provided with built-in external alarm input/ output ports minimum(8 in, 2 out)
9.	Network Operation Capable	To be provided by using WAN or LAN router
10.	Remote Internet Viewing Capable	Using WAN or LAN router
11.	HDD Storage Consumption	1GB ~ per hour / channel variable based on frame speed and resolution settings, as well as compression
12.	Operation	Triplex operation (simultaneous recording, playback, network operation)
13.	Number of Video Channel	32
14.	Audio Recording Capable	32
15.	Input Voltage	230V AC or equivalent with UPS as a back up for 30 minutes.

1.2.3 VMS Camera

a) The color IP camera for substation shall have PAN, TILT and ZOOM facilities so that it can be focused to the required location from the remote station through a controller. Whereas wireless IP cameras with PTZ controls are required for installation at gates of the POWERGRID premises as per the direction of Engineer-In-Charge

b) The IP Camera at the main gate can be fixed or PTZ based and shall be used for monitoring entry and exit

c) It should have sufficient range for viewing all the poles of isolators and other equipments with high degree of clarity.

d) The VMS camera shall be suitable for wall mounting, ceiling mounting and switchyard structure mounting.

e) It shall be possible to define at 128 selectable preset locations so that the camera gets automatically focused on selection of the location for viewing a predefined location.

f) The camera should be able to detect motion in day & night environments having light intensity of Color: 0.5 Lux; B&W:0.05 Lux

g) Housing of cameras meant for indoor use shall be of IP 42 or better rating whereas outdoor camera housing shall be of IP 66 or better rating. Housing shall be robust and not have the effect of electromagnetic induction in 765/400KV switchyard.

h) All camera recordings shall have Camera ID & location/area of recording as well as date/time stamp. Camera ID, Location/Area of recording & date/time shall be programmable by the system administrator with User ID & Password

i) Facility of camera recording in real-time mode (25 FPS)/15/12.5/10 or lower FPS as well as in any desired combination must be available in the system.

A. Outdoor IP Fixed Megapixel Camera Specifications (For Main Gate)

1.	Image Sensor	2-megapixel Progressive ,1 / 3" CMOS/CCD sensor, Minimum illumination 0.1 Lux
2.	Min Luminous	0.5LUX(Color) 0.05Lux(Black)
3.	Camera Enclosure Type	IP66 Grade
4.	Iris/Focus	Auto/Manual
5.	Video Compression	Dual Stream H.264 and MPEG 4 user selectable
6.	Support Dual-stream	primary/secondary stream, H.264/MPEG 4 optional
7.	Video Definition	Primary stream:1600x1200,1280x960,1280x720, Secondary stream:800x600,400x288,192x144
8.	Video Parameters	Brightness, hue, contrast, saturation and image quality
9.	Video Frame Rate	PAL: 1-25frames/second NTSC:1-30frames/second
10.	Video Compression BR	32Kbit/S - 6Mbit/S
11.	Video Output	One channel composite Streaming
12.	Supported Protocols	TCP, UDP, IP, HTTP, FTP, SMTP, DHCP, DNS,ARP, ICMP, POP3, NTP, IPsec, UpnP, RTP, RTCP
13.	Operating Temperature	-5 ~ +50°C
14.	Operating Humidity	10 ~ 90%

B. Outdoor IP66 PTZ HD Camera Specifications (For Switch Yards)

1.	Image sensor	1/3 type Solid State Progressive Scan CCD,WDR(High Definition)
2.	Security	Multiple user access with password protection
3.	Effective Pixels	**(PAL): Main Stream：1280x720** Sub Stream：640x360、320x280 selectable
4.	Compression	Dual Stream H.264 and MPEG 4 user selectable
5.	Signal System	50 Hz
6.	S/N (signal to noise) Ratio	Better than 50 dB
7.	Electronic Shutter	1/60 ~ 1/10,000 sec. automatic or better
8.	Scanning System	Progressive/interlace
9.	Low Light Sensitivity (lux)	Color: 0.5 Lux; B&W:0.02 Lux
10.	Lens	Minimum 10x (minimum) optical in High Definition **(The system shall be able to zoom the images on the monitor without any distortion to the maximum level of optical zoom)**
11.	Lens Size	Minimum 4.1~73.8 mm
12.	Lens Aperture	F1.6(wide)~F2.8(tele), f=4.1~41.0mm, 10X Zoom, Video Auto Focus Angle of View Horizontal : 52°(wide) , 2.8°(tele)
13.	PTZ Data Transfer Baud/Bit Rates Supported	Selectable 2400 bps / 4800 bps / 9600 bps

14.	Panning Range	Complete 360 degrees (horizontal)
15.	Pan Speed	Adjustable, 0.1 degrees / second ~ 250 degrees / second
16.	Tilting Range	Minimum 180° Tilt Rotation
17.	Tilt Speed	Adjustable, 0.1 degrees / second ~ 150 degrees / second
18.	In Built Storage	Camera should have inbuilt storage TF or SD format for recording and storing Pictures
19.	IP Class	IP66 Standard
20.	Working temperature	-0℃ ~ +50℃
21.	Working Humidity	10 ~ 90%

1.2.4 PTZ-Keyboards

The features of PTZ shall include:

- Fully functional dynamic keyboard/joystick controllers
- Controls all pan, tilt, zoom, iris, preset functions
- Control up to 255 units from a single keyboard
- Many preset options and advanced tour programming
- Compatible with all connected cameras

1.	Key Application	wired keyboard control operation of PTZ functions for weatherproof dome cameras
2.	Pan / Tilt / Zoom Protocol Languages Supported	Selectable
3.	PTZ Data Transfer Baud Rates Supported	selectable 1200 bps / 2400 bps / 4800 bps / 9600 bps
4.	Additional Features	dynamic joystick for smooth camera movements, preset location option for quick access to frequently monitored areas

Annexure- S10

ANNEXURE-12

Of Section-GIS Rev 5A

Reference Guidelines for GIS Grounding

1. GIS Grounding

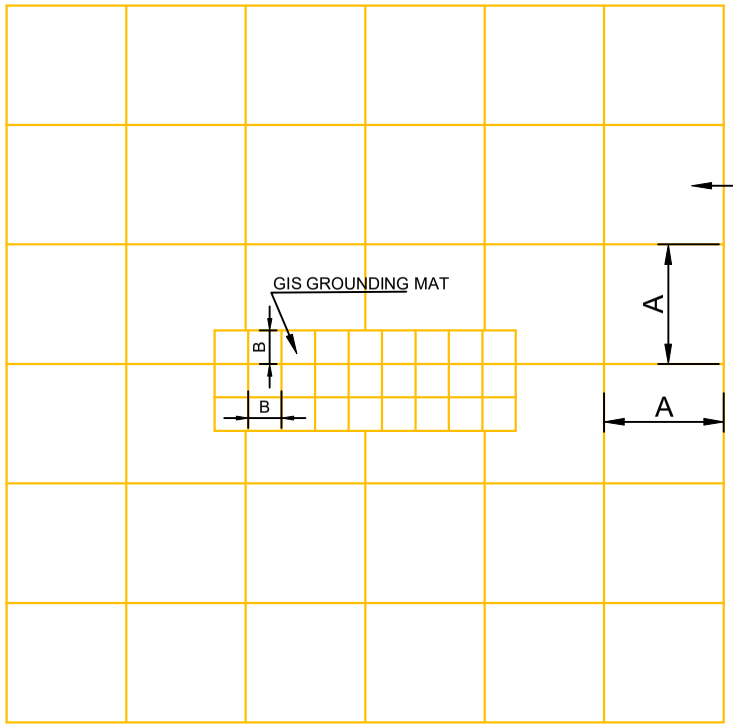
These reference guidelines are minimum requirement and do not override manufacturer's recommendations or design criteria. These Reference Guidelines shall be read and implemented in conjunction with manufacturer recommendation/Criteria for GIS grounding design.

GIS Grounding system shall be designed to provide low-impedance grounding path for ground fault currents. Very Fast Transient generated due to electrical breakdown in the insulating gas, either across the contacts of a switching device during operation or under fault conditions shall also need to be considered in the overall grounding design for GIS. Grounding conductors or system of conductors shall be provided for connecting all designated metallic components of gas-insulated substation (GIS) to a substation grounding system.

1.1. **Power Frequency Grounding**: Manufacturer recommended designated grounding points of GIS equipment shall be connected with the risers directly coming from buried main GIS grounding mat. The Size of the conductor (copper) for making this connection shall be submitted by GIS manufacturer based on the specified fault current and its duration. The location and numbers of above said risers shall be as per the manufacturer recommended designated grounding points for GIS equipment. Main GIS grounding mat shall be buried at the level of station grounding mat. It shall be made up of same conductor as that of station grounding mat. The spacing of main GIS grounding mat for different voltage levels of GIS shall be as per attached Typical Drawing.

1.2. **High Frequency Grounding of GIS equipment**: Dedicated copper grounding mesh with specified spacing and cross-section shall be provided at the top of GIS building finished floor level. This dedicated copper grounding mesh shall be spread-over, beneath complete GIS switchgears installation and extended up to 500 mm away in all direction from GIS switchgears installation. This dedicated copper grounding mesh shall be directly connected to the GIS enclosures (min. at two distant points in each phase/bay) and to the risers directly coming from GIS grounding mat (min. at two distant locations per phase/bay) with the shortest path to the connection point. All Crossing of copper grounding mesh shall be suitably clamped/welded together. Bolted joint at crossings is not allowed, further this copper grounding mesh shall be clamped adequately to the floor at suitable locations. At the jointing of two different metals the joint shall be made using requisite bi-metallic jointer. This dedicated copper grounding mesh is laid at the top of GIS floor and shall also be connected with dedicated grounding rod electrodes provided at a regular interval of not more than 12 meters around periphery of GIS building. This copper grounding mesh shall be laid after the GIS bays are place on the floor and shall be suitably covered with Non-Electrostatic rubber mats to avoid damage to mesh and to avoid hinderance in regular operation of equipment. The Spacing, conductor detail and cross-section of copper grounding mesh shall be as per attached Typical Drawing.

Typical Drawing No, Standard/GIS/GROUNDING/01 for above said grounding recommendation is part of this document.



A - TYPICAL SPACING FOR STATION GROUNDING MAT

B - TYPICAL SPACING FOR MAIN GIS GROUNDING MAT

C - COPPER GROUNDING MESH

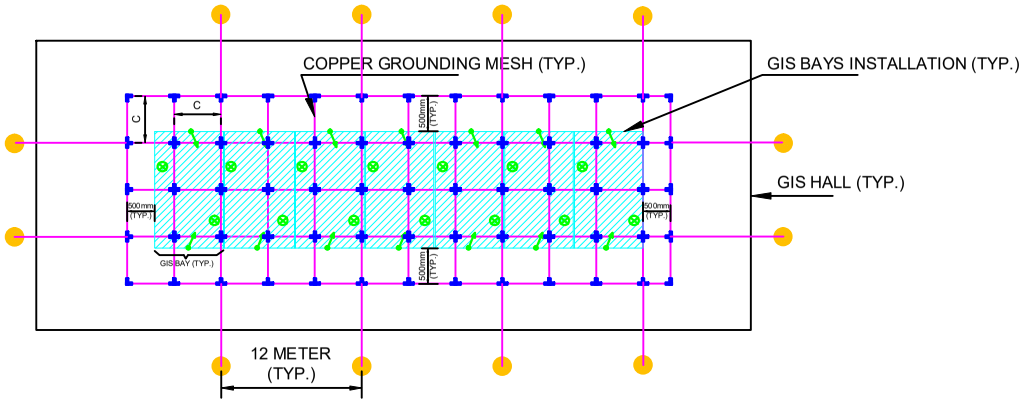
CONNECTION POINT OF COPPER GROUNDING MESH WITH GIS ENCLOSURE (TYP.)

CONNECTION POINT OF COPPER GROUNDING MESH WITH MAIN GIS GROUNDING MAT RISERS(75X12 MM GI FLAT) (TYP.)

COPPER CLAMP/ WELDED JOINT (TYP.)

3000mm LONG, 40mm DIA ROD ELECTRODE

	STATION GROUNDING MAT			MAIN GIS GROUNDING MAT			COPPER GROUNDING MESH			
VOLTAGE LEVEL	TYPICAL SPACING (MTRxMTR)	PLACEMENT AT (TYP.)	CONDUCTOR (TYP.)	TYPICAL SPACING (MTRxMTR)	PLACEMENT AT (TYP.)	CONDUCTOR (TYP.)	TYPICAL SPACING (MTRxMTR)	PLACEMENT AT (TYP.)	CONDUCTOR	CONDUCTOR CROSS SECTION
765kV	AS PER STATION GROUNDING DESIGN	600MM BELOW FGL	40MM DIA. MS ROD	5x5	600MM BELOW FGL	40MM DIA. MS ROD	5x5	GIS BUILDING FLOOR FFL	COPPER STRIP	50x6mm
400kV				3x3			3X3			50x6mm
220kV & 132kV				3x3			---			---



NOTES:-

1. THIS DRAWING SHALL BE REFEREED AS COLORED PRINT ONLY.
2. THESE REFERENCE GUIDELINES DO NOT OVERRIDE MANUFACTURER'S RECOMMENDATIONS OR DESIGN CRITERIA. THESE REFERENCE GUIDELINES SHALL BE READ AND IMPLEMENTED IN CONJUNCTION WITH MANUFACTURER RECOMMENDATION/CRITERIA FOR GIS GROUNDING DESIGN.
3. THE MAIN GIS GROUNDING MAT SHALL BE LAID BENEATH GIS BUILDING COVERING LENGTH AND WIDTH OF GIS BUILDING.
4. ANNEXURE FOR "REFERENCE GUIDELINES FOR GIS GROUNDING" ENCLOSED.

POWER GRID CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

TITLE: TYPICAL GIS GROUNDING REFERENCE GUIDELINES

DATE	DRAWN	SCALE	DRG.NO. STD/GIS/GROUNDING/01	REV
JAN 2023		NTS		0

Annexure-S11

ANNEXURE- 13
Of GIS Rev5A

DESCRIPTION OF GIS BAY MODULE & EQUIPMENTS

765kV Gas Insulated Switchgear (One & half breaker Scheme)

The SF6 gas insulated switchgear (50 Hz) shall be of the indoor metal-enclosed type & configuration of different GIS modules shall be as specified below:

i) GIS Bus bar Module:

Three isolated phase, SF6 gas-insulated metal enclosed bus bar module, each set comprising of the following:

i. Three (3) no's individual bus bars enclosures running across the length of the switchgear to interconnect each of the bay modules in one and a half breaker bus system.

ii. One (1) number 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

iii. One (1) number 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

iv. Three (3) numbers 1-phase Potential Transformers.

v. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, Support structures etc., as required.

vi. End Piece (Interface) modules with isolating test link for Future extension **on one side** of Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link. End piece (interface) module for both the buses shall be in one alignment.

> Project Specific Requirement: Requirement of End Piece (Interface) module with isolating test link **on both side** of Bus bar module shall be considered based upon GIS Layout as and when specified under Section-Project.

vii. Three (3) numbers single phase, SF6 ducts (as required) inside GIS hall.

viii. Local Control Cubicle (if required separately).

ii) GIS Bus bar Module Extension (Make of Existing GIS: As per Section-Project):

Extension of Three isolated phase, SF6 gas-insulated metal enclosed bus bar module, each set comprising of the following:

i. Three (3) no's individual bus bars enclosures running across the length of the switchgear to interconnect each of the bay modules in one and a half breaker bus system.

ii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, Support structures etc., as required.

iii. Extension piece (Interface) module, as required to extend existing bus so as to maintain minimum possible inter connection space between GIS supplied under present scope and the GIS being extended .

iv. End Piece (Interface) modules with isolating test link for Future extension of Bus bar module on one side. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link. End piece (interface) module for both the buses shall be in one alignment.

v. Three (3) numbers single phase, SF6 ducts (as required) inside GIS hall.

iii) GIS Line Bay module:

SF6 gas-insulated metal enclosed Line feeder bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker (**#)** with/without PIR complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Three (3) numbers, 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. One (1) number 3-phase, single pole, group operated high speed fault making grounding switch, complete with manual and motor driven operating mechanisms.

vii. Three (3) numbers single phase, SF6 ducts inside GIS hall (up to the outer edge of the wall of GIS Hall).

viii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc., as required.

ix. Local Control Cubicle.

'#' As per BPS

iv) GIS Tie Bay module:

SF6 gas-insulated metal enclosed Tie bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker (#) with/without PIR complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on other side of circuit breaker.

iv. Two (2) numbers 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

vii. Local Control Cubicle.

'#' As per BPS

v) GIS ICT Bay module:

SF6 gas-insulated metal enclosed ICT bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 gas insulated circuit breaker without PIR, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Two (2) numbers 3-phase, single pole, group operated isolator switches complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole, group operated safety grounding switches complete with manual and motor driven operating mechanisms.

vi. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms.

vii. Three (3) numbers 1-phase, individual pole operated safety grounding switches, complete with manual and motor driven operating mechanisms.

viii. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms for switching of Spare ICT through Auxiliary bus. The isolator must meet the operational requirement in terms of Phase-phase insulation withstand capability.

ix. Three (3) numbers single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall)

x. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

xi. Local Control cubicle.

vi) GIS Bus Reactor Bay module:

SF6 gas insulated metal enclosed Bus Reactor Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 gas insulated circuit breaker without PIR, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Two (2) numbers 3-phase, single pole, group operated isolator switches complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole, group operated safety grounding switches complete with manual and motor driven operating mechanisms.

vi. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms.

vii. Three (3) numbers 1-phases, individual pole operated safety grounding switches, complete with manual and motor driven operating mechanisms.

viii. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms for switching of Spare Bus reactor through Auxiliary bus. The isolator must meet the operational requirement in terms of Phase-phase insulation withstand capability.

ix. Three (3) numbers single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall)

x. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

xi. Local Control cubicle.

vii) GIS Switchable Line Reactor Bay module:

SF6 gas insulated metal enclosed Switchable Line reactor bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 gas insulated circuit breaker without PIR, complete with operating mechanism.

ii. One (1) number 3-phase, single pole, group operated isolator switches complete with manual and motor driven operating mechanisms.

iii. One (1) number 3-phase, single pole, group operated safety grounding switches complete with manual and motor driven operating mechanisms.

iv. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Three (3) numbers 1-phases, individual pole operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms for switching of Spare Line reactor through Auxiliary bus. The isolator must meet the operational requirement in terms of Phase-phase insulation withstand capability.

vii. Three (3) numbers single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall)

viii. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

ix. Local Control cubicle.

viii) GIS Line Reactor Bay module:

SF6 gas insulated metal enclosed Non-Switchable Line reactor bay module, each set comprising of the following:

i. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms.

ii. Three (3) numbers 1-phases, individual pole operated safety grounding switches, complete with manual and motor driven operating mechanisms.

iii. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms for switching of Spare Line reactor through Auxiliary bus. The isolator must meet the operational requirement in terms of Phase-phase insulation withstand capability.

iv. Three (3) numbers single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall).

v. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

vi. Local Control cubicle (if required separately).

ix) GIS Auxiliary Bus module for Spare ICT Connection:

Set of isolated phase, SF6 gas-insulated metal enclosed Auxiliary bus bars module for ICT bays, each set comprising of the following:

i. One (1) number 1-Phase, Auxiliary bus bar enclosure running across the length of the switch gear to inter-connect the spare unit of ICT with all ICT bay Modules through GIS Duct and provision of extension for future ICT.

ii. One (1) number 1-Phase, single pole operated safety grounding switch, complete with manual and motor driven operating mechanisms.

iii. One (1) number single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall).

iv. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

v. End Piece (Interface) module with Isolating test link for Future extension **on one side** of Auxiliary Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link.

Project Specific Requirement: Requirement of End Piece (Interface) module with isolating test link **on both side** of Auxiliary Bus bar module shall be considered based upon GIS Layout as and when specified under Section-Project.

x) GIS Auxiliary Bus module Extension for Spare ICT connection:

Set of isolated phase, SF6 gas-insulated metal enclosed Auxiliary bus bars module for ICT bays, each set comprising of the following:

i. One (1) number 1-Phase, Auxiliary bus bar enclosure running across the length of the switch gear to inter-connect the spare unit of ICT with all ICT bay Modules through GIS Duct and provision of extension for future ICT.

ii. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

iii. Extension piece (Interface) module, as required to extend existing Auxiliary bus to maintain minimum possible inter connection space between GIS supplied under present scope and the GIS being extended.

iv. End Piece (Interface) module with the Isolating test link for Future extension (on one side) of Auxiliary Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link.

xi) GIS Auxiliary Bus module for Spare Reactor Connection:

Set of isolated phase, SF6 gas-insulated metal enclosed Auxiliary bus bars module for Reactor bays, each set comprising of the following:

i. One (1) number 1-Phase, Auxiliary bus bar enclosure running across the length of the switch gear to inter-connect the spare unit of Reactor with all Reactor Bay Modules through GIS Duct and provision of extension for future Reactors.

ii. One (1) number 1-Phase, single pole operated safety grounding switch, complete with manual and motor driven operating mechanisms.

iii. One (1) number single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall)

iv. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

vi. End Piece (Interface) module with Isolating test link for Future extension **on one side** of Auxiliary Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link.

Project Specific Requirement: Requirement of End Piece (Interface) module with isolating test link **on both side** of Auxiliary Bus bar module shall be considered based upon GIS Layout as and when specified under Section-Project.

xii) GIS Auxiliary Bus module Extension for Spare Reactor connection:

Set of isolated phase, SF6 gas-insulated metal enclosed Auxiliary bus bars module for Reactor bays, each set comprising of the following:

i. One (1) number 1-Phase, Auxiliary bus bar enclosure running across the length of the switch gear to inter-connect the spare unit of Reactor with all Reactor Bay Modules through GIS Duct and provision of extension for future Reactors.

ii. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

iii. Extension piece (Interface) module, as required to extend existing Auxiliary bus to maintain minimum possible inter connection space between GIS supplied under present scope and the GIS being extended.

iv. End Piece (Interface) module with the Isolating test link for Future extension (on one side) of Auxiliary Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link.

xiii) GIS Bus Section Module:

SF6 gas-insulated metal enclosed Bus Sectionaliser Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker without PIR complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Two (2) numbers 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Three (3) Numbers single phase, SF6 ducts for interconnection of above mentioned elements.

vii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, Support structures etc., as required.

viii. Local Control Cubicle

420kV Gas Insulated Switchgear (One & half breaker Scheme)

The SF6 gas insulated switchgear (50 Hz) shall be of the indoor metal-enclosed type, comprising of following modules:

i) GIS Bus bar Module:

Three isolated phase, SF6 gas-insulated metal enclosed bus bar module, each set comprising of the following:

i. Three (3) no's individual bus bars enclosures running across the length of the switchgear to interconnect each of the bay modules in one and a half breaker bus system.

ii. One (1) number 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

iii. Three (3) numbers 1-phase Potential Transformers complete with manual operated isolating Switch/device.

iv. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, Support structures etc., as required.

v. End Piece (Interface) modules with isolating test link for Future extension **on one side** of Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link. End piece interface module for both the buses shall be in one alignment.

> Project Specific Requirement: Requirement of End Piece (Interface) module with isolating test link **on both side** of Bus bar module shall be considered based upon GIS Layout as and when specified under Section-Project.

vi. Three (3) numbers single phase, SF6 ducts (as required) inside GIS hall.

vii. Local Control Cubicle (if required separately).

ii) GIS Bus bar Module Extension (Make of Existing GIS: As per Section-Project):

Extension of Three isolated phase, SF6 gas-insulated metal enclosed bus bar module, each set comprising of the following:

i. Three (3) no's individual bus bars enclosures running across the length of the switchgear to interconnect each of the bay modules in one and a half breaker bus system.

ii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, Support structures etc., as required.

iii. Extension piece (Interface) module, as required to extend existing bus to maintain minimum possible inter connection space between GIS supplied under present scope and the GIS being extended.

iv. End Piece (Interface) modules with the isolating test link for Future extension of Bus bar module on one side. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link. End piece interface module for both the buses shall be in one alignment.

v. Three (3) numbers single phase, SF6 ducts (as required) inside GIS hall.

iii) GIS Line Bay module:

SF6 gas-insulated metal enclosed Line feeder bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker (**#)** with/without PIR complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Three (3) numbers, 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. One (1) number 3-phase, single pole, high speed fault making grounding switch, complete with manual and motor driven operating mechanisms.

vii. Three (3) numbers single phase, SF6 ducts inside GIS hall (up to the outer edge of the wall of GIS Hall).

viii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc., as required.

ix. Local Control Cubicle.

'#' As per BPS

iv) GIS Tie Bay module:

SF6 gas-insulated metal enclosed Tie Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker (#) with/without PIR complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on other side of circuit breaker

iv. Two (2) numbers 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

vii. Local Control Cubicle.

'#' As per BPS

v) GIS ICT bay module (For 400kV side of 765/400kV ICT):

SF6 gas-insulated metal enclosed ICT bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 gas insulated circuit breaker without PIR, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Two (2) numbers 3-phase, single pole, group operated isolator switches complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole, group operated safety grounding switches complete with manual and motor driven operating mechanisms.

vi. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms.

vii. Three (3) numbers 1-phase, individual pole operated safety grounding switches, complete with manual and motor driven operating mechanisms.

viii. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms for switching of Spare ICT through Auxiliary bus. The isolator must meet the operational requirement in terms of Phase-phase insulation withstand capability.

ix. Three (3) numbers single phase SF6, ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall).

x. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

xi. Local Control cubicle.

vi) GIS Auxiliary Bus module for Spare ICT Connection (For 400kV side of 765/400kV ICT):

Set of isolated phases, SF6 gas-insulated metal enclosed Auxiliary bus bars module for ICT bays, each set comprising of the following:

i. One (1) number 1-Phase, Auxiliary bus bar enclosure running across the length of the switch gear to inter-connect the spare unit of ICT with all ICT bay Modules through GIS Duct and provision of extension for future ICT.

ii. One (1) number 1-Phase, single pole operated safety grounding switch, complete with manual and motor driven operating mechanisms.

iii. One (1) number, single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall)

iv. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

v. End Piece (Interface) module with Isolating test link for Future extension **on one side** of Auxiliary Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link.

Project Specific Requirement: Requirement of End Piece (Interface) module with isolating test link **on both side** of Auxiliary Bus bar module shall be considered based upon GIS Layout as and when specified under Section-Project.

vii) GIS Auxiliary Bus module Extension for Spare ICT connection (For 400kV side of 765/400kV ICT):

Set of isolated phase, SF6 gas-insulated metal enclosed Auxiliary bus bars module for ICT bays, each set comprising of the following:

i. One (1) number 1-Phase, Auxiliary bus bar enclosure running across the length of the switch gear to inter-connect the spare unit of ICT with all ICT bay Modules through GIS Duct and provision of extension for future ICT.

ii. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

iii. Extension piece (Interface) module, as required to extend existing Auxiliary bus to maintain minimum possible inter connection space between GIS supplied under present scope and the GIS being extended.

iv. End Piece (Interface) module with the Isolating test link for Future extension (on one side) of Auxiliary Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link.

viii) GIS ICT bay module (For 400kV HV side of 400/220kV ICT):

SF6 gas-insulated metal enclosed ICT bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker without PIR, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Three (3) numbers 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Three (3) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Three (3) numbers single phase, SF6 ducts inside GIS hall (upto the outer edge of the wall of GIS Hall).

vii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

viii. Local Control Cubicle.

ix) GIS Bus reactor bay module:

SF6 gas insulated metal enclosed Bus reactor bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 gas insulated circuit breaker without PIR, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Three (3) numbers 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Three (3) numbers 3-phases, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Three (3) numbers single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall).

vii. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc., as required.

viii. Local Control cubicle.

x) GIS Line Reactor Bay module:

SF6 gas insulated metal enclosed Line reactor bay module, each set comprising of the following:

i. One (1) number 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

ii. One (1) number 3-phases, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

iii. Three (3) numbers single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall).

iv. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc., as required.

v. Local Control cubicle (if required separately).

xi) GIS Switchable Line reactor bay module:

SF6 gas insulated metal enclosed switchable Line reactor bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 gas insulated circuit breaker without PIR, complete with operating mechanism.

ii. One (1) number 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

iii. One (1) number 3-phases, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

iv. Three (3) numbers single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall).

v. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc., as required.

vi. Local Control cubicle.

Note: Quantity of "3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms" and "3-phases, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms" shall be Two (2) nos. in case of direct connection of Line Reactor with GIS.

xii) GIS Bus Section Module:

SF6 gas-insulated metal enclosed Bus Sectionaliser Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker without PIR, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Two (2) numbers 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Three (3) numbers single phase, SF6 ducts for interconnection of above mentioned elements.

vii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, Support structures etc., as required.

viii. Local Control Cubicle

420 kV Gas Insulated Switchgear (Double Main Busbar Scheme)

The SF6 gas insulated switchgear (50 Hz) shall be of the indoor metal-enclosed type, comprising of following modules:

i) GIS Bus bar Module:

Three isolated phase, SF6 gas-insulated metal enclosed bus bar module, each set comprising of the following:

i. Three (3) no's individual bus bars enclosures running across the length of the switchgear to interconnect each of the bay modules in Double Main Bus bar system.

ii. One (1) number 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

iii. Three (3) numbers 1-phase Potential Transformers complete with manual operated isolating Switch/device.

iv. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structure etc. as required.

v. End Piece (Interface) modules with isolating test link for Future extension **on one side** of Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link. End piece interface module for both the buses shall be in one alignment.

> Project Specific Requirement: Requirement of End Piece (Interface) module with isolating test link **on both side** of Bus bar module shall be considered based upon GIS Layout as and when specified under Section-Project.

vi. Three (3) numbers single phase, SF6 ducts (as required) inside GIS hall.

vii. Local control cubicle (if required separately).

ii) GIS Bus bar Module Extension (Make of Existing GIS: As per Section-Project):

Extension of Three isolated phase, SF6 gas-insulated metal enclosed bus bar module, each set comprising of the following:

i. Three (3) no's individual bus bars enclosures running across the length of the switchgear to interconnect each of the bay modules in Double Main Bus bar system.

ii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structure etc. as required.

iii. Extension piece (Interface) module, as required to extend existing bus so as to maintain minimum possible inter connection space between GIS supplied under present scope and the GIS being extended.

iv. End Piece (Interface) modules with the isolating test link for Future extension of Bus bar module on one side. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link. End piece interface module for both the buses shall be in one alignment.

v. Three (3) numbers single phase, SF6 ducts (as required) inside GIS hall.

iii) GIS Line Bay module:

SF6 gas-insulated metal enclosed Line feeder bay module, each set comprising of the following:

i One (1) number 3-phase, SF6 insulated circuit breaker (**#)** with/without PIR complete with operating mechanism.

ii Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv Three (3) numbers 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v Two (2) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi One (1) number 3-phase, single pole, group operated high speed fault making grounding switch, complete with manual and motor driven operating mechanisms.

vii Three (3) numbers single phase, SF6 ducts inside GIS hall (upto the outer edge of the wall of GIS Hall)

viii Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

ix Local Control Cubicle.

'#' As per BPS

iv) GIS ICT bay module (For 400kV side of 765/400kV ICT):

SF6 gas-insulated metal enclosed ICT bay module each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker without PIR, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Two (2) numbers 3-phase, single pole group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms.

vii. Three (3) numbers 1-phases, individual pole operated safety grounding switches, complete with manual and motor driven operating mechanisms.

viii. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms for switching of Spare ICT through Auxiliary bus. The isolator must meet the operational requirement in terms of Phase-phase insulation withstand capability.

ix. Three (3) numbers single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall)

x. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

xi. Local Control cubicle.

v) GIS Auxiliary Bus module for Spare ICT Connection (For 400kV side of 765/400kV ICT):

Set of isolated phases, SF6 gas-insulated metal enclosed Auxiliary bus bars module for ICT bays, each set comprising of the following:

i. One (1) number 1-Phase, Auxiliary bus bar enclosure running across the length of the switch gear to inter-connect the spare unit of ICT with all ICT bay Modules through GIS Duct and provision of extension for future ICT.

ii. One (1) number 1-Phase, single pole operated safety grounding switch, complete with manual and motor driven operating mechanisms.

iii. One (1) number, single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall)

iv. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

v. End Piece (Interface) module with Isolating test link for Future extension **on one side** of Auxiliary Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link.

Project Specific Requirement: Requirement of End Piece (Interface) module with isolating test link **on both side** of Bus bar module shall be considered based upon GIS Layout as and when specified under Section-Project.

vi) GIS Auxiliary Bus module Extension for Spare ICT connection (For 400kV side of 765/400kV ICT):

Set of isolated phases, SF6 gas-insulated metal enclosed Auxiliary bus bars module for ICT bays, each set comprising of the following:

i. One (1) number 1-Phase, Auxiliary bus bar enclosure running across the length of the switch gear to inter-connect the spare unit of ICT with all ICT bay Modules through GIS Duct and provision of extension for future ICT.

ii. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

iii. Extension piece (Interface) module, as required to extend existing Auxiliary bus to maintain minimum possible inter connection space between GIS supplied under present scope and the GIS being extended.

iv. End Piece (Interface) module with the Isolating test link for Future extension (on one side) of Auxiliary Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link.

vii) GIS ICT bay module (For 400kV HV side of 400/220kV ICT):

SF6 gas-insulated metal enclosed ICT bay module each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker without PIR, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Three (3) numbers 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Three (3) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Three (3) numbers single phase, SF6 ducts inside GIS hall (upto the outer edge of the wall of GIS Hall).

vii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

viii. Local Control Cubicle.

viii) GIS Bus Coupler Bay module:

SF6 gas-insulated metal enclosed Bus Coupler Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker without PIR, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Two (2) numbers 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

vii. Local Control Cubicle.

ix) GIS Bus Reactor Bay module:

SF6 gas-insulated metal enclosed Reactor Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker without PIR, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Three (3) numbers 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Three (3) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Three (3) numbers single phase, SF6 ducts inside GIS hall (upto the outer edge of the wall of GIS Hall).

vii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

viii. Local Control Cubicle.

x) GIS Line reactor bay module:

SF6 gas insulated metal enclosed Line reactor bay module, each set comprising of the following:

i. One (1) number 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

ii. One (1) number 3-phases, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

iii. Three (3) numbers single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall).

iv. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc., as required.

v. Local Control cubicle (if required separately).

xi) GIS Switchable Line reactor bay module:

SF6 gas insulated metal enclosed switchable Line reactor bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 gas insulated circuit breaker without PIR, complete with operating mechanism.

ii. One (1) number 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

iii. One (1) number 3-phases, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

iv. Three (3) numbers single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall).

v. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc., as required.

vi. Local Control cubicle.

xii) GIS Bus Section Module:

SF6 gas-insulated metal enclosed Bus Sectionaliser Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker without PIR, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Two (2) numbers 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Three (3) numbers single phase, SF6 ducts for interconnection of above mentioned elements.

vii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, Support structures etc., as required.

viii. Local Control Cubicle

245 kV Gas Insulated Switchgear (Double Main Busbar Scheme)

The SF6 gas insulated switchgear (50 Hz) shall be of the indoor metal-enclosed type, comprising of following modules:

i) GIS Bus bar Module:

3-single (isolated) phase/Three phase enclosed, SF6 gas-insulated metal enclosed bus bar module, each set comprising of the following:

i. Three (3) numbers single(isolated) phase / One (1) number three phase Bus bar enclosures running across the length of the switchgear to interconnect each of the bay modules in Double Main Bus bar system.

ii. One (1) number 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

iii. Three (3) numbers 1-phase Potential Transformers, complete with manual operated isolating Switch/device.

iv. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structure etc. as required.

v. End Piece (Interface) modules with isolating test link for Future extension **on one side** of Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link.End piece interface module for both the buses shall be in one alignment.

> Project Specific Requirement: Requirement of End Piece (Interface) module with isolating test link **on both side** of Bus bar module shall be considered based upon GIS Layout as and when specified under Section-Project.

vi. Three (3) numbers single(isolated) phase / One (1) number three phase, SF6 ducts (as required) inside GIS hall

vii. Local control cubicle (if required separately).

ii) GIS Bus bar Module Extension (Make of Existing GIS: As per Section-Project):

Extension of 3-single (isolated) phase/Three phase, SF6 gas-insulated metal enclosed bus bar module, each set comprising of the following:

i. Bus bars enclosures running across the length of the switchgear to interconnect each of the bay modules in Double Main Bus bar system.

ii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structure etc. as required.

iii. Extension piece (Interface) module, as required to extend existing bus to maintain minimum possible inter connection space between GIS supplied under present scope and the GIS being extended.

iv. End Piece (Interface) modules with the isolating test link for Future extension (on one side) of Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link. End piece interface module for both the buses shall be in one alignment.

v. Three (3) numbers single(isolated) phase / One (1) number three phase, SF6 ducts (as required) inside GIS hall.

iii) GIS Line Bay module:

SF6 gas-insulated metal enclosed Line feeder bay module, each set comprising of the following:

i One (1) number 3-phase, SF6 insulated circuit breaker complete with operating mechanism.

ii Three (3) numbers 1-phase, 4-core, multi ratio, current transformers.

iii Three (3) numbers 3-phase, group operated isolator switches, complete with manual and motor driven operating mechanisms.

iv Two (2) numbers 3-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

v One (1) number 3-phase, group operated high speed fault making grounding switch, complete with manual and motor driven operating mechanisms.

vi Three nos. 1-phase (isolated)/one no. 3-phase SF6 ducts inside GIS hall (upto the outer edge of the wall of GIS Hall)

vii Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

viii Local Control Cubicle.

iv) GIS ICT bay module:

SF6 gas-insulated metal enclosed ICT bay module each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker complete with operating mechanism.

ii. Three (3) numbers 1-phase, 4-core, multi ratio, current transformers.

iii. Three (3) numbers 3-phase, group operated isolator switches, complete with manual and motor driven operating mechanisms.

iv. Three (3) numbers 3-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

v. Three nos. 1-phase (isolated)/one no. 3-phase SF6 ducts inside GIS hall (upto the outer edge of the wall of GIS Hall).

vi. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

vii. Local Control Cubicle.

v) GIS Bus Coupler Bay module:

SF6 gas-insulated metal enclosed Bus Coupler Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker complete with operating mechanism.

ii. Three (3) numbers 1-phase, 4-core, multi ratio, current transformers.

iii. Two (2) numbers 3-phase, group operated isolator switches, complete with manual and motor driven operating mechanisms.

iv. Two (2) numbers 3-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

v. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

vi. Local Control Cubicle.

vi) GIS Bus Section Bay module:

SF6 gas-insulated metal enclosed Bus Section Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker complete with operating mechanism.

ii. Three (3) numbers 1-phase, 4-core, multi ratio, current transformers.

iii. Two (2) numbers 3-phase, group operated isolator switches, complete with manual and motor driven operating mechanisms.

iv. Two (2) numbers 3-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

v. Three (3) numbers single phase(isolated) / One (1) number three phase , SF6 ducts for interconnection of above mentioned elements.

vi. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

vii. Local Control Cubicle.

vii) GIS Reactor Bay module:

SF6 gas-insulated metal enclosed Reactor Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker complete with operating mechanism.

ii. Three (3) numbers 1-phase, 4-core, multi ratio, current transformers.

iii. Three (3) numbers 3-phase, group operated isolator switches, complete with manual and motor driven operating mechanisms.

iv. Three (3) numbers 3-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

v. Three nos. 1-phase (isolated)/one no. 3-phase SF6 ducts inside GIS hall (upto the outer edge of the wall of GIS Hall).

vi. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

vii. Local Control Cubicle.

145 kV Gas Insulated Switchgear (Double Main Busbar Scheme)

The SF6 gas insulated switchgear (50 Hz) shall be of the indoor metal-enclosed type, comprising of following modules:

i) GIS Bus bar Module:

Sets of three phase enclosed, SF6 gas-insulated metal enclosed Bus Bar modules, each set comprising of the following:

i. One (1) number three phase Bus bar enclosures running across the length of the switchgear to interconnect each of the bay modules in Double main bus bar system.

ii. One (1) number 3-phase, group operated safety grounding switch, complete with manual and motor driven operating mechanisms.

iii. One (1) number 3-phase inductive potential transformers, complete with manual operated isolating Switch/device.

iv. Gas monitoring devices, barriers, pressure switches, support structures etc. as required.

v. End Piece (Interface) modules with isolating test link for Future extension **on one side** of Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link. End piece interface module for both the buses shall be in one alignment.

> Project Specific Requirement: Requirement of End Piece (Interface) module with isolating test link **on both side** of Bus bar module shall be considered based upon GIS Layout as and when specified under Section-Project.

vi. One (1) number three phase, SF6 ducts (as required) inside GIS hall.

vii. Local control cubicle (if required separately).

ii) GIS Bus bar Module Extension (Make of Existing GIS: As per Section-Project):

Extension of Three phase, SF6 gas-insulated metal enclosed bus bar module, each set comprising of the following:

i. One (1) number three phase Bus bar enclosures running across the length of the switchgear to interconnect each of the bay modules in Double Main Bus bar system.

ii. Gas monitoring devices, barriers, pressure switches, support structure etc. as required.

iii. Extension piece (Interface) module, as required to extend existing bus to maintain minimum possible inter connection space between GIS supplied under present scope and the GIS being extended.

iv. End Piece (Interface) modules with the isolating test link for Future extension (on one side) of Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link. End piece interface module for both the buses shall be in one alignment.

v. One (1) number three phase, SF6 ducts (as required) inside GIS hall.

iii) GIS Line bay module:

SF6 gas-insulated metal enclosed Line feeder bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 gas insulated circuit breaker, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 4-core, multi ratio, current transformers.

iii. Three (3) numbers 3-phase, group operated isolator switches complete with manual and motor driven operating mechanisms.

iv. Two (2) numbers 3-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

v. One (1) number 3-phase, high speed fault making grounding switch, complete with group operated manual and motor driven operating mechanisms.

vi. One (1) number 3-phase SF6 ducts inside GIS hall (upto the outer edge of the wall of GIS Hall).

vii. Gas monitoring devices, barriers, pressure switches, support structures etc. as required.

viii. Local Bay control cubicle.

iv) GIS ICT bay module:

SF6 gas-insulated metal enclosed ICT feeder bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 gas insulated circuit breaker, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 4-core, multi ratio, current transformers.

iii. Three (3) numbers 3-phase, group operated isolator switches complete with manual and motor driven operating mechanisms.

iv. Three (3) numbers 3-phase, group operated safety grounding switches complete with manual and motor driven operating mechanisms.

v. One (1) number 3-phase SF6 ducts inside GIS hall (upto the outer edge of the wall of GIS Hall).

vi. Gas monitoring devices, barriers, pressure switches, support structures etc. as required.

vii. Local Bay control cubicle.

v) GIS Bus Coupler Bay Module:

SF6 gas-insulated metal enclosed Bus-Coupler Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 gas insulated circuit breaker, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 4-core, multi ratio, current transformers.

iii. Two (2) numbers 3-phase, group operated isolator switches, complete with manual and motor driven operating mechanisms.

iv. Two (2) numbers 3-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

v. Gas monitoring devices, barriers, pressure switches, support structures etc. as required.

vi. Local Bay Control Cubicle.

vi) GIS Bus Section Bay Module:

SF6 gas-insulated metal enclosed Bus Section Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 gas insulated circuit breaker, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 4-core, multi ratio, current transformers.

iii. Two (2) numbers 3-phase, group operated isolator switches, complete with manual and motor driven operating mechanisms.

iv. Two (2) numbers 3-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

v. One (1) number 3-phase, SF6 ducts for interconnection of above mentioned elements.

vi. Gas monitoring devices, barriers, pressure switches, support structures etc. as required.

vii. Local Bay Control Cubicle.

vii) GIS Reactor Bay module:

SF6 gas-insulated metal enclosed Reactor Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 gas insulated circuit breaker, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 4-core, multi ratio, current transformers.

iii. Three (3) numbers 3-phase, group operated isolator switches complete with manual and motor driven operating mechanisms.

iv. Three (3) numbers 3-phase, group operated safety grounding switches complete with manual and motor driven operating mechanisms.

v. One (1) number 3-phase SF6 ducts inside GIS hall (upto the outer edge of the wall of GIS Hall).

vi. Gas monitoring devices, barriers, pressure switches, support structures etc. as required.

vii. Local Bay control cubicle.

Gas Insulated Outdoor Bus Duct (GIB):

(i) **765kV & 420kV GIB:**

For making connections with outdoor overhead lines/Transformer/Reactor, Single Phase enclosed SF6 Gas Insulated Bus Duct (including support structure, gas monitoring device, gas barrier, pressure switch, UHF PD Sensor etc.) shall be provided. The GIB shall be measured in running meter as per actual at site and the same shall be paid as per unit rate quoted in Bid Price Schedule. This outdoor bus duct shall be measured from outer wall edge of GIS Building to centerline of SF6 to Air Bushing/SF6 to Oil Bushing (as applicable). SF6 gas duct inside GIS building are part of respective GIS Bay Module.

(ii) **245kV GIB:**

For making connections with outdoor overhead lines/Transformer/Reactor, **Single/Three Phase** enclosed SF6 Gas Insulated Bus Duct (including support structure, gas monitoring device, gas barrier, pressure switch, UHF PD Sensor etc.) shall be provided. The GIB shall be measured in running meter as per actual at site and the same shall be paid as per unit rate quoted in Bid Price Schedule. This outdoor bus duct shall be measured from outer wall edge of GIS Building to centerline of SF6 to Air Bushing/SF6 to Oil Bushing (as applicable). SF6 gas duct inside GIS building are part of respective GIS Bay Module.

(iii) 145kV GIB:

For making connections with overhead lines/Transformer/Reactor, Three Phase enclosed SF6 Gas Insulated Bus Duct (including support structure, gas monitoring device, gas barrier, pressure switch etc.) shall be provided. The GIB shall be measured in running meter as per actual at site and the same shall be paid as per unit rate quoted in Bid Price Schedule. This outdoor bus duct shall be measured from outer wall edge of GIS Building to centerline of SF6 to Air Bushing/ SF6 to Oil Bushing (as applicable). SF6 gas duct inside GIS building are part of respective GIS Bay Module.

The GIB duct length shall be optimized further meeting present & future bay requirements without affecting the switchyard arrangement, bay orientation and any of the specified functional requirements.

Gas Insulated SF6 to Air Termination:

For making connections with overhead lines/Transformer/Reactor, SF6 to Air bushing including accessories shall be as specified below:

(i) **For 765kV/420/245/145kV:** SF6 to air bushings along with terminal connectors & support structure etc. as required for outdoor connections to connect GIS with overhead line/Transformer/Reactor.

Gas Insulated SF6 to Oil Termination:

For making direct connections with Transformer/Reactor, GIS Interface module along with associated active parts to facilitate the direct connection of GIS duct with Transformer/Reactor is under the present scope of subject package which is as specified below:

(i) **For 765kV/420/245/145kV:** 1-phase Gas insulated interface module along with associated active parts to facilitate the direct inter-connection of GIS duct with the Transformer/Reactor.

Supply of SF6 to Oil bushing is in the scope of Transformer/Reactor Manufacturer. The limits of supply of the GIS switchgear manufacturer and transformer manufacturer shall be as per IEC 62271-211. The drawings/details of SF6 to Oil bushing along with other required data of Transformer/Reactor shall be provided during detailed engineering.

Gas Insulated SF6 to Cable Termination:

For making connections of GIS switchgear/duct with XLPE Cable, GIS Interface module along with associated active parts to facilitate the connection of GIS switchgear/duct with XLPE Cable as per IEC-62271-209 is under the present scope of subject package which is as specified below:

(i) **For 245kV:** 1-phase / 3-Phase Gas Insulated SF6 to cable connection module along with associated active parts to interconnect GIS with XLPE Cable. The Support Structure required to support the XLPE cable upto the GIS termination point is also in the present scope of subject package.

(ii) **For 145kV:** 3-Phase Gas Insulated SF6 to cable connection module along with associated active parts to interconnect GIS with XLPE Cable. The Support Structure required to support the XLPE cable upto the GIS termination point is also in the present scope of subject package.

Supply of XLPE Cable along with termination kit is in the scope of Cable Manufacturer. The limits of supply of the GIS switchgear manufacturer and Cable termination shall be as per IEC 62271-209.The drawings/details of XLPE cable along with termination kit shall be provided during detailed engineering.

Gas Insulated Surge Arrester:

(i) **For 765kV/420kV :** 1-phase Gas insulated Surge Arrester along with required accessories (i.e. surge monitor etc.)

(ii) **For 245kV:** 1-phase/3-Phase Gas insulated Surge Arrester along with required accessories (i.e. surge monitor etc.)

(iii) **For 145kV:** 3-phase Gas insulated Surge Arrester along with required accessories (i.e. surge monitor etc.)