




| CONTENTS                                 |  | Annex.-(02.00)           |  |
|--|--|--------------------------|---|
|  | <b><u>Technical Specification and Scope of Supply</u></b>                    |                          |   |
|  | <b>PART-A</b>  |                          |   |
|  | I Project Information  |                          |   |
|  | II Scope of Supply   |                          |   |
|  | III Terminal Points & Exclusions   |                          |   |
|  | IV Functional Guarantees & Liquidated Damages                                |                          |   |
|  | V Mandatory Spares   |                          |   |
|  | <b>PART-B</b>  |                          |   |
|  | I Technical Requirement<br>GT 201.67 MVA                                     |                          |   |
|  | II Quality Assurance<br>GT 201.67 MVA  |                          |   |
|  | <b>PART-C</b><br><b>List of Tender Drawings</b>                              |                          |   |
|  | I Rating & Diagram Plate of existing GT ( <b>Drawing No- 310/1304/3300</b> ) |                          |   |
|  | II Outline General Arrangement ( <b>Drawing No- 310/1300/2550</b> )          |                          |   |
|  | III Bus Duct Mounting Flange Detail  |                          |   |
|  | IV Foundation Plan ( <b>Drawing No- TA 31466</b> )                           |                          |   |
|  | V Arrangement of CTs of existing GTs ( <b>Drawing No- 310/1304/3318</b> )    |                          |   |
|  | VI HV Neutral Earthing Arrangement ( <b>Drawing No- 310/1313/2203</b> )      |                          |   |
|  | VII Arrangement of LV leads ( <b>Drawing No- 310/1300/2570</b> )             |                          |   |
|  | VIII LV Bushing drawing ( <b>Drawing No- 310/1300/2572</b> )                 |                          |   |
|  | <b>PART-D</b>  |                          |   |
|  | I List of Mandatory Spares   |                          |   |
|  | <b>PART-E</b>  |                          |   |
|  | I Technical Data Requirement (along with bid)                                |                          |   |
|  | II Technical Data Requirement (post award)                                   |                          |   |
| Stage-I GT 201.67 MVA for<br>Rihand STPP |  | <b>TABLE OF CONTENTS</b> | Page 6  |

| Clause No.                            | Project Information <u>Annex.-(02.01)</u>    |
|---------------------------------------|---|
|                                       | <p style="text-align: center;"><b><u>Project Synopsis</u></b></p> <p><b>1.00.00 BACKGROUND</b></p> <p><b>Details of Stage / Units</b></p> <p>Project name : Rihand STPP</p> <p>No. of Units x capacity : Stage I : 2 x 500 MW<br/>Stage II : 2 x 500 MW<br/>Stage III: 2 x 500 MW</p> <p>Project set up by : NTPC Ltd.</p><br><p><b>2.00.00 LOCATION AND APPROACH</b></p> <p>Project Location : Rihand</p> <p>District : Sonbhadra</p> <p>State : Uttar Pradesh</p> <p>Nearest Railway station : Shakti Nagar, UP</p> <p>Distance of project location : 48 KM<br/>from the Railway station</p> <p>Nearest Major Town : WAIDHAN (MP)</p> <p>Distance of the town from the : 30 Km<br/>Project site</p> <p>Nearest Commercial Airport : Varanasi (UP)</p> <p>Nearest Highway : State Highway</p> <p>Any other information: : Further to the information given in this sub-section, <b>Bidders are advised to visit the project site and collect data on local site conditions</b></p> |
| Stage-I GT 201.67 MVA for Rihand STPP | <div>Technical Specifications<br/><b>PART-A</b></div> <div>Sub Section-I<br/>Project Information</div> <div>Page 7</div>  |

| Clause No.                            | Scope of Supply<br><u>Annex.-(02.02)</u>   |                                    |                                   |  |
|---------------------------------------|--|------------------------------------|-----------------------------------|--|
| 1.00.00                               | <b>Scope of Supply</b>   |                                    |                                   |  |
|                                       | <b>GENERATOR TRANSFORMER</b>   |                                    |                                   |  |
|                                       | The scope of the specification covers Design, Engineering, Manufacturing, testing at works, loading, transit insurance, transportation to site, receipt, unloading, handling of supplied Generator Transformer (GT) at site, shifting of new transformer to the new foundation in the bay,(Transformer Foundation along with Cooler Bank foundations is in the scope of Supplier) Supply of insulating oil, assembly of supplied transformer including erection, oil filling, testing & commissioning of transformer, supply of necessary tools, tackles, Mandatory spares and 5% extra transformer oil. |                                    |                                   |  |
|                                       | The Transformer to be supplied under this package shall match the technical requirement with existing transformer and fulfill all technical requirement.   |                                    |                                   |  |
|                                       | The bill of material is attached as “BOQ details with Basis of estimate”   |                                    |                                   |  |
| 2.00.00                               | <b>General Information to Bidder</b>   |                                    |                                   |  |
| 2a)                                   | The offered transformer should be suitable for one to one replacement with existing transformer for any of the three phases.   |                                    |                                   |  |
| 2b)                                   | The Generator transformer intended to be stationed at Rihand STPP will be used in Rihand STPP Stage-I. <b>The bidder is advised to visit project site and get detail information /drawings</b> and make comparative study of HV & LV side connection ( <i>Rough sketch of orientations of HV &amp; LV terminals is enclosed</i> ), existing fire water connection, orientation of marshalling box & conservator, existing foundation plan and location of fire wall & sprinkler system of both GT's.   |                                    |                                   |  |
| 2c)                                   | The bidder shall offer the GT for one-to-one replacement of existing transformer i.e. there will be <b>no need to change the existing foundation</b> , LV side Busduct connection etc.   |                                    |                                   |  |
| 2d)                                   | Bidders to ensure necessary air clearances of the offered 1-ph GT while placing on foundation of any either of 3 phases w.r.t other existing GTs & structures.   |                                    |                                   |  |
|                                       | <b>The supplier necessarily has to supply the Transformer which perfectly matches with Bus-Duct (LV side) specific to NTPC Rihand Stage –I GTs.</b>  |                                    |                                   |  |
| Stage-I GT 201.67 MVA for Rihand STPP |  | Technical Specifications<br>PART-A | Sub Section-II<br>Scope of Supply | Page 8   |

| Clause No.  | Scope of Supply <span style="float: right;"><b><u>Annex.-(02.02)</u></b></span>   |   |        |
|---|---|---|--------|
| <p><b>3.00.00</b></p> <p>1)</p> <p>2)</p> <p>3)</p> <p>4)</p> <p>5)</p> <p>6)</p> | <p><b>Intent Of Specification</b></p> <p>This specification is intended to cover the following activities and services in respect of Transformer to supplied and commissioned at NTPC Rihand Site.</p> <p>a) Detailed design of the Transformers along with its cooling system. (Transformer shall be designed to match the transformer detailed as per enclosed drawing. Technical parameters of the existing transformer are given in this specification. Further details if required for design will be shared during detail Engineering.)</p> <p>b) Furnishing the design details for Employer's review.</p> <p>c) Complete manufacturing including shop testing and type testing including short circuit test.</p> <p>d) Providing engineering data, drawings, and O &amp; M manuals as per specified format etc for employer's review approval and records.</p> <p>e) Packing, loading, transportation, unloading and insurance from the manufacturer's work to the site including customs clearance/port clearance if required. Reconciliation with customers if applicable.</p> <p>f) Receipt, storage, Insurance, assembly, preservation and conservation at site including oil filling.</p> <p>g) Fabrication, reassemble if any, erection, testing and commissioning of the equipment.</p> <p>h) Supply of Mandatory Spares.</p> <p>i) Supply of 5% extra transformer oil.</p> <p>j) Assembling the transformer and its shifting to bay location.</p> <p>k) Equipment's, services, tools and tackles required for the transportation, shifting and preservation to be supplied.</p> <p>l) Satisfactory conclusion of contract.</p> <p>The equipment and services to be supplied as required in this "technical specification and scope of work", shall also meet all the requirements as stated in the general conditions of contract, Special conditions of contract, bid document which shall be considered as a part of this specification as if completely bound herewith.</p> <p>The equipment offered by the bidder shall be complete in all respect. Any material and component not specifically stated in this specification, and which is necessary for trouble free operation of the equipment and accessories specified in this specification shall be deemed to be included unless specifically excluded. All such equipment and accessories shall be supplied without any extra cost.</p> <p>It is not the intent to specify completely herein, all aspects of design and construction of equipment. Nevertheless, the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation</p> <p>Whenever a material or article is specified or described by the name of a particular brand, manufacturer or trademark, the specific item shall be understood as establishing type, function, and quality desired. Other manufacturer's products may also be considered provided sufficient information is furnished so as to enable the Employer to determine that the products are equivalent to those named.</p> <p>Bidder is requested to carefully examine and understand the specifications and seek clarifications, if required, to ensure that they have understood the specifications. Such clarification should be sought before the scheduled date of seeking such clarification as mentioned in the NIT. The Bidders offer should not carry any sections like clarifications, interpretations and/or assumptions.</p> |   |        |
| Stage-I GT 201.67 MVA for Rihand STPP   | <b>Technical Specifications<br/>PART-A</b>  | <b>Sub Section-II<br/>Scope of Supply</b> | Page 9 |

| Clause No. | Scope of Supply  | <u><b>Annex.-(02.02)</b></u> |
|------------|--|------------------------------|
| 7)         | It will be the responsibility of the Bidder to fully meet the intent and the requirements of the specification within the quoted price. No departure of the specification by the Bidder with his proposal shall be considered. Bids not complying with requirement shall be treated as non-responsive and hence liable for rejection. The interpretation of the Owner in respect of the scope, details and services to be performed by the Bidder, shall be binding, unless specifically clarified otherwise by the Owner in writing before the Award of Contract. |                              |
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| Clause No.     | Scope of Supply <span style="float: right;"><u><b>Annex.-(02.02)</b></u></span>   |
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| <b>5.00.00</b> | <p><b>Testing Requirements</b></p> <p><b>A) Type tests (Except Dynamic short circuit test):</b></p> <ol style="list-style-type: none"> <li>1) The contractor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The bidder shall indicate the charges (except Dynamic short circuit test) for each of these type tests separately during the bid and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the employer.</li> <li>2) The type tests shall be carried out in presence of the employer's representative, for which minimum 15 days' notice shall be given by the contractor. The contractor shall obtain the employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.</li> <li>3) In case the contractor has conducted such specified type test(s) not earlier than <b>ten years (As per latest CEA guideline)</b> prior to the date of techno-commercial bid opening, he may submit during detailed engineering the type test reports to the owner for waiver of conducting of such type test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The owner reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor.</li> <li>4) <b>"Similar equipment"</b> is as defined in Annexure-J of Standard Specifications and technical Parameters for Transformers and Reactors (66 kV &amp; above voltage class) issued by CEA. The party shall submit the duly filled Annexure-J for waive off of type tests.</li> <li>5) Type test report of transformer shall only be acceptable provided the offered transformer has been manufactured from the same plant.</li> </ol> <p><b>B) Dynamic short circuit test (DSCT):</b></p> <p><b><u>Case-A:</u></b></p> <p><b><u>If DSCT is available for a transformer of similar rating as the offered transformer:</u></b></p> <ol style="list-style-type: none"> <li>1) Bidders shall submit the duly filled Annexure-J along with the relevant DSCT report, which shall remain valid till change in the design as on the date of techno-commercial bid opening.</li> <li>2) Bidders shall also submit a self-declaration certificate stating that the <u>submitted DSCT report is applicable to the offered transformers and that a duly filled affidavit (as per the attached format at Annexure-1) will be submitted after the award of the purchase order.</u></li> <li>3) These documents [Stated in point no (1) &amp; (2)] are mandatory for the technical evaluation of the bid.</li> <li>4) In case the vendor fails to submit the affidavit (as per the attached Annexure-1) after award of purchase order, then DSCT shall be conducted on the offered transformer under this contract. This DSCT shall be carried out in the presence of the client/ employer's representative, and the corresponding report must be submitted for approval. In that case, the DSCT Charges for the Transformer as filled in the BOQ by the bidder, shall be payable by NTPC. In case, no charge for DSCT has been filled in the tender BOQ by the Bidder, then the Bidder shall be required to conduct the DSCT</li> </ol> |

at no additional cost to NTPC.

- 5) Criteria for similar design shall be as per Annexure-J of Central Electricity Authority's "Standard Specifications and Technical Parameters for Transformers and Reactors (66kV and above)".
- 6) The test has been performed in accordance with Indian Standard 2026, Part 5, or the relevant IEC standard.

**Case-B:**

**If DSCT is not available for a transformer of similar rating as the offered transformer:**

In the absence of a DSCT report as per Case A than the DSCT shall need to be conducted on the supplied Transformer, as filled in the Tender BOQ by the bidder, shall be payable by NTPC under this contract. The bidder shall indicate the charges for DSCT separately in the Tender BOQ during the bid submission and the same shall be considered for the evaluation of the bids.


**C) Components Type test:**


- 1) All components to be supplied shall be of tested design. During detailed engineering, the contractor shall submit for employer's approval the reports of all the type tests as listed below in specification and carried out within given years from the date of techno-commercial bid opening. The reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witness by a client. However if the contractor is not able to submit report of the type test(s) conducted within given years from date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the employer either at third party lab or in presence of client/employer's representative and submit the reports for approval.
- a) All type tests on 132 KV and above Bushings as per IEC 60137. *(within last 10 years from the date of Techno- Commercial bid opening)*.
- b) All type tests on OLTC as per IEC 60214. *(within last 10 years from the date of Techno-Commercial bid opening)*
- c) Tank Vacuum and Pressure test. *(within last 10 years from the date of Techno-Commercial bid opening)*
- D)** All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.
- E)** Each transformer shall be completely assembled with all fittings & accessories meant for the particular transformer before offering for inspection & testing by Employer.


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| Stage-I GT 201.67 MVA for<br>Rihand STPP | <b>Technical Specifications<br/>PART-A</b> | <b>Sub Section-II<br/>Scope of Supply</b> | Page 11 |
|--|--|---|---------|


| Clause No.                               | Terminal Points and Exclusions <span style="float: right;"><u>Annex.-(02.03)</u></span>  |                                    |         |
|--|--|------------------------------------|---------|
| 1.00.00                                  | <p><b>Exclusions</b></p> <p><b>Generator Transformer</b></p> <p>The following are specific exclusion from the scope of contractor.</p> <ol style="list-style-type: none"> <li>1. Transformer foundation</li> <li>2. Fire fighting system for the transformer</li> <li>3. ACSR conductors on 400 KV side for GT.</li> </ol> |                                    |         |
| Stage-I GT 201.67 MVA for<br>Rihand STPP | Technical Specifications<br><b>PART-A</b>  | Sub Section-III<br>Scope of Supply | Page 12 |



|                                       |   |  |         |  |
|---------------------------------------|---|--|---------|--|
| Clause No.                            | <b>FUNCTIONAL GUARANTEES &amp; LIQUIDATED DAMAGES</b>   |  |         |  |
|                                       | <b>Annex.-(02.04)</b>   |  |         |  |
|                                       | <b>GUARANTEE, Functional Guarantee, Liquidated Damages &amp; Performance Adjustment Price</b>   |  |         |  |
|                                       | The bidder shall guarantee that the equipments offered shall meet the rating and performance requirements stipulated in the specifications. The bidder shall also furnish a “Declaration on Functional Guarantee” which shall attract deduction in payment towards liquidated damages for non-performance. The losses declared in guaranteed declaration shall be at rated voltage and frequency <b>at 75 degree centigrade</b> . The guaranteed parameters shall be without any tolerance values. Bidders may note following terms and conditions in this regard -   |  |         |  |
| (I)                                   | <b><u>DEFECTS LIABILITY PERIOD / GUARANTEE</u></b>  |  |         |  |
|                                       | <div>1. The contractor shall warrant that the equipment will be new and in accordance with the Contract Documents and be free from defects in material and workmanship for a period of <b>18 months from the date of acceptance of material</b> at site or <b>12 months from the date of charging of transformer</b> whichever comes earlier. The Contractor’s liability shall be limited to the defects arising due to design, engineering, material and workmanship of the equipment supplied or of the work executed by the contractor. Contractor shall promptly, in constitution and agreement with purchaser regarding appropriate remedying of the defects, and at its cost, repair, replace or otherwise make good such defect as well as any damage caused to facilities caused by such defect. If repair of such defects is only possible at contractors’ works, transportation cost of equipment shall be borne by the contractor.</div> <div>2. If it becomes necessary for the Contractor to replace or renew any defective portions of the plant under this clause, the provisions of this clause shall apply to the portions of the plant so replaced or renewed until the expiration of <b>twelve (12) months</b> from the date of such replacement or renewal. If any defects be not remedied within a reasonable time, the Engineer may proceed to do the work at the Contractor’s risk and costs, but without prejudice to any other rights which the Owner may have against the Contractor in respect of such defects.</div> <div>3. The repaired or new parts will be furnished and erected free of cost by the Contractor. If any repair is carried out on his behalf at the Site, the Contractor shall bear the cost or such repair.</div> <div>4. The cost of any special or general overhaul rendered necessary during the maintenance period due to defects in the equipment or defective work carried out by the Contractor shall be borne by the Contractor.</div> <div>5. The acceptance of the equipment by the Engineer shall in no way relieve the Contractor of his obligation under the GUARANTEE.</div> <div>6. In the case of those defective parts, which are not repairable at Site but are essential for the commercial operation of the equipment, the Contractor and the Engineer shall mutually agree to a program of replacement or renewal, which will minimize interruption to the maximum extent, in the operation of the equipment.</div> <div>7. At the end of the Guarantee Period, the Contractor’s liability ceases except for latent defects as per cl. no. II of “Annex.-(02.04)”. In respect of goods supplied by</div> |  |         |  |
| Stage-I GT 201.67 MVA for Rihand STPP | Technical Specifications<br>PART – A  | <b>Sub Section-IV</b><br>Functional Guarantee & LD | Page 13 |  |

| Clause No.   | FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES<br>Annex.-(02.04)  |  |            |  |       |   |                      |            |   |  |                  |        |   |  |                 |         |   |  |                 |        |
|--|---|--|------------|---|-------|---|----------------------|------------|---|--|------------------|--------|---|--|-----------------|---------|---|--|-----------------|--------|
|  | Sub-contractor to the Contractor where a longer guarantee ( <b>more than 12 months</b> ) is provided by such Sub-contractors, the Owner shall be entitled to the benefit of such longer guarantees.   |  |            |   |       |   |                      |            |   |  |                  |        |   |  |                 |         |   |  |                 |        |
|  | 8. The provisions contained in this clause will not be applicable:<br>(a) If the Owner has not operated the equipment according to generally approved industrial practices and in accordance with the conditions of operation specified and in accordance with the operating manuals, if any.<br>(b) In cases of normal wear and tear of the parts to be specifically mentioned by the Contractor in the offer.   |  |            |   |       |   |                      |            |   |  |                  |        |   |  |                 |         |   |  |                 |        |
|  | (II)  | <b><u>LATENT DEFECTS LIABILITY</u></b> |            |   |       |   |                      |            |   |  |                  |        |   |  |                 |         |   |  |                 |        |
|  | At the end of Guarantee Period, Contractor's liability ceases except for latent defects. The Contractor Liability for latent defects warranty for equipment and spares shall be limited to a period of Five (05) years from the end of Guarantee period for the material supplied. For the purpose of this clause, the latent defects shall be the defects inherently lying within the Material or arising out of design deficiency which do not manifest themselves during the Guarantee Period as defined in the contract or GCC but may surface later. |  |            |   |       |   |                      |            |   |  |                  |        |   |  |                 |         |   |  |                 |        |
|  | (III)   | <b><u>MAXIMUM LOSSES:</u></b>          |            |   |       |   |                      |            |   |  |                  |        |   |  |                 |         |   |  |                 |        |
| The maximum permissible losses (No load loss, I2R loss, auxiliary loss and load loss) at rated voltage/current (at 75 deg C) have been specified in Table-2 for Generator transformers covered under this specification. Following penalties (Table-1) shall be levied on the manufacturer/contractor (as the case may be) if losses measured during routine test are found to be within +2% tolerance of the losses specified in Table-2, beyond which the generator transformer shall be liable for rejection. No benefit shall be given for supply of transformer, with losses (measured during routine tests) less than the losses specified in Table-2: |   |  |            |   |       |   |                      |            |   |  |                  |        |   |  |                 |         |   |  |                 |        |
| <b><u>TABLE-1:</u></b>   |   |  |            |   |       |   |                      |            |   |  |                  |        |   |  |                 |         |   |  |                 |        |
| <table><tr><th>S.NO.</th><th>Differential of specified losses vs Measured losses</th><th colspan="2">RATE (in INR per KW)</th></tr><tr><td>1</td><td>No load Loss</td><td colspan="2">Rs. 10,00,000/KW</td></tr><tr><td>2</td><td>I<sup>2</sup>R Losses/Load Losses (Differential of whichever loss is higher shall be considered for penalty)</td><td colspan="2">Rs. 8,00,000/KW</td></tr><tr><td>3</td><td>Auxiliary Losses</td><td colspan="2">Rs. 8,00,000/KW</td></tr></table>   |   |  |            |   | S.NO. | Differential of specified losses vs Measured losses | RATE (in INR per KW) |            | 1 | No load Loss                                     | Rs. 10,00,000/KW |        | 2 | I <sup>2</sup> R Losses/Load Losses (Differential of whichever loss is higher shall be considered for penalty) | Rs. 8,00,000/KW |         | 3 | Auxiliary Losses                                   | Rs. 8,00,000/KW |        |
| S.NO.  | Differential of specified losses vs Measured losses   | RATE (in INR per KW)                   |            |   |       |   |                      |            |   |  |                  |        |   |  |                 |         |   |  |                 |        |
| 1  | No load Loss  | Rs. 10,00,000/KW                       |            |   |       |   |                      |            |   |  |                  |        |   |  |                 |         |   |  |                 |        |
| 2  | I <sup>2</sup> R Losses/Load Losses (Differential of whichever loss is higher shall be considered for penalty)  | Rs. 8,00,000/KW                        |            |   |       |   |                      |            |   |  |                  |        |   |  |                 |         |   |  |                 |        |
| 3  | Auxiliary Losses  | Rs. 8,00,000/KW                        |            |   |       |   |                      |            |   |  |                  |        |   |  |                 |         |   |  |                 |        |
| <b>Note:</b> For a fraction of a kW, the penalty shall be applied on pro rata basis.   |   |  |            |   |       |   |                      |            |   |  |                  |        |   |  |                 |         |   |  |                 |        |
| <b><u>TABLE-2:</u></b>   |   |  |            |   |       |   |                      |            |   |  |                  |        |   |  |                 |         |   |  |                 |        |
| <table><tr><th>S.NO.</th><th>Maximum Permissible Losses of Transformers</th><th>Unit</th><th>201.67 MVA</th></tr><tr><td>1</td><td>Max. No Load Loss at rated voltage and frequency</td><td>KW</td><td>[98KW]</td></tr><tr><td>2</td><td>Max. Load Loss at rated current and frequency and at 75°C, at principal tap position</td><td>KW</td><td>[308KW]</td></tr><tr><td>3</td><td>Max. Auxiliary Loss at rated voltage and frequency</td><td>KW</td><td>[19KW]</td></tr></table>   |   |  |            |   | S.NO. | Maximum Permissible Losses of Transformers          | Unit                 | 201.67 MVA | 1 | Max. No Load Loss at rated voltage and frequency | KW               | [98KW] | 2 | Max. Load Loss at rated current and frequency and at 75°C, at principal tap position                           | KW              | [308KW] | 3 | Max. Auxiliary Loss at rated voltage and frequency | KW              | [19KW] |
| S.NO.  | Maximum Permissible Losses of Transformers  | Unit                                   | 201.67 MVA |   |       |   |                      |            |   |  |                  |        |   |  |                 |         |   |  |                 |        |
| 1  | Max. No Load Loss at rated voltage and frequency  | KW                                     | [98KW]     |   |       |   |                      |            |   |  |                  |        |   |  |                 |         |   |  |                 |        |
| 2  | Max. Load Loss at rated current and frequency and at 75°C, at principal tap position  | KW                                     | [308KW]    |   |       |   |                      |            |   |  |                  |        |   |  |                 |         |   |  |                 |        |
| 3  | Max. Auxiliary Loss at rated voltage and frequency  | KW                                     | [19KW]     |   |       |   |                      |            |   |  |                  |        |   |  |                 |         |   |  |                 |        |
| Stage-I GT 201.67 MVA for Rihand STPP  |   | Technical Specifications<br>PART – A   |            | Sub Section-IV<br>Functional Guarantee & LD   |       |   |                      |            |   |  |                  |        |   |  |                 |         |   |  |                 |        |
| Page 14  |   |  |            |   |       |   |                      |            |   |  |                  |        |   |  |                 |         |   |  |                 |        |

| Clause No.   | SPARES  | Annex.-(02.05)                       |  |
|--|---|--------------------------------------|---|
| <div>1.00.00</div> <div>2.00.00</div> <div>3.00.00</div> <div>4.00.00</div> <div>5.00.00</div> <div>5.01.00</div> <div>5.02.00</div> | <p style="text-align: center;"><b>MANDATORY SPARES</b></p> <p><b>GENERAL</b></p> <p>The general requirements pertaining to the supply of these spares have been described in the following paragraphs.</p> <p><b>MANDATORY SPARES</b></p> <p>(a.) The list of mandatory spares considered essential by the Employer is indicated in “<b>Annex.-(02.12)</b>”. The bidder shall indicate the prices for each and every item.</p> <p>(b.) The prices of mandatory spares shall be included for bid evaluation purposes.</p> <p><b>RECOMMENDED SPARES AND MAINTENANCE EQUIPMENTS</b></p> <p>(a.) In addition to the mandatory spares mentioned above, the contractor shall also provide a list of recommended spares and maintenance equipment for 3 years of trouble-free normal operation of the plant along with the price of each item. The price of recommended spares shall not be included for bid evaluation purposes.</p> <p>(b.) The price of recommended spares and maintenance equipments will remain valid upto 6 months after placement of order. However, the Contractor shall be liable to provide necessary justification for the quoted prices for these spares during the validity period of six months. If contractor fails to provide the aforesaid justification, the prices of recommended spares shall remain valid for three months from the last date of providing justification.</p> <p><b>START-UP &amp; COMMISSIONING SPARES/ EQUIPMENTS</b></p> <p>Start-up and commissioning spares/ equipments are those which may be required during the start-up and commissioning of the Generator Transformer. All spares/ equipments used, till the Generator Transformer is handed over to the Employer, shall come under this category. The Contractor shall provide for an adequate stock of such start up and commissioning spares/ equipments to be brought by him to the site for the erection and commissioning of the Generator Transformer. They must be available at site before the Generator Transformer is energized. The unused spares/ equipments, if any, should be removed from there only after handing over the Generator Transformer to the Employer. All start up spares/ equipments which remain unused at the time shall remain the property of the Contractor.</p> <p><b>COMMON REQUIREMENTS:</b></p> <p>The general requirements pertaining to the supply of the spares is given below - The Contractor shall indicate the service expectancy period for the spares parts (both mandatory and recommended) under normal operating conditions.</p> <p>All spares supplied under this contract shall be strictly interchangeable with the parts for which they are intended for replacements. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site.</p> |                                      |   |
|  | Stage-I GT 201.67 MVA for<br>Rihand STPP  | Technical Specifications<br>PART – A | <div>Sub Section- V</div> <div>Mandatory</div> <div>Spares</div> <div>Page 15</div> |

| Clause No.                               | SPARES   | Annex.-(02.05)                       |  |
|--|--|--------------------------------------|---|
| 5.03.00                                  | <p>The contractor will provide Employer with cross-sectional drawings, catalogues, assembly drawings and other relevant documents so as to enable the Employer to identify and finalize order for recommended spares if required.</p> <p>Each spares part shall be clearly marked or labeled on the outside of the packing with its description. When more than one spares part is packed in a single case, a general description of the content shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification.</p> <p>All cases, containers or other packages are to be opened for such examination as may be considered necessary by the Employer.</p> <p>The contractor will provide the Employer with all the addresses and particulars of his sub suppliers while placing the order on vendors for items/components/equipment covered under the contract and will further ensure with his vendors that the Employer, if so desires, will have the right to place order for spares directly on them on mutually agreed terms based on offers of such vendors.</p> <p>The Contractor shall warrant that all spares supplied will be new and in accordance with the contract Documents and will be free from defects in design, material and workmanship.</p> <p>The Contractor shall guarantee the long term availability of spares to the Employer For the full life of the equipment covered under the contract. The Contractor shall guarantee that before going out of production of spares parts of the equipment covered under the Contract, he shall give the Employer atleast 2 years advance Notice so that the latter may order his bulk requirement of spares, if he so desires. The same provision will also be applicable to sub-contractors. Further, in case of discontinuance of manufacture of any spares by the Contractor and/or his sub contractors, Contractor will provide the Employer, two years in advance, with full manufacturing drawings, material specifications and technical information including Information on alternative equivalent makes required by the Employer for the purpose of manufacturing/procurement of such items.</p> |                                      |   |
| 5.04.00                                  |  |                                      |   |
| 5.05.00                                  |  |                                      |   |
| 5.06.00                                  |  |                                      |   |
| 5.07.00                                  |  |                                      |   |
| 5.08.00                                  |  |                                      |   |
| Stage-I GT 201.67 MVA for<br>Rihand STPP | Technical Specifications<br>PART – A   | Sub Section-V<br>Mandatory<br>Spares | Page 16   |

| Clause No.                            | TECHNICAL REQUIREMENTS <u>Annex.-(02.06)</u> |  |  |                                       |                              |
|---------------------------------------|--|--|--|---------------------------------------|------------------------------|
| 1.00.00<br>1.01.00                    | <b>Generator Transformer</b>                 |  |  |                                       |                              |
|                                       | <b>TECHNICAL PARAMETERS</b>                  |  |  |                                       |                              |
|                                       | Generator Transformer                        |  |  |                                       |                              |
|                                       | <b>S.N.</b>                                  | <b>Technical Parameters</b>                                | <b>Generator Transformer</b>   |                                       |                              |
|                                       | (a.)   | Rated output   | 201.67 MVA   |                                       |                              |
|                                       | (b.)   | Cooling & Cooling Rating                                   | OFAF   |                                       |                              |
|                                       | (c.)   | Type   | Two Winding  |                                       |                              |
|                                       | (d.)   | Voltage Ratio  | 20 kV /(400/ $\sqrt{3}$ ) kV   |                                       |                              |
|                                       | (e.)   | Vector group<br>(After 3-phase connection)                 | YNd1<br>(HV neutral shall be made at site by the Bidder. LV side delta shall be made by employer). |                                       |                              |
|                                       | (f.)   | Frequency  | 50 Hz  |                                       |                              |
|                                       | (g.)   | Phase  | Single Phase<br>(3 no. single phase units shall form a three phase bank)                           |                                       |                              |
|                                       | (h.)   | Service  | Outdoor  |                                       |                              |
|                                       | (i.)   | Duty   | Continuous   |                                       |                              |
|                                       | (j.)   | Overload capacity  | As per IEC 60076-7   |                                       |                              |
|                                       | (k.)   | Maximum design Ambient temperature                         | 50°C   |                                       |                              |
|                                       | (l.)   | Permissible Temperature rise over an ambient temp. of 50°C |  |                                       |                              |
|                                       |  | (i) Winding<br>(by resistance method)                      | 40°C   |                                       |                              |
|                                       |  | (ii) Top oil<br>(by thermometer)                           | 35°C   |                                       |                              |
|                                       | (m.)   | Impedance at 75 deg.C                                      |  |                                       |                              |
|                                       |  | (i) On Principal Tap                                       | 13.5% (with +/- 5% tolerance)  |                                       |                              |
|                                       |  | (ii) On Other Taps   | 12% to 15% without any further tolerance   |                                       |                              |
|                                       | (n.)   | Short circuit withstand time                               | 3 sec.   |                                       |                              |
|                                       | (o.)   | Noise Level  | As per NEMA TR- 1  |                                       |                              |
|                                       |  | (p.)   | <b>Winding Details</b>   |                                       |                              |
|                                       |  | <b>S.No.</b>   | <b>Parameter</b>   | <b>Unit</b>                           | <b>HV LV HVN</b>             |
|                                       |  | (i.)   | System Fault Level   | kA                                    | 63 - -                       |
|                                       |  | (ii.)  | Lightning impulse withstand voltage  | kVp                                   | 1425 170 95                  |
|                                       |  | (iii.)   | Chopped Wave lightning impulse withstand voltage   | kVp                                   | 1570 187 -                   |
|                                       |  | (iv.)  | Switching Impulse withstand voltage  | kVp                                   | 1175 - -                     |
|                                       |  | (v.)   | One min power frequency withstand voltage  | kVrms                                 | 630/38* 70 38                |
|                                       |  | (vi.)  | Winding connection   | -                                     | Star Delta Solidly Ground ed |
| Stage-I GT 201.67 MVA for Rihand STPP |  | Bid Doc. No.:  | TECHNICAL SPECIFICATIONS PART-B  | Sub-Section – I Technical Requirement | Page 17                      |

| Clause No.                            | TECHNICAL REQUIREMENTS   |   |  |                                       |            | Annex.-(02.06) |
|---------------------------------------|--|---|--|---------------------------------------|------------|----------------|
|                                       | (vii.)   | Insulation                                | -  | Graded                                | Uniform    | -              |
|                                       | * In case of non-uniformly insulated.  |   |  |                                       |            |                |
|                                       | (q.)   | Bushing Details                           |  |                                       |            |                |
|                                       | S.No.  | Parameter                                 | Unit   | HV                                    | LV         | HVN            |
|                                       | (i.)   | Rated Voltage                             | kV   | 420                                   | 36         | 36             |
|                                       | (ii.)  | Rated Current                             | A  | 1250                                  | 12500      | 1250           |
|                                       | (iii.)   | Lightning impulse withstand voltage       | kVp  | 1550**                                | 170        | 170            |
|                                       | (iv.)  | Switching Impulse withstand voltage       | kVp  | 1175                                  | -          | -              |
|                                       | (v.)   | One min power frequency withstand voltage | kVrms  | 750                                   | 70         | 70             |
|                                       | (vi.)  | Minimum total Creepage distance           | mm   | 10500                                 | 900        | 900            |
|                                       | (vii.)   | Mounting                                  | -  | Tank Cover                            | Tank Cover | Tank Cover     |
|                                       | ** The bushing shall be suitable for chopped wave lightning impulse test on transformer at 1570 KVp. |   |  |                                       |            |                |
|                                       | (r.)   | Tap changer Details                       |  |                                       |            |                |
|                                       | (i.)   | Tap Change Type                           | Off Circuit Tap Changer (OCTC)   |                                       |            |                |
|                                       | (ii.)  | Tap range                                 | ±10% in steps of 2.5% on HV neutral side.  |                                       |            |                |
|                                       | (s.)   | Termination Details                       |  |                                       |            |                |
|                                       | HV (phase)   |   | Twin Moose ACSR conductor with 450 mm sub-conductor spacing and horizontal/vertical takeoff. |                                       |            |                |
|                                       | HVN (Neutral)  |   | Matching with existing Neutral Formation   |                                       |            |                |
|                                       | LV(phase)  |   | Isolated Phase Bus duct.   |                                       |            |                |
|                                       | (t.)   | Partial Discharge levels (HV)             |  |                                       |            |                |
|                                       | Max. P.D. Level  |   |  |                                       | 500 pC     |                |
|                                       | Max. allowed change in PD after voltage enhancement  |   |  |                                       | 100 pC     |                |
| Stage-I GT 201.67 MVA for Rihand STPP |  | Bid Doc. No.:                             | TECHNICAL SPECIFICATIONS PART-B  | Sub-Section – I Technical Requirement | Page 18    |                |

| Clause No.  | TECHNICAL REQUIREMENTS   |  |                |             |                                 |                       |                                       | Annex.-(02.06)   |                      |       |  |  |  |  |
|---|--|--|----------------|-------------|---------------------------------|-----------------------|---------------------------------------|--|----------------------|-------|--|--|--|--|
| 2.00.00   | <b>(u.) CURRENT TRASFORMERS</b>  |  |                |             |                                 |                       |                                       |  |                      |       |  |  |  |  |
|   | NOMENCLATURE   | RATIO  | ACCURACY CLASS | BURDEN VA/Ω | KNEE POINT VOLTAGE              | EXCITING CURRENT (mA) | SECONDARY RESISTANCE Ohm              | PURPOSE  |                      |       |  |  |  |  |
|   | HV WTI C.T   | 931/5A S1-S2   | 5              | -           | -                               | -                     | -                                     | WTI C.T for HV   |                      |       |  |  |  |  |
|   | HV Differential & REF Protection   | 1000/1A 4S1-4S2                                      | X(PS)          | -           | -                               | -                     | -                                     | HV Differential & REF Protection                             |                      |       |  |  |  |  |
|   | Overcurrent & Earth fault (Inst.) & pole slipping protection   | 1000/1A 3S1-3S2                                      | 30 VA 5P20/1.0 | -           | -                               | -                     | -                                     | Overcurrent & Earth fault (Inst.) & pole slipping protection |                      |       |  |  |  |  |
|   | Instrument CTs   | 1000/1A 2S1-2S2                                      | 30 VA 0.5      | -           | -                               | -                     | -                                     | Instrument C.Ts  |                      |       |  |  |  |  |
|   | 2nd Circulating current Protection CTs   | 1000/1 1S1-1S2                                       | X(PS)          | -           | -                               | -                     | -                                     | 2nd Circulating current Protection CTs                       |                      |       |  |  |  |  |
|   | LV WTI CT  | 10083/5 S1-S2  | 5              | -           | -                               | -                     | -                                     | WTI C.T. for LV  |                      |       |  |  |  |  |
|   | 1st Circulating current Protection CTs at Neutral  | 1000/1 1S1-1S2                                       | X(PS)          | -           | -                               | -                     | -                                     | 1st Circulating current Protection C.Ts at Neutral           |                      |       |  |  |  |  |
|   | Standby Earth fault Neutral CT   | 1000/1 2S1-2S2                                       | 15 VA 5P10     | -           | -                               | -                     | -                                     | Standby Earth fault Neutral CT                               |                      |       |  |  |  |  |
|   | Restricted Earth fault Neutral CT  | 1000/1 3S1-3S2                                       | X(PS)          | -           | -                               | -                     | -                                     | Restricted Earth fault Neutral C.T.                          |                      |       |  |  |  |  |
| 2.01.00   | <b>Other Requirements</b>  |  |                |             |                                 |                       |                                       |  |                      |       |  |  |  |  |
|   | <div>1) Minimum phase spacing of the isolated phase bus ducts shall be about 1800 mm. LV Terminal spacing shall match this. Exact value would be intimated to successful bidder during detailed engineering.</div> <div>2) Ground and Phase Clearance :<br/>The minimum electrical clearance between any earthed object and live part for 400 kV shall be 3500 mm.</div> <div>3) The impedance of each single-phase unit shall have to be identical as far as possible and variation of impedance of any single-phase unit shall be within ± 5% of impedance of other two units.</div> |  |                |             |                                 |                       |                                       |  |                      |       |  |  |  |  |
| <b>GENERAL</b>  |  |  |                |             |                                 |                       |                                       |  |                      |       |  |  |  |  |
| <b>STANDARDS</b>  |  |  |                |             |                                 |                       |                                       |  |                      |       |  |  |  |  |
| All equipment provided under the specification shall in general, conform to the latest issue of the following standards:  |  |  |                |             |                                 |                       |                                       |  |                      |       |  |  |  |  |
| <table><tr><td>Indian Standards No.</td><td>Title</td><td>International &amp; internationally recognized standards</td></tr><tr><td> </td><td> </td><td> </td></tr></table> |  |  |                |             |                                 |                       |                                       |  | Indian Standards No. | Title | International & internationally recognized standards |  |  |  |
| Indian Standards No.  | Title  | International & internationally recognized standards |                |             |                                 |                       |                                       |  |                      |       |  |  |  |  |
|   |  |  |                |             |                                 |                       |                                       |  |                      |       |  |  |  |  |
| Stage-I GT 201.67 MVA for Rihand STPP   |  |  | Bid Doc. No.:  |             | TECHNICAL SPECIFICATIONS PART-B |                       | Sub-Section – I Technical Requirement |  |                      |       |  |  |  |  |
|   |  |  |                |             |                                 |                       | Page19                                |  |                      |       |  |  |  |  |

| Clause No.                            | TECHNICAL REQUIREMENTS <b><u>Annex.-(02.06)</u></b> |   |                                 |                                       |
|---------------------------------------|---|---|---------------------------------|---------------------------------------|
|                                       | (1)   | (2)   | (3)                             |                                       |
|                                       | IS: 2026  | Power Transformers  | IEC: 60076                      |                                       |
|                                       | IS: 3639  | Fittings & accessories for power transformers   |                                 |                                       |
|                                       |   | Insulating oil for transformer & switchgear   | IEC: 60296, BS:148              |                                       |
|                                       | IS: 2099  | Bushing for alternating voltages above 1000 V   | IEC: 60137, BS: 223             |                                       |
|                                       | IS: 2705  | Current transformers  | IEC: 60044-1                    |                                       |
|                                       | IS: 325   | Three phase induction motors  | IEC: 60034                      |                                       |
|                                       | IS: 3637  | Gas operated relays   |                                 |                                       |
|                                       | IS: 10028   | Code of practice for selection installation & maintenance of transformers                                 |                                 |                                       |
|                                       | IS: 4691  | Degree of protection provided by enclosure for rotating electrical machinery                              |                                 |                                       |
|                                       | IS: 13947   | Degree of protection provided by enclosure for low voltage switchgear & control                           | IEC: 60144                      |                                       |
|                                       | IS : 5  | Colours for ready mix paints  |                                 |                                       |
|                                       | IS: 1866  | Code of practice for maintenance & Supervision of mineral insulating oil in equipment                     |                                 |                                       |
|                                       | IS: 6272  | Industrial cooling fans   |                                 |                                       |
|                                       | IS: 6600  | Guide for Loading of oil immersed transformers  | IEC: 60076-7                    |                                       |
|                                       | IS: 3347  | Specification for dimensions of porcelain bushing   |                                 |                                       |
|                                       |   | High voltage test technique   | IEC: 60060                      |                                       |
|                                       |   | Insulation co-ordination  | IEC: 60071                      |                                       |
|                                       |   | NEMA standard publication for Power transformers  | NEMA-TR-1                       |                                       |
|                                       | IS: 10597   | Code of practice for selection, Installation operation & maintenance of pumps for industrial applications |                                 |                                       |
|                                       | IS: 9434  | Guide for sampling & analysis of free & dissolved gas & oil from oil filled electrical equipment          | IEC: 60567                      |                                       |
|                                       | IS:10593  | Guide to the interpretation of Dissolved and free   | IEC : 60599                     |                                       |
|                                       |   |   |                                 |                                       |
| Stage-I GT 201.67 MVA for Rihand STPP |   | Bid Doc. No.:   | TECHNICAL SPECIFICATIONS PART-B | Sub-Section – I Technical Requirement |
|                                       |   |   |                                 | Page 20                               |



| Clause No.                            | TECHNICAL REQUIREMENTS  |   |                                 |                                       | Annex.-(02.06) |
|---------------------------------------|---|---|---------------------------------|---------------------------------------|----------------|
|                                       |   | gasses analysis   |                                 |                                       |                |
|                                       | IS: 12676   | Dimensions for OIP insulated condenser bushings   |                                 |                                       |                |
|                                       |   | Guidelines for conducting Design reviews for transformers 100MVA and 123KV and above    |                                 | Cigre SC 12 (working Group 12.22)     |                |
|                                       |   | Ability to withstand S.C.Test (Guidelines for conducting the Design review)             |                                 | IEC-60076 Part-5 (Point A.3)          |                |
|                                       | IS: 3203  | Code of practice for climatic proofing of Electrical equipment                          |                                 |                                       |                |
|                                       | 2.02.00   | The electrical installation shall meet the requirements of Indian Electricity act 2003. |                                 |                                       |                |
| 3.00.00                               | <b>PERFORMANCE</b><br><br>(a.) The generator transformer would step up the output of 500 MW Generator from generator voltage (20KV) to 400/√3 kV voltage for power evacuation. Generator Transformer should be suitable for back charging from HV side and used to step down for feeding loads through unit transformer.<br><br>(b.) Total cooling system of transformer with oil forced & air forced (OFAF) or oil directed air forced (ODAF) cooling shall be so designed that during total failure of power supply to cooling fans & oil pumps, the transformer shall be able to operate at full load for at least ten (10) minutes without the calculated winding <b>hot spot temperature exceeding 140 deg. C.</b><br><br>(c.) The maximum flux density in any part of the core & yoke at the rated MVA, voltage & frequency shall be such that under <b>110% continuous voltage</b> condition it does <b>not exceed 1.9 tesla.</b><br><br>(d.) The transformer & all its accessories including CTs etc, shall be designed to withstand without injury the thermal & mechanical effects of any external short circuit to earth & of short circuits at the terminal of any winding for a <b>period of 3 secs</b> Contractor shall submit the short circuit withstands calculations assuming maximum operating voltages.<br><br>(e.) Transformers shall withstand, without injurious heating, combined voltage & frequency fluctuations, which produce the following over fluxing condition:<br><br>110 %                      - continuous<br><br>125%                        - for one minute<br><br>140%                        - for five seconds<br><br>Bidder shall indicate 150% & 170% over voltage withstand time. Over fluxing characteristics up to 170 % shall be submitted. |   |                                 |                                       |                |
| Stage-I GT 201.67 MVA for Rihand STPP |   | Bid Doc. No.:   | TECHNICAL SPECIFICATIONS PART-B | Sub-Section – I Technical Requirement | Page 21        |

| Clause No.                               | TECHNICAL REQUIREMENTS <u>Annex.-(02.06)</u>   |   |                                       |  |         |
|--|--|---|---------------------------------------|--|---------|
| 4.00.00                                  | <p>(f.) The air core reactance of HV winding of transformers shall not be less than 20%.</p> <p>(g.) The transformers shall be capable of being operated continuously without danger on any tapping at the rated KVA with voltage variation of ± 10% corresponding to the voltage of tapping.</p> <p>(h.) The transformers shall be capable of being loaded in accordance with IS: 6600 / IEC: 60076-7 up to load of 150 %. There shall be no limitation imposed by bushings, tap changers etc. or any other associated equipment.</p> <p>(i.) Max oil velocity shall be such that it does not lead to static discharges inside the transformer with all unit coolers working.</p> <p><b>CONSTRUCTION</b></p> <p>The features &amp; construction details of each transformer shall be in accordance with the requirement stated hereunder.</p> |   |                                       |  |         |
|  | 4.01.00  | <p><b><u>TANK AND TANK ACCESSORIES</u></b></p> <p>(a.) Tank shall be of welded construction &amp; fabricated from tested quality low carbon steel of adequate thickness. The welding procedure specified (WPS), procedure qualification record (PQR), shop welding schedule, welder's qualification shall be subject to Owner's approval. After completion of welding, all joints shall be subjected to dye penetration testing. Weld joints at all load bearing member shall be left unpainted till carrying out of jacking test followed by DP test during final inspection of transformer. Details of acceptance norms of welding shall be submitted for Owner's approval which shall include permissible undercut, overlap, surface crack, porosity, out of alignment of plate surface in butt joints, maximum gap due to incorrect fit up of fillet joint etc.</p> <p>(b.) Transformers shall be with bell type tank with the joint at about 500-mm above the bottom of the tank.</p> <p>(c.) Each tank shall be provided with :</p> <div><div>1)</div><div>Lifting lug suitable for lifting the equipment complete with oil.</div></div> <div><div>2)</div><div>A minimum of four jacking pads in accessible position to enable the transformer complete with oil to be raised or lowered using hydraulic or mechanical screw jacks.</div></div> <div><div>3)</div><div>Suitable haulage holes shall be provided for transformer wheeling in all four directions.</div></div> <div><div>4)</div><div>Four number lifting pads on the bell tank cover shall be provided with a purpose to lift the tank cover for rim gasket replacement</div></div> <p>(d.) The transformers are to be provided with flanged bi-directional wheels &amp; axles &amp; shall be mounted on wheels on foundation. Suitable locking arrangement shall be provided for the wheels to prevent accidental movement of transformer. The <b>rail track gauge shall be 1676 mm</b> along longer axis as well as along shorter axis.</p> |                                       |  |         |
|  |  |   |                                       |  |         |
| Stage-I GT 201.67 MVA<br>for Rihand STPP |  | Bid Doc. No.:   | TECHNICAL<br>SPECIFICATIONS<br>PART-B | Sub-Section – I<br>Technical Requirement | Page 22 |

| Clause No.   | TECHNICAL REQUIREMENTS  |   |   |                                       | Annex.-(02.06) |  |       |          |                    |    |   |   |    |                  |          |
|--|---|---|---|---------------------------------------|----------------|--|-------|----------|--------------------|----|---|---|----|------------------|----------|
| 4.02.00  | (e.) At least two adequately sized inspection openings one at each end of the tank shall be provided for easy access to bushing & earth connections. The inspection covers shall not weight more than 25 Kg. Handles shall be provided on the inspection cover to facilitate lifting. |   |   |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
|  | (f.) Metal parts surrounding the conductor of individual phase for LV shall be nonmagnetic.   |   |   |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
|  | (g.) All bolted connections shall be fitted with weather proof & hot oil resistant of ‘O’ ring of Nitrile rubber in between for complete oil tightness. If gasket is compressible, metallic stops shall be provided to prevent over compression.                                      |   |   |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
|  | <b>Core</b>   |   |   |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
|  | (a.) The core shall be constructed from high-grade non-aging, cold rolled, super grain oriented, silicon steel laminations, known as HI-B steel trade name.   |   |   |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
|  | (b.) The insulation of core to bolts & core to clamp plates shall be able to withstand a voltage of 10 kV (rms.) for 1 minute in air.   |   |   |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
|  | (c.) In order to ensure prevention of multiple core earthing, core isolation test at 10 kV for 1 minute shall be done during pre commissioning stage. To facilitate above, the core earthing has to be done outside the tank with suitable bushing.                                   |   |   |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
|  | (d.) Adequate lifting lugs will be provided to enable the core & windings to be lifted.   |   |   |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
|  | 4.03.00   | <b>Windings</b>   |   |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
|  |   | (a.) The contractor shall ensure that windings are made in dust proof & conditioned atmosphere. The bidder shall furnish details of the facilities available at his works along with the bid.   |   |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
| (b.) The conductors shall be of electrolytic grade copper free from scales & burrs.            |   |   |   |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
| (c.) All windings of the transformers having voltage less than 66 kV shall be fully insulated. |   |   |   |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
| (d.) All windings of GT shall have thermally upgraded paper covering insulation.               |   |   |   |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
| (e.) For GT winding paper moisture shall be less than 0.5%.                                    |   |   |   |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
| 4.04.00  |   | <b>Insulating Oil</b>   |   |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
|  |   | No inhibitors shall be used in the transformer oil. The oil supplied with transformers shall be new and previously unused and must conform to following while tested at supplier’s premises and shall have following parameters.                                      |   |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
|  |   | <table><tr><th>S.No.</th><th>Property</th><th>Permissible values</th></tr><tr><td>1.</td><td>Kinematic Viscosity, mm<sup>2</sup>/s</td><td>≤ 12.0 at 40 ° C<br/>≤ 1800.0 at (-)30 ° C</td></tr><tr><td>2.</td><td>Flash Point, ° C</td><td>≥ 140° C</td></tr></table> |   |                                       |                |  | S.No. | Property | Permissible values | 1. | Kinematic Viscosity, mm <sup>2</sup> /s | ≤ 12.0 at 40 ° C<br>≤ 1800.0 at (-)30 ° C | 2. | Flash Point, ° C | ≥ 140° C |
|  |   | S.No.   | Property                                  | Permissible values                    |                |  |       |          |                    |    |   |   |    |                  |          |
|  | 1.  | Kinematic Viscosity, mm <sup>2</sup> /s   | ≤ 12.0 at 40 ° C<br>≤ 1800.0 at (-)30 ° C |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
|  | 2.  | Flash Point, ° C  | ≥ 140° C                                  |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
|  |   |   |   |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
|  |   |   |   |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
|  |   |   |   |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
|  |   |   |   |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
|  |   |   |   |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
|  |   |   |   |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
|  |   |   |   |                                       |                |  |       |          |                    |    |   |   |    |                  |          |
| Stage-I GT 201.67 MVA for Rihand STPP  |   | Bid Doc. No.:   | TECHNICAL SPECIFICATIONS PART-B           | Sub-Section – I Technical Requirement | Page 23        |  |       |          |                    |    |   |   |    |                  |          |

| Clause No.                            | TECHNICAL REQUIREMENTS |   |   | Annex.-(02.06)                        |         |
|---------------------------------------|------------------------|---|---|---------------------------------------|---------|
|                                       |                        |   |   |                                       |         |
|                                       | S.No.                  | Property  | Permissible values                              |                                       |         |
|                                       | 3.                     | Pour point, ° C   | ≤ (-)40 ° C                                     |                                       |         |
|                                       | 4.                     | Appearance  | Clear , free from sediment and suspended matter |                                       |         |
|                                       | 5.                     | Density kg/dm³ at 20 ° C  | ≤ 0.895   |                                       |         |
|                                       | 6.                     | Interfacial Tension N/m at 25° C  | ≥ 0.04  |                                       |         |
|                                       | 7.                     | Neutralisation value, mg KOH/g  | ≤ 0.01  |                                       |         |
|                                       | 8.                     | Corrosive sulphur   | Non Corrosive                                   |                                       |         |
|                                       | 9.                     | Water content mg/kg   | ≤ 30 in bulk supply<br>≤ 40 in drum supply      |                                       |         |
|                                       | 10.                    | Anti oxidants additives   | Not detectable                                  |                                       |         |
|                                       | 11.                    | Oxidation Stability<br>Neutralisation value, (mgKOH/g)<br>Sludge, % by mass | ≤ 1.2<br>≤ 0.8                                  |                                       |         |
|                                       | 12.                    | Breakdown voltage<br>As delivered, kV<br>After treatment, kV                | ≥ 30<br>≥ 70                                    |                                       |         |
|                                       | 13.                    | Dissipation factor, at 90°C<br>And 40 Hz to 60 Hz                           | ≤ 0.005   |                                       |         |
|                                       | 14.                    | PCA content   | ≤1%   |                                       |         |
|                                       | 15.                    | Impulse withstand Level, kVp  | ≥ 145   |                                       |         |
|                                       | 16.                    | Gassing tendency at 50 Hz after 120 min, mm³/min                            | ≤ 5   |                                       |         |
|                                       |                        |   |   |                                       |         |
| Stage-I GT 201.67 MVA for Rihand STPP |                        | Bid Doc. No.:   | TECHNICAL SPECIFICATIONS PART-B                 | Sub-Section – I Technical Requirement | Page 24 |

| Clause No.  | TECHNICAL REQUIREMENTS                      |  |                                       |  | Annex.-(02.06) |
|---|---|--|---------------------------------------|--|----------------|
| 4.05.00<br><br>4.05.01  | Subsequently oil samples shall be drawn at: |  |                                       |  |                |
|   | 1)  | Before filling in main tank at site & tested for                           |                                       |  |                |
|   | i)  | BDV  | 60 kV (min)                           |  |                |
|   | ii)   | Moisture content   | 10 ppm (max.)                         |  |                |
|   | iii)  | Tan delta at 90 deg. C   | 0.005 (max.)                          |  |                |
|   | iv)   | Interfacial tension  | 0.04 N/m(min)                         |  |                |
|   | 2)  | Prior to energization at site for following properties & acceptance norms: |                                       |  |                |
|   | i)  | BDV  | 60 kV (MIN)                           |  |                |
|   | ii)   | Moisture content   | 10 ppm (max.)                         |  |                |
|   | iii)  | Tan delta at 90 deg. C   | 0.05 (max.)                           |  |                |
| iv)   | Interfacial tension                         | 0.035 N/m (min)  |                                       |  |                |
| <b>Terminal Arrangements</b>  |   |  |                                       |  |                |
| <b><u>Bushings</u></b>  |   |  |                                       |  |                |
| (a.) The electrical & mechanical characteristics of bushings shall be in accordance with IS: 2099, IS: 3347 & IS: 12676.  |   |  |                                       |  |                |
| (b.) Bushing for 52 KV & above shall be of <b>Resin Impregnated Paper (RIP)</b> with composite insulator. Bushing for rating below 52 KV, shall be solid porcelain/ condenser/ RIP (Resin impregnated Paper) type. All condenser bushings shall be non-communicating type.  |   |  |                                       |  |                |
| (c.) All composite resin impregnated bushings (RIP) shall be provided with provision for long term storage to protect from moisture and rodents. The oil side shall be provided with tank which can be filled with oil. Tank shall have necessary provision for oil filling, level gauge etc. Suitable covering to be provided on air side to protect from any damage. The arrangement shall be suitable for storage in horizontal/ vertical direction in outdoor location. |   |  |                                       |  |                |
| (d.) The oil end dimension of RIP bushing shall be same for all bushings of similar voltage rating.   |   |  |                                       |  |                |
| (e.) Condenser type bushings shall be provided with:  |   |  |                                       |  |                |
| i) Oil level gauge  |   |  |                                       |  |                |
| ii) Oil filling plug  |   |  |                                       |  |                |
| iii) Tap for capacitance and Tan delta test   |   |  |                                       |  |                |
| (f.) Clamps & fittings shall be of hot dip galvanized steel.  |   |  |                                       |  |                |
| Stage-I GT 201.67 MVA<br>for Rihand STPP  |   | Bid Doc. No.:  | TECHNICAL<br>SPECIFICATIONS<br>PART-B | Sub-Section – I<br>Technical Requirement | Page 25        |

| Clause No.                               | TECHNICAL REQUIREMENTS <u>Annex.-(02.06)</u>  |  |                                       |  |
|--|---|--|---------------------------------------|--|
| 4.05.02                                  | <p>(g.) Bushing &amp; fittings shall be provided with vent pipes that shall be connected to route any gas collection through the Buchholz relay.</p> <p>(h.) No arcing horns shall be provided on the bushings.</p> <p>(i.) LV Bushing palm shall be Silver/Tin plated.</p> <p><b><u>Bus Duct Terminations</u></b></p> <p>(a.) For termination of bus duct a flanged throat or equivalent connection shall be provided for termination of bus duct enclosure. The LV winding termination shall be on outdoor type of bushings. <b>Transformer supplier would provide necessary flexible connection along with all accessories including bellows, hardware</b> etc between the bushing terminal &amp; the bus duct conductor. The material of the bus duct termination shall be non-magnetic. A drain with stopcock arrangement shall be provided at flange to drain leakage of oil/water at termination. As bus duct will be pressurized stopcocks shall be airtight.</p> <p>(b.) Tolerance permissible for the height of the terminal connected to bus duct over rail top level is ± 10 mm. Contractor has to ensure that coolers &amp; conservator do not obstruct the path of the bus ducts in position &amp; during movement of transformer. The contractor shall co-ordinate final design of terminal arrangement to suit bus duct arrangement during detailed engineering.</p> <p>(c.) The transformer bushing enclosed in bus duct enclosure shall be designed for satisfactory operation in the high ambient temperature existing inside the bus duct enclosure. The temperature inside the bus duct enclosure may be of the order of 90 – 100 deg. C. The bus duct conductor temperature may be as high as 105 deg. C &amp; temperature in the bus duct enclosure will be of the order of 80 deg. C.</p> |  |                                       |  |
|  | 4.05.03   | <p><b><u>TERMINAL CONNECTOR</u></b></p> <p>(a.) Bushing terminal shall be provided with terminal connectors of approved type &amp; size for connection to external part. Terminal connectors must have been successfully type tested as per IS: 5561.</p> <p>(b.) Terminal connectors shall be coordinated with the Employer. These shall be suitable for either horizontal or vertical take-off.</p> <p>(c.) Aluminum alloy if used shall conform to designation 4600 M of IS: 617 or of better quality.</p> <p>(d.) No part of a clamp shall be less than 10 mm thick.</p> <p>(e.) All ferrous parts shall be hot dip galvanized conforming to IS: 2633.</p> <p>(f.) For bi-metallic clamp, copper alloy liner of minimum 2-mm thickness shall be cast integral with aluminum body. Alternatively Bidder may offer bimetallic connector with loose bimetallic sleeve.</p> <p>(g.) Flexible connectors shall be made from tinned copper sheets.</p> <p>(h.) Size of terminal/conductor for which the clamp is suitable &amp; rated current under the conditions shall be embossed/ punched on each component of the clamp, except hardware.</p> |                                       |  |
| Stage-I GT 201.67 MVA<br>for Rihand STPP |   | Bid Doc. No.:  | TECHNICAL<br>SPECIFICATIONS<br>PART-B | Sub-Section – I<br>Technical Requirement |
|  |   |  |                                       | Page 26                                  |

| Clause No.                            | TECHNICAL REQUIREMENTS <b><u>Annex.-(02.06)</u></b>  |               |                                 |                                       |
|---------------------------------------|--|---------------|---------------------------------|---------------------------------------|
|                                       | <p>(i.) Rated current of the terminal connectors shall be same as that of corresponding bushing. However the short circuit current for 400 kV connectors shall be 63 kA for 3 secs.</p>  |               |                                 |                                       |
| <b>4.06.00</b>                        | <p><b><u>Bushing Current Transformer</u></b></p> <p>(a.) Current transformer shall comply with IS: 2705/IEC 60044-1.</p> <p>(b.) It shall be possible to remove turret mounted current transformers from the transformer tank without removing the tank cover. Necessary precautions shall be taken to minimize eddy currents &amp; local heat generated in the turret.</p> <p>(c.) All secondary leads shall be brought to a weatherproof terminal box near each bushing. These terminals shall be wired out to cooler control cabinet using separate cables for each core.</p>   |               |                                 |                                       |
| <b>4.07.00</b>                        | <p><b><u>Terminal Marking</u></b></p> <p>The terminal marking &amp; their physical position shall be as per IS: 2026 unless specified otherwise.</p>   |               |                                 |                                       |
| <b>4.08.00</b>                        | <p><b><u>HV Neutral Earthing Arrangement</u></b></p> <p>(a.) The neutral terminals of winding of three single phase transformers shall be connected to an overhead common copper grounding bars, supported from tank and firewalls by using porcelain insulators. <b>Puncturing of firewall shall not be permitted.</b></p> <p>(b.) The neutral of transformers shall be brought through insulated support from tank to the ground level at a convenient point to match <b>with existing neutral formation</b>, The connection shall be made by using two (2) bolted neutral grounding terminals with necessary accessories.</p>   |               |                                 |                                       |
| <b>4.09.00</b>                        | <p><b><u>Common Marshalling Box (CMB), Cooler Control Cabinet (CCC) Unit</u></b></p> <p>(a.) Each transformer shall be provided with one cooler control cabinet housing all the cooler control, OTI, WTI for each winding etc. for one unit. Alternatively the contractor may provide two different boxes; one for housing cooler controls named as cooler control cabinet &amp; separate box for housing OTI, WTI etc. named as Marshalling box. <b>One common marshalling box shall be provided for three single phase Generator Transformers.</b> These boxes shall not obstruct removal of any of the transformer phases.</p> <p>(b.) The marshalling box shall be of stainless steel (SS-316 or better) and shall be at least 2.5 mm thick. The gasket used shall be of neoprene rubber. A space heater &amp; cubicle lighting with on – off switch shall be provided in each cabinet. A circuit breaker/contactors with thermal overload device for controlling the AC auxiliary supply shall be provided.</p> |               |                                 |                                       |
| Stage-I GT 201.67 MVA for Rihand STPP |  | Bid Doc. No.: | TECHNICAL SPECIFICATIONS PART-B | Sub-Section – I Technical Requirement |
|                                       |  |               |                                 | Page 27                               |

| Clause No.                            | TECHNICAL REQUIREMENTS <u>Annex.-(02.06)</u>   |                                 |                                       |         |
|---------------------------------------|--|---------------------------------|---------------------------------------|---------|
|                                       | <p>(c.) <b>Terminal Blocks</b></p> <p>1) The terminal blocks to be provided shall be fully enclosed with removable covers &amp; made of molded, non-inflammable plastic material with blocks &amp; barriers molded integrally. The terminal blocks shall be 1100V grade &amp; have 10 A continuous rating. Terminal blocks for current transformer secondary leads shall be provided with test links &amp; isolating facilities. Also current transformer secondary leads shall be provided with short circuiting &amp; earthing facilities. At least 20% spare terminals shall be provided on each panel &amp; these spare terminals shall be uniformly distributed on all terminal blocks.</p> <p>2) Terminal blocks shall be suitable for connecting the following conductors on each side :</p> <p>i) <u>Current transformer circuits</u>: Minimum of two No. of 2.5 sq. mm copper wires each side</p> <p>ii) <u>Other circuits</u> : Minimum of one No. of 2.5 sq. mm copper wire each side</p> <p>(d.) All CT terminals shall be provided as fixed type terminals on the Marshalling Box to avoid any hazard due to loose connection leading to CT opening or any other loose connection. In no circumstances Plug In type connectors shall be used for CT connection. TB shall be stud type for all CT's &amp; Power connections.</p> <p>(e.) Where apparatus is mounted on panels, all metal cases shall be separately earthed by means of copper wires or strips having a cross section of not less than 2 sq mm where strip is used, joints shall be sweated.</p> <p>(f.) Terminal board rows shall be spaced adequately not less than 100mm apart to permit convenient access to wires and terminations.</p> <p>(g.) CMB incomer shall be suitable for 1CX300mm sq (max) armour aluminium cable per phase as incomer. Suitable space for termination &amp; bending of cable to be provided.</p> <p>(h.) The temperature indicators shall be so mounted that the dials are not more than 1500 mm from ground level. Glazed door of suitable size shall be provided for convenience of reading.</p> <p>(i) Cooler control cabinet / marshalling box shall be suitable for IP 55 protection in accordance with IS: 13947.</p> <p>(j.) One dummy terminal block in between each trip wire terminal shall be provided.</p> <p>(k.) <b>Common kiosk</b> shall have two compartments one for AC power supply arrangement and other for CT and control cable, as high temp. inside kiosks make CT cables brittle.</p> <p>(l.) Wiring scheme shall be engraved in a plate (MS) and the same shall be fixed inside the Marshalling box door.</p> <p>(m.) CCC shall preferably be Tank Mounted</p> |                                 |                                       |         |
| Stage-I GT 201.67 MVA for Rihand STPP | Bid Doc. No.:  | TECHNICAL SPECIFICATIONS PART-B | Sub-Section – I Technical Requirement | Page 28 |



| Clause No.                               | TECHNICAL REQUIREMENTS  |               |                                       |  | Annex.-(02.06) |
|--|---|---------------|---------------------------------------|--|----------------|
| 4.10.00                                  | Auxiliary Power Supply For Coolers  |               |                                       |  |                |
| 4.10.01                                  | Two Auxiliary power supplies at 415 V three phase four wires shall be provided by Employer at CMB. All loads shall be fed by one of the two feeders through an electrically interlocked automatic transfer switch housed in CMB. Design features of the transfer switch shall include the following:<br><br>(a.) Provision for the selection of one of the feeder as normal source & other as standby.<br><br>(b.) Upon failure of the normal source, the loads shall automatically transfer, after an adjustable time delay, to standby source.<br><br>(c.) Indication to be provided for failure of normal source & for transfer to standby source.<br><br>(d.) Automatic retransfer to normal source without any intentional time delay following re-energization of the normal source.<br><br>(e.) Both the transfer & the re- transfer shall be dead transfers & AC feeders shall not be paralleled at any time.<br><br>(f.) Isolating switches shall be provided to isolate each unit cooler individually so as to facilitate maintenance work separately on each cooler without affecting other coolers. |               |                                       |  |                |
| 4.10.02                                  | The contractor shall derive AC feeders for cooler control cabinets after suitable selection at CMB for which description is given above. The supplier shall derive AC supply for control circuitry from the AC feeder as mentioned above by using appropriately rated dry type transformer. If the control circuit is operated by DC supply, then suitable main & standby converters shall be provided by the supplier to be operated from AC feeder.   |               |                                       |  |                |
| 4.11.00                                  | Control Wiring & Cabling.<br>Supply, laying & termination of all cables & accessories required of proper termination from the CCC except for those stated under next clause below so as to make equipment complete & functional shall be in scope of supplier. The cable between the CCC & transformer shall be laid by the supplier through GI conduits/ pipes. Cable box / sealing end shall be suitable for following types of cables:<br><br>1) <b>415 V power</b> : 1100 V grade PVC insulated aluminum conductor cable with armour.<br>2) <b>Control</b> : 1100 V grade PVC insulated 2.5 sq. mm stranded copper conductor with armour  |               |                                       |  |                |
| 4.12.00                                  | Following cabling is specifically excluded from the scope of the Bidder, however interconnection drawings for the same are to be submitted by the contractor:<br>(a.) Cabling between Employer’s unit control panel to CMB.<br><br>All the control cables for Employer’s unit control panel shall be wired by the contractor up to CMB  |               |                                       |  |                |
| Stage-I GT 201.67 MVA<br>for Rihand STPP |   | Bid Doc. No.: | TECHNICAL<br>SPECIFICATIONS<br>PART-B | Sub-Section – I<br>Technical Requirement | Page 29        |

| Clause No.  | TECHNICAL REQUIREMENTS  |  |                                 |                                       | Annex.-(02.06) |               |             |           |  |   |          |                   |  |  |               |                    |                         |   |                |                    |                                |   |                |                    |
|---|---|--|---------------------------------|---------------------------------------|----------------|---------------|-------------|-----------|--|---|----------|-------------------|--|--|---------------|--------------------|-------------------------|---|----------------|--------------------|--------------------------------|---|----------------|--------------------|
| 4.13.00   | <b>PAINTING</b><br>Painting of transformer and its accessories shall be in accordance with the following chart.   |  |                                 |                                       |                |               |             |           |  |   |          |                   |  |  |               |                    |                         |   |                |                    |                                |   |                |                    |
|   | <table><tr><th>PARTS NAME</th><th>TYPE OF PAINT</th><th>NO.OF COATS</th><th>TOTAL DFT</th></tr><tr><td>Inside of tank and accessories (except CM Box and CCC)</td><td>Oil &amp; heat resistant fully glossy white</td><td>One coat</td><td>Atleast 30 micron</td></tr><tr><td>External surface of transformer and accessories including CM Box/CCC (except Cooler)</td><td>Chemical resistant epoxy zinc phosphate primer, MIO (Micaceous iron oxide) as intermediate paint followed by polyurethane finish paint (RAL 5012 Blue)</td><td>One coat each</td><td>Atleast 100 micron</td></tr><tr><td>External Cooler surface</td><td>Anticorrosive primary paint followed by high quality full glossy outer finish paint (RAL 5012 Blue)</td><td>Two coats each</td><td>Atleast 100 micron</td></tr><tr><td>Internal surface of CM Box/CCC</td><td>Chemical resistant epoxy zinc phosphate primer followed by chemical and heat resistant epoxy enamel white paint</td><td>Two coats each</td><td>Atleast 100 micron</td></tr></table> |  |                                 |                                       | PARTS NAME     | TYPE OF PAINT | NO.OF COATS | TOTAL DFT | Inside of tank and accessories (except CM Box and CCC) | Oil & heat resistant fully glossy white | One coat | Atleast 30 micron | External surface of transformer and accessories including CM Box/CCC (except Cooler) | Chemical resistant epoxy zinc phosphate primer, MIO (Micaceous iron oxide) as intermediate paint followed by polyurethane finish paint (RAL 5012 Blue) | One coat each | Atleast 100 micron | External Cooler surface | Anticorrosive primary paint followed by high quality full glossy outer finish paint (RAL 5012 Blue) | Two coats each | Atleast 100 micron | Internal surface of CM Box/CCC | Chemical resistant epoxy zinc phosphate primer followed by chemical and heat resistant epoxy enamel white paint | Two coats each | Atleast 100 micron |
|   | PARTS NAME  | TYPE OF PAINT  | NO.OF COATS                     | TOTAL DFT                             |                |               |             |           |  |   |          |                   |  |  |               |                    |                         |   |                |                    |                                |   |                |                    |
|   | Inside of tank and accessories (except CM Box and CCC)  | Oil & heat resistant fully glossy white  | One coat                        | Atleast 30 micron                     |                |               |             |           |  |   |          |                   |  |  |               |                    |                         |   |                |                    |                                |   |                |                    |
|   | External surface of transformer and accessories including CM Box/CCC (except Cooler)  | Chemical resistant epoxy zinc phosphate primer, MIO (Micaceous iron oxide) as intermediate paint followed by polyurethane finish paint (RAL 5012 Blue) | One coat each                   | Atleast 100 micron                    |                |               |             |           |  |   |          |                   |  |  |               |                    |                         |   |                |                    |                                |   |                |                    |
|   | External Cooler surface   | Anticorrosive primary paint followed by high quality full glossy outer finish paint (RAL 5012 Blue)  | Two coats each                  | Atleast 100 micron                    |                |               |             |           |  |   |          |                   |  |  |               |                    |                         |   |                |                    |                                |   |                |                    |
| Internal surface of CM Box/CCC  | Chemical resistant epoxy zinc phosphate primer followed by chemical and heat resistant epoxy enamel white paint   | Two coats each   | Atleast 100 micron              |                                       |                |               |             |           |  |   |          |                   |  |  |               |                    |                         |   |                |                    |                                |   |                |                    |
| 4.14.00   |   |  |                                 |                                       |                |               |             |           |  |   |          |                   |  |  |               |                    |                         |   |                |                    |                                |   |                |                    |
| Cooling Equipment   |   |  |                                 |                                       |                |               |             |           |  |   |          |                   |  |  |               |                    |                         |   |                |                    |                                |   |                |                    |
| 4.14.01   |   |  |                                 |                                       |                |               |             |           |  |   |          |                   |  |  |               |                    |                         |   |                |                    |                                |   |                |                    |
| Cooling equipment for Generator Transformer   |   |  |                                 |                                       |                |               |             |           |  |   |          |                   |  |  |               |                    |                         |   |                |                    |                                |   |                |                    |
| Generator Transformer cooling shall be <b>OFAF/ODAF</b> . The cooling system for each single-phase transformer shall be independent & complete in itself. In addition cooling equipment shall conform to the requirement stipulated below:  |   |  |                                 |                                       |                |               |             |           |  |   |          |                   |  |  |               |                    |                         |   |                |                    |                                |   |                |                    |
| a.) Transformer cooling shall be affected by use of a No. of detachable type unit coolers. Capacity of each unit cooler shall be limited to maximum of 20% of the total cooling requirements. The coolers shall be tank mounted. The orientation of coolers shall be subject to Employer’s approval.  |   |  |                                 |                                       |                |               |             |           |  |   |          |                   |  |  |               |                    |                         |   |                |                    |                                |   |                |                    |
| b.) Each unit cooler shall have its own cooling fans, oil flow indicator, shut off valves at the top and bottom (80mm size) lifting lugs, top and bottom oil filling valves, air release plug at the top, a drain plug and sampling valve and thermometer pocket fitted with captive screw cap on the inlet and outlet. For GT all power contactor used for pump & fan motors shall be latch type. All oil pumps (cooler) shall be located at the cooler outlet pipe connected at the bottom of the tank. |   |  |                                 |                                       |                |               |             |           |  |   |          |                   |  |  |               |                    |                         |   |                |                    |                                |   |                |                    |
| c.) Total capacity of unit coolers furnished for each transformer shall be minimum 120% of actual requirements.   |   |  |                                 |                                       |                |               |             |           |  |   |          |                   |  |  |               |                    |                         |   |                |                    |                                |   |                |                    |
| Stage-I GT 201.67 MVA for Rihand STPP   |   | Bid Doc. No.:  | TECHNICAL SPECIFICATIONS PART-B | Sub-Section – I Technical Requirement | Page 30        |               |             |           |  |   |          |                   |  |  |               |                    |                         |   |                |                    |                                |   |                |                    |

| Clause No.                               | TECHNICAL REQUIREMENTS  | Annex.-(02.06)                        |  |         |
|--|---|---------------------------------------|--|---------|
|  | <p>(d.) Cooler fans &amp; oil pumps of all unit coolers (except standby cooler) shall operate continuously. Unit coolers shall automatically start by generator field breaker contact. Provision shall be kept to start the coolers by WTI contact. <b>Standby cooler shall automatically come into service in case failure of any running cooler.</b></p> <p>(e) There shall be provision in the cooler control logic to make any cooler bank as a stand by cooler in case of need &amp; that <b>Standby cooler shall automatically come into service in case failure of any running main cooler.</b></p> <p>(f.) Suitable manual control facility for cooler fans &amp; oil pumps shall be provided.</p> <p>(g.) Centrifugal or axial in line oil pumps shall be so designed that upon failure of power supply to the pump motor, the pump impeller shall not limit the natural circulation of oil.</p> <p>(h.) An oil flow indicator shall be provided for the confirmation of normal pump operation. An indicator shall be provided in the flow indicator to indicate reverse flow through the pump.</p> <p>(i.) Cooling fan &amp; oil pump motor shall be suitable for operation on <math>415 \pm 10\%</math> V, three phase, 50 Hz + 3%, -5% power supply &amp; shall conform to IS:325. Each cooling fan &amp; oil pump motors shall be provided with starter with thermal overload &amp; short circuit protection. The motor winding insulation shall be conventional <b>class F type</b>. Motor shall have enclosure with degree of protection equivalent to IP 55 as per IS: 4691. The temperature rise of the motor shall be limited to 70 deg. C above ambient of 50 deg. By winding resistance method &amp; shall comply with IS:325.</p> <p>(j.) <u>Fault Indicating device</u> - For each transformer, an alarm contact shall be furnished to indicate the unintended stoppage of a fan, pump or oil flow. The contractor shall also indicate if any additional lamp is required to be provided in Employer's control room.</p> <p>(k.) Following lamp indications shall be provided in CMB/CCC:</p> <div><div>1) Control supply failure (main)</div><div>2) Cooler supply changeover</div><div>3) Cooler supply failure (standby)</div><div>4) Control supply failure</div><div>5) Cooling unit failure for each unit cooler for GTs</div><div>6) More than two cooler bank failure for GT.</div><div>7) No oil/reverse oil flow for pumps</div><div>8) Common thermal overload trip</div></div> <p>One potential free initiating contact for all the above conditions including alarm for "supply fail to transfer" shall be wired independently to the terminal blocks of CMB exclusively for Employer's use.</p> |                                       |  |         |
| Stage-I GT 201.67 MVA<br>for Rihand STPP | Bid Doc. No.:   | TECHNICAL<br>SPECIFICATIONS<br>PART-B | Sub-Section – I<br>Technical Requirement | Page 31 |

| Clause No.                               | TECHNICAL REQUIREMENTS  |               |                                       |  | Annex.-(02.06) |
|--|---|---------------|---------------------------------------|--|----------------|
| 4.15.00                                  | <b>Off-circuit tap change switch.</b>   |               |                                       |  |                |
|  | <p>(a.) The tap change switch shall be single-phase hand operated for switching taps on single phase by operating an external hand wheel.</p> <p>(b.) The tap changing shall be possible without disturbing the transformer in any way except de-energizing.</p> <p>(c.) Arrangement shall be made for securing &amp; pad locking the tap changer in any of the working positions &amp; it shall not be possible for setting or padlocking it in any intermediate position. An indicating device shall be provided to show the tap in use.</p> <p>(d.) The cranking device for manual operation of the off-circuit tap changing gear shall be removable &amp; suitable for operation by a man standing on ground level. The mechanism shall be complete with the following :</p> <p>(1.) A mechanical operation indicator.</p> <p>(2.) Mechanical tap position indicator which shall be clearly visible from near the transformer.</p> <p>(3.) Mechanical stops to prevent over cranking of the mechanism beyond the extreme positions.</p> <p>(4.) The manual operating mechanism shall be labeled to show the direction of operations for raising the secondary voltage &amp; vice versa.</p> <p>(5.) A warning plate indicating “The switch shall be operated only when the transformer has been de-energized” shall be fitted.</p> <p>(e.) Measurement of Tan Delta values of OCTC to be done before installing in the transformer.</p> <p>(f.) Following signals to be provided:</p> <p>1. Out of step digital position indicator, showing mismatch between tap positions of transformers in three phases.</p> <p>2. An analog signal (4-20 mA) for tap position of transformer.</p> |               |                                       |  |                |
| 4.16.00                                  | <b>VALVES</b>   |               |                                       |  |                |
|  | <p>(a.) All valves upto and including <b>50mm</b> shall be of gun metal or of cast steel. Larger valves may be of gun metal or may have cast iron bodies with gun metal fittings. They shall be of full way type with internal screw and shall open when turned counter clockwise when facing the hand wheel.</p>   |               |                                       |  |                |
| Stage-I GT 201.67 MVA<br>for Rihand STPP |   | Bid Doc. No.: | TECHNICAL<br>SPECIFICATIONS<br>PART-B | Sub-Section – I<br>Technical Requirement | Page 32        |

| Clause No. | TECHNICAL REQUIREMENTS  |  |  |  | Annex.-(02.06) |
|------------|---|--|--|--|----------------|
| 4.17.00    | <p>(b.) Suitable means shall be provided for locking the valves in the open and close positions. Provision is not required for locking individual radiator valves.</p> <p>(c.) Each valve shall be provided with the indicator to show clearly the position of the valve.</p> <p>(d.) Gland packing/gasket material shall be of <b>“O” ring</b> of Nitrile rubber for all the valve’s flanges. All the flanges shall be machined.</p> <p>(e.) Oil sampling shall have provision to fix rubber hose <b>of 100mm</b> size to facilitate oil sampling.</p> <p>(f.) After testing, inside surface of all cast iron valves coming in contact with oil shall be applied with one coat of <b>oil resisting paint/varnish</b> with two coats of red oxide zinc chromate primer followed by two coats of fully glossy finishing paint conforming to IS:2932 and of a shade (Preferably red or yellow) distinct and different from that of main tank surface. Outside surface except gasket setting surface of butterfly valves shall be painted with two coats of red oxide zinc chromate conforming to IS:2074 followed by two coats of fully glossy finishing paint.</p> <p>(g) Sampling &amp; drain plug/valves should have zero leakage rate.</p> <p>(h) All hardware used shall be cadmium plated/electro galvanized.</p> |  |  |  |                |
|            | <p><b>Oil Preservation Equipment</b></p> <p>Bidder shall offer air cell type sealing in conservator to prevent oxidation and contamination of oil due to contact with water. The Bidder shall furnish his experience list for the system offered. The requirements of air cell type oil sealing system are given below.</p> <p>(a.) Contact of the oil with atmosphere is prohibited by using a flexible urethane or Nitrile rubber reinforced with nylon cloth air cell.</p> <p>(b.) The temperature of oil is likely to rise up to 110°C. As such air cell used shall be suitable for operating continuously at 110°C.</p> <p>(c.) Air cell of conservator shall be able to withstand the vacuum during installation/maintenance periods. Otherwise provision shall be kept to isolate the conservator from the main tank when the later is under vacuum by providing a vacuum sealing valve or other suitable means in the pipe connecting main tank with the conservator.</p> <p>(d.) The connection of air cell to the top of the reservoir is by air proof seal preventing entrance of air into the conservator.</p>  |  |  |  |                |
|            | <p><b>Conservator Tank</b></p>  |  |  |  |                |
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| Clause No.                               | TECHNICAL REQUIREMENTS   |   |                                       |  | Annex.-(02.06) |
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| 5.00.00<br><br>5.01.00                   | (a.) The conservator tank shall have adequate capacity between highest and lowest visible levels to meet the requirement of expansion of the total cold oil volume in the transformer and cooling equipment from minimum ambient temperature to 110 °C.            |   |                                       |  |                |
|  | (b.) The conservator shall be bolted in such a position so that it can be removed for cleaning purposes and suitable provision shall be kept to replace air cell in it.  |   |                                       |  |                |
|  | (c.) <b>Buchholz type gas detection relay with</b> alarm contacts, on top of the conservator to detect any gas bubbles from a ruptured conservator bag. Contacts to be wired down to the CMB.  |   |                                       |  |                |
|  | (d.) Conservator shall be provided in such a position so as not to obstruct the electrical connections.  |   |                                       |  |                |
|  | (e.) The conservator shall be fitted with magnetic oil level gauge with low level electrically insulated alarm contact.  |   |                                       |  |                |
|  | <b>Fittings</b>  |   |                                       |  |                |
|  | The following fittings shall be provided with each transformer covered in this specification:  |   |                                       |  |                |
|  | a)   | Conservator for main tank with oil filling hole and cap, isolating valves, drain valve, magnetic oil level gauge with low level alarm contacts. Breather shall be mounted not more <b>than 1400 mm above rail top</b> . Conservator shall be preferably tank mounted.   |                                       |  |                |
|  | b)   | Oil preservation system: - Air cell type.   |                                       |  |                |
|  | c)   | Minimum two Nos. of spring operated pressure relief devices with alarm/trip contacts. Discharge of PRD shall be properly taken through pipes & directed away from the transformer /other equipment. Armored cable be used between PRD to Marshalling box. PRD shall have DOP of IP-67. Plugin type connector shall be provided for proper sealing for terminating cables/ glands. |                                       |  |                |
| d)                                       | Buchholz relay (magnetic type) with isolating valves on both sides, bleeding pipe with Gas collecting device at the end to collect gases and alarm and trip contacts. Control cable termination at Buchhloz relay shall be properly sealed to prevent water entry. |   |                                       |  |                |
| e)                                       | Air release plug.  |   |                                       |  |                |
| f)                                       | Inspection openings and covers.  |   |                                       |  |                |
| g)                                       | Bushing with metal parts and gaskets to suit the termination arrangement.  |   |                                       |  |                |
| h)                                       | Cover lifting eyes, transformer lifting lugs, jacking pads, towing holes, core and winding lifting lugs & 4 nos. lifting pads on bell tank cover so as to lift bell tank cover for rim gasket replacement.   |   |                                       |  |                |
| i)                                       | Protected type Mercury or alcohol in glass thermometer.  |   |                                       |  |                |
| Stage-I GT 201.67 MVA<br>for Rihand STPP |  | Bid Doc. No.:   | TECHNICAL<br>SPECIFICATIONS<br>PART-B | Sub-Section – I<br>Technical Requirement | Page 34        |

| Clause No.                               | TECHNICAL REQUIREMENTS |  |                                       |  | Annex.-(02.06) |
|--|------------------------|--|---------------------------------------|--|----------------|
|  | j)                     | Bottom and top filter valves with threaded male adapters, bottom Sampling valve & drain valve.   |                                       |  |                |
|  | k)                     | Bilingual Rating and diagram plates on transformers and auxiliary apparatus.   |                                       |  |                |
|  | l)                     | Fans, Pumps and Coolers as specified.  |                                       |  |                |
|  | m)                     | Prismatic/toughened glass oil gauge for transformers   |                                       |  |                |
|  | n)                     | 150 mm dial type oil temp indicator with alarm and trip contacts, maximum reading pointer & resetting device. Accuracy class shall be ± 1.5 % or better.   |                                       |  |                |
|  | o)                     | 150 mm dial type Winding temp indicator for each winding with alarm and trip contacts, maximum reading pointer & resetting device. Accuracy class shall be ± 1.5 % or better.  |                                       |  |                |
|  | p)                     | Duplex platinum RTD to be provided for remote winding temp. indication. In addition atleast 2 nos of 4-20 mA signal shall be provided for Employer's DDCMIS. Any special cable required for shielding purpose for connection between CCC & remote WTI. |                                       |  |                |
|  | q)                     | Flanged bi-directional wheels /Trolley for movement.   |                                       |  |                |
|  | r)                     | Cooler control cabinet, Common Marshalling Box .   |                                       |  |                |
|  | s)                     | Off load tap changing gear.  |                                       |  |                |
|  | t)                     | Cooling equipment.   |                                       |  |                |
|  | u)                     | Bushing current transformers.  |                                       |  |                |
|  | v)                     | Insulating oil.  |                                       |  |                |
|  | w)                     | Drain valves/plugs shall be provided in order that each section of pipe work can be drained independently. Sludge valve at bottom most point of tank to be provided for easy flush out/removal of sludge during maintenance.                           |                                       |  |                |
|  | x)                     | Terminal marking plates.   |                                       |  |                |
|  | y)                     | Oil flow indicator   |                                       |  |                |
|  | z)                     | Valves schedule plates.  |                                       |  |                |
|  | aa)                    | Two (2) earthing terminals on all the equipment mounted separately suitable for connection to employer's suitable size flat along with 2 Nos. tapped holes M10 bolts etc.  |                                       |  |                |
|  | ab)                    | Rain hoods to be provided on Buchholz, MOG & PRV. Entry points of wires shall be suitably sealed.  |                                       |  |                |
|  | ac)                    | On line DGA Analyzer   |                                       |  |                |
| Stage-I GT 201.67 MVA<br>for Rihand STPP |                        | Bid Doc. No.:  | TECHNICAL<br>SPECIFICATIONS<br>PART-B | Sub-Section – I<br>Technical Requirement | Page 35        |

| Clause No.                            | TECHNICAL REQUIREMENTS  |   |                                 |                                       | Annex.-(02.06) |
|---------------------------------------|---|---|---------------------------------|---------------------------------------|----------------|
| 5.02.00                               | ad)   | Online moisture removal system  |                                 |                                       |                |
|                                       | ae)   | Conservator air cell rupture relay  |                                 |                                       |                |
|                                       | af)   | 1 no. Rapid Pressure Rise Relay   |                                 |                                       |                |
|                                       | ag)   | Regenerative Maintenance free Breather: The transformer shall be equipped with Online non Carcinogenic regenerative type breather which shall regenerate silica gel automatically using moisture sensors, with suitable alarm/indication signal |                                 |                                       |                |
|                                       | The fittings listed above are only indicative and other fittings, which generally are required for satisfactory operation of the transformer, are deemed to be included.  |   |                                 |                                       |                |
| 5.03.00                               | <b>GASKETS</b><br><br>All the gasket shall be of 'O' ring of Nitrile rubber for all valves, flanges, HV, LV & Neutral Turrets, Bushings, Tank rim, etc. For this, all the flanges shall be machined. The gaskets shall not deteriorate during the life of transformer if not opened for maintenance at site. Supplier shall also recommend quality & make of gaskets to be used for replacement during maintenance if required. All joints flanged or welded associated with oil shall be such that no oil leakage or sweating occurs during the life of transformer. The quality of these joints is considered established, only if the joints do not exhibit any oil leakage or sweating for a continuous period of at least 3 months during the guarantee period. In case any sweating / leakage is observed, contractor shall rectify the same & establish for a further period of 3 months of the same. If it is not established during the guaranteed period, the guaranteed period shall be extended until the performance is established. |   |                                 |                                       |                |
| 6.00.00                               | <b>INSPECTION AND TESTING</b><br><br>(a.) The Contractor shall carry out a comprehensive inspection and testing program during manufacture of the transformer. An indication of inspection envisaged by the Owner is given elsewhere in the specification. This is however not intended to form a comprehensive program, as it is Contractor's responsibility to draw up and carry out such a program in the form of detailed quality plan duly approved by Owner for necessary implementation.<br><br>(b.) The Contractor shall carry out all type tests and routine tests on the transformers. The tests are listed elsewhere in the specification.<br><br>(c.) The charges for conduction each type test to be carried out by the contractor <b>shall be indicated separately in the bid.</b><br><br>(d.) The equipment checks to be carried out by the Contractor are specified elsewhere in the specification<br><br>(e.) The requirements of site tests are specified elsewhere in the specification  |   |                                 |                                       |                |
| Stage-I GT 201.67 MVA for Rihand STPP |   | Bid Doc. No.:   | TECHNICAL SPECIFICATIONS PART-B | Sub-Section – I Technical Requirement | Page 36        |



| Clause No.                            | TECHNICAL REQUIREMENTS <b><u>Annex.-(02.06)</u></b>   |   |                                 |                                       |
|---------------------------------------|---|---|---------------------------------|---------------------------------------|
| <b>6.01.00</b><br><br><b>6.01.01</b>  | (f.) The makes of all major bought out items shall be subject to Employer's approval. The Contractor shall also prepare a comprehensive inspection and testing program for all bought out/sub-contracted items and shall submit the same to the Employer.<br><br>(g.) Transformer shall be completely assembled with all fittings & accessories meant for the particular transformer before offering for inspection & testing by Employer.<br><br><b>Routine / Type tests on Generator Transformer :</b><br><br><b><u>Routine Tests</u></b> |   |                                 |                                       |
|                                       | <b>S.N.</b>   | <b>Transformer Type</b>   | <b>GT (1-PH)</b>                |                                       |
|                                       |   | <b>Rating (MVA)</b>   | <b>201.67</b>                   |                                       |
|                                       |   | <b>Voltage (KV)</b>   | <b>20/ (400/√3) KV Class</b>    |                                       |
|                                       | 1   | All routine tests in accordance with IEC 60076 shall be carried out in all the transformers.  | √                               |                                       |
|                                       | 2   | Measurement of Voltage Ratio & phase displacement (as per IEC 60076-1)  | √                               |                                       |
|                                       | 3   | Measurement of winding resistance on all the taps (as per IEC 60076-1)  | √                               |                                       |
|                                       | 4   | Vector group and Polarity Check (as per IEC 60076-1)  | √                               |                                       |
|                                       | 5   | Measurement of no load current with 415 V, 50 Hz AC supply  | √                               |                                       |
|                                       | 6   | Measurement of no load losses and current at 90%, 100% & 110% of rated voltage (as per IEC 60076-1)   | √                               |                                       |
|                                       | 7   | Load Loss & Short Circuit Impedance Measurement on principal & Extreme Taps   | √                               |                                       |
|                                       | 8   | IR measurement (As per IEC 60076-1)   | √                               |                                       |
|                                       | 9   | 10 KV core isolation(core-clamp, clamp-tank, core-tank)   | √                               |                                       |
|                                       | 10  | Measurement of capacitance & tan delta to determine capacitance between winding & earth.<br>(for 132 kV & above class transformer, tan delta should not exceed 0.5% at 20 0C, also refer Note-iv below) | √                               |                                       |
|                                       | 11  | Dielectric tests shall be carried out as per IEC 60076-3.   | √                               |                                       |
|                                       | 12  | Applied Voltage Withstand Test (as per IEC 60076-3)   | √                               |                                       |
|                                       | 13  | Lightning impulse (Full & Chopped Wave) test on windings (as per IEC 60076-3)   | √                               |                                       |
|                                       | 14  | Switching impulse test (as per IEC 60076-3)   | √                               |                                       |
|                                       | 15  | IVPD test as per IEC 60076-3 shall be conducted (for U1 & U2 level refer Note & Table given below)  | √                               |                                       |
|                                       | 16  | Repeat no load current/loss measurement & IR after completion of all electrical test  | √                               |                                       |
|                                       | 17  | Oil leakage test on completely assembled transformer along with unit coolers/ radiators (as per relevant clause of this sub section)  | √                               |                                       |
|                                       | 18  | Jacking test followed by D.P. test  | √                               |                                       |
|                                       |   |   |                                 |                                       |
| Stage-I GT 201.67 MVA for Rihand STPP |   | Bid Doc. No.:   | TECHNICAL SPECIFICATIONS PART-B | Sub-Section – I Technical Requirement |
|                                       |   |   |                                 | Page 37                               |

| Clause No.  | TECHNICAL REQUIREMENTS  |  |  | Annex.-(02.06)                                     |         |  |  |   |  |  |        |                        |        |
|---|---|--|--|--|---------|--|--|---|--|--|--------|------------------------|--------|
| 6.01.02   | 19  | Frequency Response Analysis test   |  | √  |         |  |  |   |  |  |        |                        |        |
|   | 20  | Marshalling Box/Cable box: It shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.  |  | √  |         |  |  |   |  |  |        |                        |        |
|   | 21  | IR measurement on wiring of Marshalling Box.   |  | √  |         |  |  |   |  |  |        |                        |        |
|   | 22  | Temperature Rise test at a tap corresponding to maximum losses and at minimum 110 % of rated current of corresponding tap.<br>Gas chromatography shall be conducted on oil sample taken before & immediately after temp. rise test. Gas analysis shall be as per IS: 9434 (based on IEC: 60567), results will be interpreted as per IEC:61181.<br>Infra red thermography shall be done during temp rise test. Result shall be recorded for future reference. |  | √**  |         |  |  |   |  |  |        |                        |        |
|   | 23  | Measurement of power taken by the fans and oil pumps   |  | √  |         |  |  |   |  |  |        |                        |        |
|   | <b>Type Tests (#)</b>   |  |  |  |         |  |  |   |  |  |        |                        |        |
|   | S.N.  | Transformer Type   | GT (1-PH)                                  |  |         |  |  |   |  |  |        |                        |        |
|   |   | Rating (MVA)   | 201.67                                     |  |         |  |  |   |  |  |        |                        |        |
|   |   | Voltage (KV)   | 20/ (400 /√3)<br>KV Class                  |  |         |  |  |   |  |  |        |                        |        |
|   | 1   | LTAC test as IEC 60076-3<br>(also refer Table given below)   | √  |  |         |  |  |   |  |  |        |                        |        |
|   | 2   | Short circuit test (special test) as per IEC 60076-5.<br><br>In addition, For GT :-<br>i) DGA & FRA shall also be conducted before & after S.C. test.<br>ii)Physical inspection of transformer to be done before S.C. Test in presence of NTPC inspector and photographs to be taken for reference.  | √  |  |         |  |  |   |  |  |        |                        |        |
|   | 3   | Measurement of harmonics of no load current (special test)   | √  |  |         |  |  |   |  |  |        |                        |        |
|   | 4   | Measurement of acoustic noise level as per NEMA TR-1 (special test)  | √  |  |         |  |  |   |  |  |        |                        |        |
|   | <b>NOTE:-</b><br>i) (#) All the type/special tests & temperature rise test shall be conducted after performing Short Circuit Test. If Tank Vacuum & Pressure Test is to be carried out then it shall be conducted before SC test.<br>ii) (√) mark indicates test to be carried out and (X) mark indicates test need not to be carried out.<br>iii) The power factors should not exceed 0.5% (at 20 °C). However in case of deviation from limiting values the same shall be resolved in line with <b>IEEE Std-62</b> .<br>iv) (*) this test is applicable on Transformer neutral earthed thru NGR.<br>v) For <b>IVPD Test</b> U1 & U2 are as follows:-<br>a) <b>U1</b> (Enhancement Voltage)=510KV & <b>U2</b> (PD measurement voltage)= 460KV (for 400KV class Transformer)<br>vi) ** During Infra red Thermography test of GT, the temperature of any part of tank shall be limited to 110 deg C. |  |  |  |         |  |  |   |  |  |        |                        |        |
|   | <b>Table-1</b>  |  | <b>Table-2<br/>(Test Voltage for LTAC)</b> |  |         |  |  |   |  |  |        |                        |        |
| <table><tr><th>Test</th><th>IVPD</th></tr><tr><td>Max allowed change in PD after voltage enhancement</td><td>100 pC</td></tr><tr><td colspan="2">The background noise level shall not exceed 50 pC.</td></tr></table> |   | Test   | IVPD                                       | Max allowed change in PD after voltage enhancement | 100 pC  | The background noise level shall not exceed 50 pC. |  | <table><tr><th>Highest System Voltage (Um) for 400 kV class</th><th>420 KV</th></tr><tr><td>U1(LTAC Voltage level)</td><td>630 KV</td></tr></table> |  | Highest System Voltage (Um) for 400 kV class | 420 KV | U1(LTAC Voltage level) | 630 KV |
| Test  | IVPD  |  |  |  |         |  |  |   |  |  |        |                        |        |
| Max allowed change in PD after voltage enhancement  | 100 pC  |  |  |  |         |  |  |   |  |  |        |                        |        |
| The background noise level shall not exceed 50 pC.  |   |  |  |  |         |  |  |   |  |  |        |                        |        |
| Highest System Voltage (Um) for 400 kV class  | 420 KV  |  |  |  |         |  |  |   |  |  |        |                        |        |
| U1(LTAC Voltage level)  | 630 KV  |  |  |  |         |  |  |   |  |  |        |                        |        |
| Stage-I GT 201.67 MVA for Rihand STPP   |   | Bid Doc. No.:  | TECHNICAL SPECIFICATIONS PART-B            | Sub-Section – I<br>Technical Requirement           | Page 38 |  |  |   |  |  |        |                        |        |

| Clause No.                                 | TECHNICAL REQUIREMENTS  |               |                                       |  | Annex.-(02.06) |  |                             |                         |     |             |     |              |     |              |     |              |      |              |      |              |      |            |      |
|--|---|---------------|---------------------------------------|--|----------------|--|-----------------------------|-------------------------|-----|-------------|-----|--------------|-----|--------------|-----|--------------|------|--------------|------|--------------|------|------------|------|
| 6.01.03                                    | <b>Type tests on Components</b><br><br>Type test reports shall be submitted for following as detailed in Cl. no. 4.00.00 of subsection V, Part A of this specification<br><br>(a.) All type tests on 132 KV & above bushings as per IEC 60137.  |               |                                       |  |                |  |                             |                         |     |             |     |              |     |              |     |              |      |              |      |              |      |            |      |
| 6.02.00                                    | <b>Tank Test</b><br><br>(a.) <b>Routine test</b><br><br><b>(1.) Oil leakage test on assembled transformer</b><br><br>All tank and oil filled compartment shall be tested for oil tightness by being completely filled with oil of viscosity not greater than that of specified oil at the ambient temperature and applying pressure equal to the normal pressure plus 35 kN/m <sup>2</sup> measured at the base of the tank. The pressure shall be maintained for a period of not less than 6 hours during which time no sweating shall occur.<br><br>(b.) <b>Type Tests</b><br><br><b>(1.) Vacuum Test</b><br><br>Each type of transformer tank shall be subjected to the specified vacuum. The tank designed for full vacuum shall be tested at an internal pressure of 3.33 kN/m <sup>2</sup> absolute (25 torr) for one hour. The permanent deflection of the plate after the vacuum has been released shall not exceed the values specified below:<br><table><tr><th>Horizontal Length of Flat Plate<br/>(in mm)</th><th>Permanent deflection(in mm)</th></tr><tr><td>Up to and including 750</td><td>5.0</td></tr><tr><td>751 to 1250</td><td>6.5</td></tr><tr><td>1251 to 1750</td><td>8.0</td></tr><tr><td>1751 to 2000</td><td>9.5</td></tr><tr><td>2001 to 2250</td><td>11.0</td></tr><tr><td>2251 to 2500</td><td>12.5</td></tr><tr><td>2501 to 3000</td><td>16.0</td></tr><tr><td>Above 3000</td><td>19.0</td></tr></table><br><b>(2.) Pressure Test</b><br><br>Transformer tank of each size shall be subjected to a pressure corresponding to twice the normal head of oil or to the normal pressure plus 35 kN /m <sup>2</sup> whichever is lower, measured at the base of the tank & maintained for one hour. The permanent deflection of the plates after the excess pressure has been released shall not exceed the figure specified above for vacuum test. |               |                                       |  |                | Horizontal Length of Flat Plate<br>(in mm) | Permanent deflection(in mm) | Up to and including 750 | 5.0 | 751 to 1250 | 6.5 | 1251 to 1750 | 8.0 | 1751 to 2000 | 9.5 | 2001 to 2250 | 11.0 | 2251 to 2500 | 12.5 | 2501 to 3000 | 16.0 | Above 3000 | 19.0 |
| Horizontal Length of Flat Plate<br>(in mm) | Permanent deflection(in mm)   |               |                                       |  |                |  |                             |                         |     |             |     |              |     |              |     |              |      |              |      |              |      |            |      |
| Up to and including 750                    | 5.0   |               |                                       |  |                |  |                             |                         |     |             |     |              |     |              |     |              |      |              |      |              |      |            |      |
| 751 to 1250                                | 6.5   |               |                                       |  |                |  |                             |                         |     |             |     |              |     |              |     |              |      |              |      |              |      |            |      |
| 1251 to 1750                               | 8.0   |               |                                       |  |                |  |                             |                         |     |             |     |              |     |              |     |              |      |              |      |              |      |            |      |
| 1751 to 2000                               | 9.5   |               |                                       |  |                |  |                             |                         |     |             |     |              |     |              |     |              |      |              |      |              |      |            |      |
| 2001 to 2250                               | 11.0  |               |                                       |  |                |  |                             |                         |     |             |     |              |     |              |     |              |      |              |      |              |      |            |      |
| 2251 to 2500                               | 12.5  |               |                                       |  |                |  |                             |                         |     |             |     |              |     |              |     |              |      |              |      |              |      |            |      |
| 2501 to 3000                               | 16.0  |               |                                       |  |                |  |                             |                         |     |             |     |              |     |              |     |              |      |              |      |              |      |            |      |
| Above 3000                                 | 19.0  |               |                                       |  |                |  |                             |                         |     |             |     |              |     |              |     |              |      |              |      |              |      |            |      |
| 6.03.00                                    | <b>Pre-Shipment Checks At Manufacturer’s Works</b><br><br>(a.) Check for interchangeability of similar transformers for mounting dimensions.<br><br>(b.) Check for proper packing and preservation of accessories like coolers, bushings, breather, rollers, Buchholz relay, fans, control cubicle, connecting pipes, conservator etc.  |               |                                       |  |                |  |                             |                         |     |             |     |              |     |              |     |              |      |              |      |              |      |            |      |
| Stage-I GT 201.67 MVA<br>for Rihand STPP   |   | Bid Doc. No.: | TECHNICAL<br>SPECIFICATIONS<br>PART-B | Sub-Section – I<br>Technical Requirement | Page 39        |  |                             |                         |     |             |     |              |     |              |     |              |      |              |      |              |      |            |      |

| Clause No.  | TECHNICAL REQUIREMENTS  |               |                                       |  | Annex.-(02.06) |
|---|---|---------------|---------------------------------------|--|----------------|
| 6.04.00   | (c.) Check for proper provision for bracing to arrest the movement of core and winding assembly inside the tank.  |               |                                       |  |                |
|   | (d.) Gas tightness test to confirm tightness.   |               |                                       |  |                |
|   | (e.) Derivation of leakage rate and ensure the adequate reserve gas capacity.   |               |                                       |  |                |
|   | (f.) Dew point measurement of Dry Air / N <sub>2</sub> at the time of filling and after 24 hours in the transformer tank. Dew point of Dry Air / Nitrogen at the time of transformer dispatch should be better than <b>(-)30deg.C</b> . Also the Dew point of Dry Air / Nitrogen Cylinders attached for makeup during transportation should be better than <b>(-)50 deg.C</b> .   |               |                                       |  |                |
|   | (g.) Functioning of impact recorder in the works (minimum two impact recorders to be provided).   |               |                                       |  |                |
|   | (h.) To avoid pilferage and tempering with the valves and other accessories used while N <sub>2</sub> filling, due security arrangements to be ensured during transportation  |               |                                       |  |                |
|   | <b>Inspection and Testing at Site</b>   |               |                                       |  |                |
|   | The Contractor shall carry out a detailed inspection and testing program for field activities covering areas right from the receipt of material stage up to commissioning stage. An indicative program of inspection as envisaged by the Employer is given below. This is however not intended to form comprehensive program, as it is contractor's responsibility to draw up and carry out such a program duly approved by the Employer. Testing of oil sample at site shall be carried out as specified elsewhere in the specification. |               |                                       |  |                |
|   | <b>6.04.01 Receipt and Storage Checks</b>   |               |                                       |  |                |
|   | (a.) Check and record condition of each package, visible parts of the transformer etc. for any damage.  |               |                                       |  |                |
| 6.04.01   | (b.) Check and record the gas pressure in the transformer tank as well as in the gas cylinder.  |               |                                       |  |                |
|   | (c.) Visual check for wedging of core and coils before filling up with oil and also check conditions of core and winding in general.  |               |                                       |  |                |
|   | (d.) Check and Record reading of impact recorder at receipt and verify the allowable limits as per manufacturer's recommendation.   |               |                                       |  |                |
|   | <b>6.04.02 Installation Checks</b>  |               |                                       |  |                |
| (a.) Dew point measurement of Dry air/ N <sub>2</sub> . |   |               |                                       |  |                |
| Stage-I GT 201.67 MVA<br>for Rihand STPP                |   | Bid Doc. No.: | TECHNICAL<br>SPECIFICATIONS<br>PART-B | Sub-Section – I<br>Technical Requirement | Page 40        |

| Clause No.                               | TECHNICAL REQUIREMENTS   |               |                                       |  | Annex.-(02.06) |
|--|--|---------------|---------------------------------------|--|----------------|
| 6.04.03                                  | (b.) Inspection and performance testing of accessories like tap changers, cooling fans, oil pumps etc.   |               |                                       |  |                |
|  | (c.)    1) Check the direction of rotation of fans and pumps.<br>2) Check the bearing lubrication.   |               |                                       |  |                |
| 6.04.04                                  | (d.) Check whole assembly for tightness, general appearance etc.   |               |                                       |  |                |
|  | (e.) Check oil sample prior to filling   |               |                                       |  |                |
|  | (f.) Connection checks for neutral formation as per drawing.   |               |                                       |  |                |
|  | Oil leakage test on assembled transformer shall be repeated as a pre-commissioning test at site for 24 hours. The gaskets & flanges used shall be capable of meeting the requirement as mentioned above. |               |                                       |  |                |
|  | <b>Commissioning Checks</b>  |               |                                       |  |                |
|  | (a.) Check the functioning of Regenerative Maintenance free breather.  |               |                                       |  |                |
|  | (b.) Check the oil level in the breather housing, conservator tanks, cooling system, condenser-bushing etc.  |               |                                       |  |                |
|  | (c.) Check the bushing for conformity of connection to the lines etc. and tan delta test for bushing at 10 kV (min.)   |               |                                       |  |                |
|  | (d.) Check for correct operation of protection devices and alarms:   |               |                                       |  |                |
|  | (1.) Buchhloz relay.   |               |                                       |  |                |
|  | (2.) Excessive winding temperature   |               |                                       |  |                |
|  | (3.) Excessive oil temperature   |               |                                       |  |                |
|  | (4.) Low oil flow  |               |                                       |  |                |
|  | (5.) Low oil level indication  |               |                                       |  |                |
|  | (6.) Fan and pump failure protection   |               |                                       |  |                |
|  | (7.) Oil flow failure  |               |                                       |  |                |
|  | (8.) Pressure relief valve   |               |                                       |  |                |
|  | (9.) Online DGA  |               |                                       |  |                |
|  | (e.) Check for the adequate protection on the electric circuit supplying the accessories.  |               |                                       |  |                |
|  | (f.) Check resistance of all windings on all steps of the tap changer. Insulation resistance measurement for the following:  |               |                                       |  |                |
|  | 1) Control wiring.   |               |                                       |  |                |
|  | 2) Cooling system motor and control  |               |                                       |  |                |
| Stage-I GT 201.67 MVA<br>for Rihand STPP |  | Bid Doc. No.: | TECHNICAL<br>SPECIFICATIONS<br>PART-B | Sub-Section – I<br>Technical Requirement | Page 41        |

| Clause No.                               | TECHNICAL REQUIREMENTS <u><b>Annex.-(02.06)</b></u>   |                                       |  |         |
|--|---|---------------------------------------|--|---------|
|  | <div>3) Main windings</div> <div>4) Tap changer motor and control</div> <div>5) Tank &amp; turret mounted CTs</div> <div>6) Core and clamp<ul style="list-style-type: none"><li>- Core to earth</li><li>- Core clamp to earth</li><li>- Core to core clamp</li></ul></div> <div>(g.) Check for cleanliness of the transformer and the surroundings.</div> <div>(h.) Check the following<ul style="list-style-type: none"><li>1) Direction and overload setting of cooling Accessories</li><li>2) Buchholz, oil level indicator, pressure gauges, temp indicators etc. for fitting &amp; operation.</li><li>3) Earthing of main tank, marshaling Box, tap changer driving gear, pump and fan motor etc.</li><li>4) Neutral earthing</li><li>5) Calibration of WTI and OTI</li><li>6) Earthing of bushing test tap</li><li>7) Connection of WTI CT with its heater</li><li>8) Tightness of CT secondary connection and shorting of unused CTs</li><li>9) All valves for their correct opening and close sequence</li></ul></div> <div>(i.) Phase out and vector group test.</div> <div>(j.) Ratio test on all taps.</div> <div>(k.) Magnetizing current test (HV winding &amp; LV winding).</div> <div>(l.) Capacitance and Tan delta measurement of winding</div> <div>(m.) Measurement of noiselevel.</div> <div>(n.) <b><u>Oil Dielectric strength test-</u></b> The various test on oil shall be conducted prior to filling in main tank at site &amp; prior to energization at site as specified elsewhere in the specification. Oil samples are to be drawn from top &amp; bottom of main tank, cooling system.</div> <div>(o.) DGA of oil before commissioning</div> <div>(p.) Core isolation test</div> |                                       |  |         |
| Stage-I GT 201.67 MVA<br>for Rihand STPP | Bid Doc. No.:   | TECHNICAL<br>SPECIFICATIONS<br>PART-B | Sub-Section – I<br>Technical Requirement | Page 42 |

| Clause No.                               | TECHNICAL REQUIREMENTS  |               |                                       |  | Annex.-(02.06) |
|--|---|---------------|---------------------------------------|--|----------------|
| 6.04.05                                  | <p>(q.) FRA test</p> <p>(r.) Short circuit impedance measurement</p> <p>(s.) Test on tank/turret mounted CTs</p> <p>1) IR value between secondary winding &amp; earth and between windings</p> <p>2) secondary resistance</p> <p>3) Polarity</p> <p>4) Ratio test</p> <p>5) Magnetization current</p> <p>(t.) Test on cooler fan &amp; pump</p> <p>1) IR Value</p> <p>2) Starting current</p> <p>3) Running current</p> <p>(u.) WTI and OTI setting for alarm/trip, fan start/stop and pump start/stop</p> <p>(v.) Final IR Value</p> <p>1) HV/E+LV</p> <p>2) LV/E+HV</p> <p>3) HV/LV</p>                         |               |                                       |  |                |
|  | <p><b>INITIAL OPERATION</b></p> <p>a) Continuously observe the transformer operation at no load for 24 hrs. w.r.t. Voltage, no load current, temperature rise and noise.</p> <p>b) Gradually put the transformer on load, check and measure increase in temperature in relation to the load and check the operation with respect to temperature rise and noise level etc.</p> <p>c) Infra red thermograph shall be done after 12 hours of full load operation and results will be recorded for future reference</p>   |               |                                       |  |                |
| 6.05.00                                  | <p><b>INSTALLATION AND MOVEMENT OF SPARE UNIT ON SITE</b></p> <p>The spare transformer shall be erected and prepared for long term storage as well as for the rapid transfer of this unit into a service position as approved by the Owner. For this purpose the manufacturer shall investigate and propose an approved method to move the fully oil filled unit with bushings installed from an on site storage position, to any one of its intended service positions. The intention is to minimise the delay time to replace a faulty unit.</p> <p>The procedures shall be subject to the Owners approval.</p> |               |                                       |  |                |
| Stage-I GT 201.67 MVA<br>for Rihand STPP |   | Bid Doc. No.: | TECHNICAL<br>SPECIFICATIONS<br>PART-B | Sub-Section – I<br>Technical Requirement | Page 43        |

| Clause No.                               | TECHNICAL REQUIREMENTS<br><u>Annex.-(02.06)</u>   |                                       |  |         |
|--|---|---------------------------------------|--|---------|
| 7.00.00                                  | <b>TRANSPORTATION</b>   |                                       |  |         |
|  | <p>The Contractor shall be responsible to select and verify the route, mode of transportation and make all necessary arrangement with the appropriate authorities for the transportation of the equipment. The dimension of the equipment shall be such that when packed for transportation, it will comply with the requirements of loading and clearance restrictions for the selected route. It shall be the responsibility of the contractor to coordinate the arrangement for transportation of the transformer for all the stages from the manufacturer’s work to site. All metal blanking plates and covers which are specifically required to transport the transformer shall be considered part of the transformer and handed over to the Employer after completion of the erection. <b>Bill of quantity and relevant drawings of these items shall also be included in the manual to enable the Employer to have it re-manufactured, if required.</b></p>   |                                       |  |         |
|  | <p>The scope of any necessary modification/ extension/ improvement to existing road, bridges, culverts etc. shall be included in the scope of the bidder. The contractor shall carry out the route survey along with the transporter.</p>   |                                       |  |         |
|  | <p>The contractor shall dispatch the transformer filled with oil or in an atmosphere of nitrogen or dry air. In the former case the contractor shall take care of the weight limitation on transport and handling facility at site. In the latter case, necessary arrangement shall be ensured by the contractor to take care of pressure drop of nitrogen or dry air during transit and storage till completion of oil filling during erection. <b>The total duration of storage at site with dry gas shall be limited to three months after which the transformer shall be processed and filled with oil.</b> A gas pressure testing valve with necessary pressure gauge and adaptor valve shall be provided. Transformer shall also be fitted with sufficient number of <b>impact recorders/accelerometer</b> during transportation to record the movement due to impact in all three directions perpendicular to each other and of which the main direction shall be in the direction of transportation. The recording shall commence in the factory and shall continue till the unit is installed on its foundation.</p> <p><b>NOTE:</b> Despite all condition monitoring done by the Owner, the Contractor shall be responsible to obtain all required inputs such as DGA to evaluate the transformer. The guarantee and costs of any repair done under the guarantee shall not be affected by any condition monitoring done or not done by the Owner during the guarantee period. A full DGA test shall be completed at the end but before expiry of the guarantee period.</p> |                                       |  |         |
| Stage-I GT 201.67 MVA<br>for Rihand STPP | Bid Doc. No.:   | TECHNICAL<br>SPECIFICATIONS<br>PART-B | Sub-Section – I<br>Technical Requirement | Page 44 |




| Clause No                             | TECHNICAL REQUIREMENTS   |  |                                 |                                       | Annex.-(02.06) |
|---------------------------------------|--|--|---------------------------------|---------------------------------------|----------------|
| 8.00.00                               | <b><u>MAINTENANCE, TESTING AND MONITORING EQUIPMENTS</u></b>   |  |                                 |                                       |                |
| 8.01.00                               | <b>ON-LINE DISSOLVED GAS ANALYSER (DGA) SYSTEM</b>   |  |                                 |                                       |                |
|                                       | Each Generator Transformer shall be fitted with on-line DGA equipment. The terminals shall be wired up to the M. Box/CMB to enable remote alarm/trip and status information. The On line DGA monitoring equipment shall be able to monitor H2, CO, C2H4, C2H2, CH4, C2H6, O2 & CO2   |  |                                 |                                       |                |
| 8.01.01                               | <b>TECHNICAL PARAMETERS</b>  |  |                                 |                                       |                |
|                                       | The system shall meet the following technical parameters:  |  |                                 |                                       |                |
|                                       | a) Detection & measurement of gases  | H2, CO, C2H4, C2H2, CH4, C2H6, O2 & CO2 with 100% sensitivity to H2 & C2H2   |                                 |                                       |                |
|                                       | b) Accuracy (maximum)  | H2: ±10% or ± 5 ppm (whichever is greater)<br>CO: ±10% or ± 10 ppm (whichever is greater)<br>C2H4: ±10% or ± 3 ppm (whichever is greater)<br>C2H2: ±10% or ± 1 ppm (whichever is greater)<br>CH4: ±10% or ± 5 ppm (whichever is greater)<br>C2H6: ±10% or ± 5 ppm (whichever is greater)<br>O2: ±10% or ± 500 ppm (whichever is greater)<br>CO2: ±10% or ± 25 ppm (whichever is greater) |                                 |                                       |                |
|                                       | c) Oil temperature range of sensor   | 100 <sup>0</sup> C to 1000 <sup>0</sup> C  |                                 |                                       |                |
|                                       | d) Sensor attachment degree of protection  | Minimum IP55   |                                 |                                       |                |
|                                       | e) Minimum detection sensitivity to C2H2   | 2 ppm  |                                 |                                       |                |
| 8.01.02                               | <b>GENERAL TECHNICAL REQUIREMENT OF DGA</b>  |  |                                 |                                       |                |
|                                       | a.) The system offered shall be suitable for online monitoring of dissolved gases in oil filled (Napthanic / Paraffanic based oil) power transformer. It shall atleast measure dissolved gases such as H2, CO, C2H4, C2H2, CH4, C2H6, O2 & CO2 with 100% sensitivity to H2 & C2H2  |  |                                 |                                       |                |
|                                       | b) The system shall suitably be fitted to transformer in accessible location to be decided by contractor with employer's approval. Contractor shall provide necessary adopter /fittings for this purpose. The attachment shall be provided with an oil sampling port to facilitate oil collection for manual off-line DGA by owner. All software/hardware/cables/PC for monitoring from control room shall be in the scope of the contractor. The supplier shall also provide a suitable calibrating arrangement for each online DGA. The software for remote monitoring in control room shall facilitate real time data logging & also historical data/trend display. |  |                                 |                                       |                |
|                                       | c) Potential free alarm contacts for high gas concentration (user programmable) of each gas shall be wired upto transformer M. Box/CMB. These will be used for facia alarm in control room and DDCMIS/SCADA. Also, real time data for concentration of each gas shall be provided at SAS/DDCIMS control room through SAS/DDCIMS with NTPC required format & communication. All required cable, software, hardware & cable laying for the above communication shall be in the scope of contractor.  |  |                                 |                                       |                |
|                                       | d.) Installation and cable connection drawing shall be furnished for approval.   |  |                                 |                                       |                |
|                                       | e) System shall be suitable for operation at 50 degree centigrade ambient temperature & 85% relative humidity.   |  |                                 |                                       |                |
| Stage-I GT 201.67 MVA for Rihand STPP |  | Bid Doc. No.:  | TECHNICAL SPECIFICATIONS PART-B | Sub-Section – I Technical Requirement | Page 45        |


| Clause No                             | SCOPE OF Work for Erection & Commissioning   | Annex.-(02.07) |                                 |   |
|---------------------------------------|--|----------------|---------------------------------|---|
| 9.00.00                               | <b><u>SCOPE OF Work for Erection &amp; Commissioning</u></b>   |                |                                 |   |
| 9.01.00                               | GTs & all accessories to be unloaded at the identified spare bays and to be dragged on the embedded rails to the locations as instructed by EIC. Fixing of wheel & positioning to the desired location and wheel rotation if required to be done by contractor only. All the tasks are to be done under full supervision of main contractor  |                |                                 |   |
| 9.02.00                               | All accessories & Mandatory spares to be shifted to the location as instructed by EIC  |                |                                 |   |
| 9.03.00                               | Erection of accessories (Bushings, Field devices, necessary wirings & connections etc.)  |                |                                 |   |
| 9.04.00                               | Vacuum process for achieving the desired Nitrogen/Dry air dew point to ensure proper removal of moisture from solid insulation.  |                |                                 |   |
| 9.05.00                               | Processing the transformer oil prior to filling in the transformer to achieve desired BDV & moisture & processed oil to be filled under vacuum.  |                |                                 |   |
| 9.06.00                               | Final HOC & final LV testing of CTs, Bushings, Windings etc. to match the results with FAT results.  |                |                                 |   |
| 9.07.00                               | After complete erection, the transformer is to be dragged, wheel rotation(if required), and to be fitted at the location as desired by NTPC <u>during unit overhauling period</u> and after GTs reached to its desired locations, their LV bust duct matching and LV connections to be done by contractor.   |                |                                 |   |
| 9.08.00                               | Fitting of accessories like online DGA, online moisture removal tool, fitting of Marshaling kiosk, fitting & matching of conservator oil piping etc. with fixed or flexible pipes, fixing of LV flexible, Neutral formation, complete wiring/cabling and complete readiness checking to be done by contractor. If for neutral formation or conservator pipe matching, any welding cutting is required, same shall be arranged by contractor only. If welding/Cutting done in the oil conservator piping, then internal paint of the conservator piping (Akzo Nobel's Interprime or any better) is in the scope of main contractor. |                |                                 |   |
| 9.09.00                               | Complete testing like Polarity test, Vector grouping, Entire LV testing, HV testing, SFRA, FDS (Bushing & Winding) to be done by contractor at the desired location.<br><br>Disconnection from Bus duct, wiring disconnections, Marshalling Kiosk disconnection (if required), cooler pipes disconnection (if required) etc.<br><br>All T&Ps like Hydra, Man Lifting machine, Filtration machines, Vacuum machine, Dry air generator, Dry Nitrogen etc. or any other tool required for completing the task is in contractor scope.   |                |                                 |   |
| Stage-I GT 201.67 MVA for Rihand STPP |  | Bid Doc. No.:  | TECHNICAL SPECIFICATIONS PART-B | Sub-Section – I<br>Technical Requirement<br>Page 45 |


| Clause No                             | QUALITY ASSURANCE  |               |                                 |                                    | <b><u>Annex.-(02.08)</u></b> |
|---------------------------------------|--|---------------|---------------------------------|------------------------------------|------------------------------|
| <b>1.00.00</b>                        | <b>Quality Assurance</b>   |               |                                 |                                    |                              |
| 1.01.00                               | a.) <b>Inspection:</b> Pre Dispatch Inspection (PDI) shall be carried out at vendor’s works by NTPC’s inspection office as per technical document, quality plan and drawing etc..<br>b.) <b>Vendor shall submit the drawing and data sheet for the approval of NTPC before start of manufacturing.</b> |               |                                 |                                    |                              |
| Stage-I GT 201.67 MVA for Rihand STPP |  | Bid Doc. No.: | TECHNICAL SPECIFICATIONS PART-B | Sub-Section – II Quality Assurance | Page 46                      |

| CLAUSE NO.                                  | List of Mandatory Spares   |                                    | Annex.-(02.12)                              |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
|---|--|------------------------------------|---|---------|---------|------------|---------------------|---|--|--------|---|--|--------|---|---|--------|---|---|--------|---|-------------|--------|---|-------------------|--------|---|---------------------|--------|---|-------------------|--------|---|------------------|--------|----|-------------------|--------|----|--|--------|----|-----|--------|----|--------------------------|--------|----|----------------|--------|----|--------------------------|--------|----|------------------------|--------|----|-----------------------|--------|----|----------------------------|--------|
| 1.00.00                                     | SPARES   |                                    |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
| 1.01.00                                     | The list of mandatory spares for the Transformer covered under this package are given below  |                                    |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
|   | (a.) LIST OF MANDATORY SPARES FOR 01 GENERATOR TRANSFORMER: -  |                                    |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
|   | <table><tr><th>Sl. No.</th><th>Components</th><th>Qty/<br/>Transformer</th></tr><tr><td>1</td><td>HV Bushing with metal parts and gasket</td><td>01 No.</td></tr><tr><td>2</td><td>LV Bushing with metal parts and gasket</td><td>02 No.</td></tr><tr><td>3</td><td>HV- Neutral Bushing with metal parts and gasket</td><td>01 No.</td></tr><tr><td>4</td><td>Set of gaskets/o rings (other than that with bushing)</td><td>01 Set</td></tr><tr><td>5</td><td>Unit Cooler</td><td>01 Set</td></tr><tr><td>6</td><td>Tap changer spare</td><td>01 Set</td></tr><tr><td>7</td><td>Oil pump with motor</td><td>02 Set</td></tr><tr><td>8</td><td>Cooling fan motor</td><td>02 Set</td></tr><tr><td>9</td><td>Valves each type</td><td>01 Set</td></tr><tr><td>10</td><td>OTI with contacts</td><td>01 No.</td></tr><tr><td>11</td><td>WTI with contact &amp; remote indicator unit</td><td>01 Set</td></tr><tr><td>12</td><td>MOG</td><td>01 No.</td></tr><tr><td>13</td><td>Buchhlotz relay complete</td><td>01 No.</td></tr><tr><td>14</td><td>Oil flow meter</td><td>01 No.</td></tr><tr><td>15</td><td>Air cell for conservator</td><td>01 No.</td></tr><tr><td>16</td><td>Pressure relief device</td><td>01 No.</td></tr><tr><td>17</td><td>Sudden pressure relay</td><td>01 No.</td></tr><tr><td>18</td><td>Regenerative type breather</td><td>01 Set</td></tr></table> |                                    |   |         | Sl. No. | Components | Qty/<br>Transformer | 1 | HV Bushing with metal parts and gasket | 01 No. | 2 | LV Bushing with metal parts and gasket | 02 No. | 3 | HV- Neutral Bushing with metal parts and gasket | 01 No. | 4 | Set of gaskets/o rings (other than that with bushing) | 01 Set | 5 | Unit Cooler | 01 Set | 6 | Tap changer spare | 01 Set | 7 | Oil pump with motor | 02 Set | 8 | Cooling fan motor | 02 Set | 9 | Valves each type | 01 Set | 10 | OTI with contacts | 01 No. | 11 | WTI with contact & remote indicator unit | 01 Set | 12 | MOG | 01 No. | 13 | Buchhlotz relay complete | 01 No. | 14 | Oil flow meter | 01 No. | 15 | Air cell for conservator | 01 No. | 16 | Pressure relief device | 01 No. | 17 | Sudden pressure relay | 01 No. | 18 | Regenerative type breather | 01 Set |
| Sl. No.                                     | Components   | Qty/<br>Transformer                |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
| 1   | HV Bushing with metal parts and gasket   | 01 No.                             |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
| 2   | LV Bushing with metal parts and gasket   | 02 No.                             |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
| 3   | HV- Neutral Bushing with metal parts and gasket  | 01 No.                             |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
| 4   | Set of gaskets/o rings (other than that with bushing)  | 01 Set                             |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
| 5   | Unit Cooler  | 01 Set                             |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
| 6   | Tap changer spare  | 01 Set                             |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
| 7   | Oil pump with motor  | 02 Set                             |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
| 8   | Cooling fan motor  | 02 Set                             |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
| 9   | Valves each type   | 01 Set                             |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
| 10  | OTI with contacts  | 01 No.                             |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
| 11  | WTI with contact & remote indicator unit   | 01 Set                             |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
| 12  | MOG  | 01 No.                             |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
| 13  | Buchhlotz relay complete   | 01 No.                             |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
| 14  | Oil flow meter   | 01 No.                             |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
| 15  | Air cell for conservator   | 01 No.                             |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
| 16  | Pressure relief device   | 01 No.                             |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
| 17  | Sudden pressure relay  | 01 No.                             |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
| 18  | Regenerative type breather   | 01 Set                             |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
|   | Note: 1 Set consists of quantities required for 1 complete transformer/unit.   |                                    |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
| 1.02.00                                     | The prices of these mandatory spare parts shall be indicated for the purpose of bid evaluation.  |                                    |   |         |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |
| Stage-I GT<br>201.67 MVA for<br>Rihand STPP | Bid Doc. No.:  | TECHNICAL<br>SPECIFICATIONS PART-D | Sub-Section - I List of<br>Mandatory Spares | Page 47 |         |            |                     |   |  |        |   |  |        |   |   |        |   |   |        |   |             |        |   |                   |        |   |                     |        |   |                   |        |   |                  |        |    |                   |        |    |  |        |    |     |        |    |                          |        |    |                |        |    |                          |        |    |                        |        |    |                       |        |    |                            |        |


| CLAUSE NO.                            | Technical Data Requirements (along with Bid)   |    |
|---------------------------------------|--|---|
|                                       | <p style="text-align: center;"><b><u>Technical Data Requirements For Bidding</u></b></p> <p style="text-align: center;"><b>PART - A</b></p> <p>This volume contains Data sheets for Generator Transformer for Rihand STPP. All copies duly completed and preferably typed or written in indelible black ink in sets of five are to be submitted along with the Bid.</p> <p><b>1.00.0 Generator Transformer</b></p> <p>1.01.00 Manufacturer's name and address .....</p> <p>1.02.00 Project Name .....</p> <p>1.03.00 Standard Applicable .....</p> <p>1.04.00 Rating (MVA) .....</p> <p>1.05.00 Voltage ratio .....</p> <p>1.06.00 Vector group .....</p> <p>1.07.00 Type of cooling .....</p> <p>1.08.00 Impedance data</p> <p style="padding-left: 40px;">Guaranteed positive sequence impedance between HV &amp; LV at 75 deg.C</p> <p style="padding-left: 40px;">Principal tap/Maximum tap/ Minimum tap .....</p> <p>1.09.00 Number of coolers and rating as % of transformer cooling equipment .....</p> <p>1.10.00 Fan/ Pump (Nos. &amp; rating of fan motors) .....</p> <p>1.11.00 Cooler/radiator Overall dimensions l x b x h (mm) .....</p> <p>1.12.00 Thermal Data</p> <p style="padding-left: 20px;">a) Temperature rise in top oil over an ambient of 50 deg.C (deg.C) .....</p> <p style="padding-left: 20px;">b) Temperature rise in winding by resistance measurement method over an ambient of .....</p> |   |
| Stage-I GT 201.67 MVA for Rihand STPP | TECHNICAL SPECIFICATION<br>PART E  | <div style="display: flex; justify-content: space-between;"> <div>Sub Section-I<br/>Technical Data<br/>Requirement (along<br/>with bid)</div> <div>PAGE 48</div> </div> |


| CLAUSE NO.  |       | Technical Data Requirements (along with Bid)  |  | एनटीपीसी<br>NTPC |         |
|---|-------|---|--|------------------|---------|
|   |       | 50 deg.C .                                    |  |                  |         |
|   |       | Bushings                                      |  |                  |         |
|   | a)    | High voltage                                  |  |                  |         |
|   | i)    | Manufacturer                                  | .....  |                  |         |
|   | ii)   | Type  | .....  |                  |         |
|   | b)    | Low Voltage                                   |  |                  |         |
|   | i)    | Manufacturer                                  | .....  | .....            |         |
|   | ii)   | Type  | .....  | .....            |         |
|   | c)    | Neutral (HV)                                  |  |                  |         |
|   | i)    | Manufacturer                                  | .....  | .....            |         |
|   | ii)   | Type  | .....  | .....            |         |
|   | d)    | Neutral (LV)                                  |  |                  |         |
|   | i)    | Manufacturer                                  | .....  | .....            |         |
|   | ii)   | Type  | .....  | .....            |         |
|   |       | HV winding insulation (Graded/ Uniform)       | .....  |                  |         |
| 1.14.00   |       | Proposed method of transformer transportation | .....  |                  |         |
|   | (i).  | Oil filled or N2 filled                       | .....  | .....            |         |
|   | (ii). | Road Freight/ Rail Freight                    | .....  | .....            |         |
| 1.15.00   |       | Tap changing equipment (Make & Type)          | .....  |                  |         |
| 1.16.00   |       | Approximate Dimensions                        |  |                  |         |
|   | a)    | Tank (lxbxh) (mm)                             | .....  | .....            |         |
|   | a)    | Overall dimensions with coolers (lxbxh) (mm)  | .....  | .....            |         |
|   | c)    | Height for un-tanking (mm)                    | .....  | .....            |         |
|   | d)    | Shipping dimensions                           | .....  | .....            |         |
| Stage-I GT 201.67 MVA for Rihand STPP<br>Bid Doc No.: |       | TECHNICAL SPECIFICATION<br>PART E             | Sub Section-I<br>Technical Data<br>Requirement (along<br>with bid) |                  | PAGE 49 |


| CLAUSE NO.  | Technical Data Requirements (along with Bid)   |  |
|---|--|---|
| 1.17.01<br>1.17.02<br>1.18.00<br>1.19.00              | <p>e)      Dimensions of largest package .....<br/>              (lxbxh) (mm)</p> <p>Approx. Weights of Transformer .....<br/> including oil &amp; cooler</p> <p>Weight of cooler (if separately mounted) .....</p> <p>Magnetising inrush current .....<br/> (Amps)</p> <p>Tank cover-Conventional/Bell Type .....</p> <p><b>Drawings to be submitted:-</b></p> <p>-      Outline drawings of transformer showing principal dimensions and location of components.</p> |   |
| Stage-I GT 201.67 MVA for Rihand STPP<br>Bid Doc No.: | <b>TECHNICAL SPECIFICATION<br/>PART E</b>  | <b>Sub Section-I<br/>Technical Data<br/>Requirement (along<br/>with bid)</b>        |
|   |  | <b>PAGE 50</b>  |


| CLAUSE NO.  | Technical Data Requirements (Post Award)  |                                   |   |  |
|---|---|-----------------------------------|---|---|
|   | <b><u>Technical Data Requirements For Post Award</u></b><br><b>PART - B</b><br><p>This volume contains Data sheets for Spare Generator Transformer for Vindhyachal STPP. All copies duly completed and preferably typed or written in indelible black ink to submitted during detailed engineering.</p> |                                   |   |   |
| <b>1.00.0</b>   | <b>Generator Transformer</b>  |                                   |   |   |
| 1.01.00   | Manufacturer's name and address   | .....                             |   |   |
| 1.01.01   | Standard Applicable   | .....                             |   |   |
| 1.02.00   | Rating (MVA)  | .....                             |   |   |
| 1.03.00   | Voltage ratio   | .....                             |   |   |
| 1.04.00   | Winding connection  | .....                             |   |   |
| 1.05.00   | Vector group  | .....                             |   |   |
| 1.06.00   | Number of phases  | .....                             |   |   |
| 1.07.00   | Frequency (Hz)  | .....                             |   |   |
| 1.08.00   | Type of cooling   | .....                             |   |   |
| 1.09.0  | Impedance data  |                                   |   |   |
|   | Guaranteed positive sequence impedance between HV & LV at 75 deg.C  |                                   |   |   |
|   | i) Principal tap  | .....                             |   |   |
|   | ii) Maximum tap   | .....                             |   |   |
|   | iii) Minimum tap  | .....                             |   |   |
| 1.10.0  | Guaranteed max. losses in KW at 100 % rated voltage at 75 deg. C at principal tap   |                                   |   |   |
|   | Iron loss at rated voltage & frequency  | .....                             |   |   |
|   | Copper loss at full load  | .....                             |   |   |
|   | Guaranteed Cooler losses at 100% load   | .....                             |   |   |
| Stage-I GT 201.67 MVA for Rihand STPP<br>Bid Doc No.: |   | TECHNICAL SPECIFICATION<br>PART E | Subsection-II<br>Technical Data<br>Requirement (post award) | PAGE 51   |





| CLAUSE NO.  | <b>Technical Data Requirements (Post Award)</b>    |   |
|---|---|---|
| 1.11.00   | HV winding DC resistance at 75 deg. C<br>i) Principal tap .....<br>ii) Maximum tap .....<br>iii) Minimum tap .....  |   |
| 1.12.00   | LV winding DC resistance .....  |   |
| 1.13.00   | Cooling Equipment Details<br>a) Number of coolers and rating<br>as % of transformer cooling<br>equipment .....<br>b) Mounting .....<br>c) Fan Motor Data<br>i) Number per cooler/radiator<br>Cooling requirement (indicate<br>no. of spare fans also) .....<br>ii) Type & make .....<br>iii) Rating .....<br>iv) Speed .....<br>v) Locked rotor current .....<br>d) Oil Pump Motor Data<br>i) Number per cooler<br>and rating as % of<br>Cooling requirement (indicate<br>no. of spare pumps also) .....<br>ii) Type .....<br>iii) Rating ..... |   |
| Stage-I GT 201.67 MVA for Rihand STPP<br>Bid Doc No.: | TECHNICAL SPECIFICATION<br>PART E   | <b>Subsection-II</b><br>Technical Data<br>Requirement (post award) <div>PAGE 52</div> |

| CLAUSE NO.  | Technical Data Requirements (Post Award)  |  |
|---|---|---|
| 1.14.00   | iv) Locked rotor current .....  |   |
|   | e) Cooler/radiator details  |   |
|   | i) Overall dimensions l x b x h (mm) .....  |   |
|   | ii) Type of mounting .....  |   |
|   | iii) Weight with oil (kg) .....   |   |
|   | iv) Weight without oil (kg) .....   |   |
|   | f) Type of oil pump & motor .....   |   |
|   | Thermal Data  |   |
|   | a) Temperature rise in top oil over an ambient of 50 deg.C (deg.C) .....                            |   |
|   | b) Temperature rise in winding by resistance measurement method over an ambient of 50 deg.C . ..... |   |
|   | c) Thermal time constant (Hours) .....  |   |
|   | d) Oil temperature at cooler inlet at rated load at max temperature .....                           |   |
|   | e) Oil temperature at cooler outlet at rated load at max temperature .....                          |   |
|   | f) Calculated Hot Spot Temperature (Design value) .....   |   |
| 1.15.00   | Withstand time for short circuit at terminals (sec.) .....  |   |
| 1.16.00   | Over excitation withstand time (secs.) for % over excitation of                                     |   |
|   | i) 110% .....   |   |
|   | ii) 125% .....  |   |
|   | iii) 140% .....   |   |
|   | iv) 150% .....  |   |
| Stage-I GT 201.67 MVA for Rihand STPP<br>Bid Doc No.: | TECHNICAL SPECIFICATION<br>PART E   | <b>Subsection-II</b><br>Technical Data<br>Requirement (post award)                  |
|   |   | PAGE 53   |


| CLAUSE NO.  | Technical Data Requirements (Post Award)  |  |   |         |
|---|---|---|---|---------|
| 1.17.00   | <p>v) 170% .....</p> <p>Bushings</p> <p>a) High voltage</p> <p>    i) Manufacturer .....</p> <p>    ii) Type .....</p> <p>    iii) Rated current (Amps) .....</p> <p>    iv) Total creepage distance (mm) .....</p> <p>    v) Mounting .....</p> <p>b) Low Voltage</p> <p>    i) Manufacturer .....</p> <p>    ii) Type .....</p> <p>    iii) Rated current (Amps) .....</p> <p>    iv) Total creepage distance (mm) .....</p> <p>    v) Mounting .....</p> <p>c) Neutral (HV)</p> <p>    i) Manufacturer .....</p> <p>    ii) Type .....</p> <p>    iii) Rated current (Amps) .....</p> <p>    iv) Total Creepage distance (mm) .....</p> <p>    v) Mounting .....</p> <p>d) Neutral (LV)</p> <p>    i) Manufacturer .....</p> <p>    ii) Type .....</p> |   |   |         |
| Stage-I GT 201.67 MVA for Rihand STPP<br>Bid Doc No.: |   | TECHNICAL SPECIFICATION<br>PART E   | Subsection-II<br>Technical Data<br>Requirement (post award) | PAGE 54 |

| CLAUSE NO.  | Technical Data Requirements (Post Award)   |  |
|---|--|---|
| 1.17.01   | iii) Rated current (Amps) .....<br>iv) Total Creepage distance (mm) .....<br>v) Mounting .....<br><br>HV Bushing CT parameters<br>(A)<br>(i) Core no. ....<br>(ii) Service .....<br>(iii) Ratio .....<br>(iv) Accuracy class .....<br>(v) Knee point voltage (V) min .....<br>(vi) VA Burden .....<br>(vii) Max. CT resistance .....<br>(vii) Magnetisation current (max) .....<br>at $V_k/2$ (mA) |   |
|   | 1.17.03 Neutral Bushing CT parameters<br>(i) Core no. ....<br>(ii) Service .....<br>(iii) Ratio .....<br>(iv) Accuracy class .....<br>(v) Knee point voltage (V) min .....<br>(vi) VA Burden .....<br>(vii) Max. CT resistance .....<br>(vii) Magnetisation current (max) .....<br>at $V_k/2$ (mA)   |   |
| Stage-I GT 201.67 MVA for Rihand STPP<br>Bid Doc No.: | TECHNICAL SPECIFICATION<br>PART E  | Subsection-II<br>Technical Data<br>Requirement (post award)                         |
|   |  | PAGE 55   |


| CLAUSE NO.  | Technical Data Requirements (Post Award)   |  |
|---|--|---|
| 1.18.00   | <p>Proposed method of transformer transportation</p> <p>(i). Oil filled or N2 filled .....</p> <p>(ii). Road Freight/ Rail Freight .....</p>   |   |
| 1.19.00   | Is vacuum filling required, if so state absolute pressure (mm of Hg) .....   |   |
| 1.20.00   | Total quantity of oil (liters) .....   |   |
| 1.21.00   | <p>Tap changing equipment</p> <p>a) Make .....</p> <p>b) Type &amp; model .....</p> <p>c) Voltage class &amp; current .....</p> <p>d) Number of steps .....</p> <p>e) Range .....</p> <p>f) Step voltage .....</p> <p>g) Rated Short circuit current</p> <p>i) Dynamic .....</p> <p>ii) Thermal .....</p> <p>h) Withstand time for Short circuit (sec.)</p> <p>i) Dynamic .....</p> <p>ii) Thermal .....</p> <p>j) No. of revolution to complete One step .....</p> <p>k) Insulation level of the connecting leads between tap changer &amp; transformer winding .....</p> <p>l) Total quantity of oil .....</p> <p>m) Whether On load Type or Off load Type .....</p> |   |
| Stage-I GT 201.67 MVA for Rihand STPP<br>Bid Doc No.: | TECHNICAL SPECIFICATION<br>PART E  | <p>Subsection-II</p> <p>Technical Data Requirement (post award)</p> <p>PAGE 56</p>  |


| CLAUSE NO.  | Technical Data Requirements (Post Award)  |  |   |         |
|---|---|---|---|---------|
| 1.22.00   | <p>Insulation level</p> <p>a) HV Windings</p> <p>i) a) Lightning impulse withstand voltage (kV) .....</p> <p>b) CW Impulse withstand voltage for HV .....</p> <p>ii) Switching surge withstand voltage (kVP) .....</p> <p>iii) Power frequency withstand voltage (kV rms.) .....</p> <p>iv) HV winding insulation (Graded/ Uniform) .....</p> <p>b) LV Winding</p> <p>i) Lightning impulse withstand voltage (kVp) .....</p> <p>ii) Power frequency withstand voltage (kV rms) .....</p> <p>c) HV Bushings</p> <p>i) Lightning impulse Withstand voltage (kV) .....</p> <p>ii) Switching surge withstand voltage (kVP) .....</p> <p>iii) Power frequency withstand voltage (kV rms) .....</p> <p>d) LV Bushings</p> <p>i) Lightning impulse withstand voltage (kV) .....</p> <p>ii) Power frequency withstand voltage (kV rms) .....</p> <p>e) Neutral Bushings (HV/LV)</p> <p>i) Lightning impulse .....</p> |   |   |         |
| Stage-I GT 201.67 MVA for Rihand STPP<br>Bid Doc No.: |   | TECHNICAL SPECIFICATION<br>PART E   | Subsection-II<br>Technical Data<br>Requirement (post award) | PAGE 57 |




| CLAUSE NO.  | Technical Data Requirements (Post Award)   |  |
|---|--|---|
| 1.26.00   | Clearances<br>to tank in oil (mm)<br><br>(b.) Minimum clearance of HV winding<br>to earth in oil (mm) .....<br><br>(c.) Clearance between coils & core(mm) .....<br><br>(d.) Clearance between coils (mm) .....<br><br>(e.) Clearance between neutral to ground<br>in air (mm) ..... |   |
| 1.27.00   | Conservator<br><br>a) Total volume (Liters) .....<br><br>b) Volume between highest<br>and lowest levels (Liters) .....   |   |
| 1.28.00   | Capacitance Values (pF)<br><br>a) HV to earth .....<br><br>b) LV to earth .....<br><br>c) HV to LV .....<br><br>d) Tap winding to earth .....  |   |
| 1.29.00   | a) Type of oil preservation .....<br><br>b) Material of diaphragm/air cell .....<br><br>c) Continuous temperature withstand/<br>capability of the diaphragm/air cell .....   |   |
| 1.30.00   | Oil<br><br>a) Quality of oil Before filling in Before<br>main tank energisation<br><br>i) Moisture content (ppm) .....<br><br>ii) Max. tan-delta value<br>(at 90 deg.C) .....<br><br>iii) Interfacial tension(N/m) .....   |   |
| Stage-I GT 201.67 MVA for Rihand STPP<br>Bid Doc No.: | TECHNICAL SPECIFICATION<br>PART E  | Subsection-II<br>Technical Data<br>Requirement (post award)                         |
|   |  | PAGE 59   |



| CLAUSE NO.  | Technical Data Requirements (Post Award)                        |                                   |   |  |
|---|---|-----------------------------------|---|---|
| 1.31.00   | iv) Breakdown strength (kV) .....                               |                                   |   |   |
|   | b) Total Quantity including 5% extra (liters) .....             |                                   |   |   |
|   | c) Oil flow inside Transformer (Directed/ Forced/ Normal) ..... |                                   |   |   |
|   | Core  |                                   |   |   |
|   | a) Type of construction (core/shell) .....                      |                                   |   |   |
|   | b) Net core area (mm <sup>2</sup> ) .....                       |                                   |   |   |
|   | c) Core material and grade used .....                           |                                   |   |   |
|   | d) Type of joint between core and yoke .....                    |                                   |   |   |
|   | e) Thickness of stamping (mm) .....                             |                                   |   |   |
|   | f) Percentage silicon content (%) .....                         |                                   |   |   |
|   | g) Maximum flux density in core at rated frequency and at       |                                   |   |   |
|   | i) 90% voltage (wb/m <sup>2</sup> ) .....                       |                                   |   |   |
|   | ii) 100% voltage (wb/m <sup>2</sup> ) .....                     |                                   |   |   |
|   | iii) 110% voltage (wb/m <sup>2</sup> ) .....                    |                                   |   |   |
| 1.32.00   | Winding   |                                   |   |   |
|   | a) Type of winding  |                                   |   |   |
|   | i) HV .....   |                                   |   |   |
|   | ii) LV .....  |                                   |   |   |
|   | iii) Tap .....  |                                   |   |   |
|   | b) Current density at rated load                                |                                   |   |   |
|   | i) HV (A/mm <sup>2</sup> ) .....                                |                                   |   |   |
|   | ii) LV (A/mm <sup>2</sup> ) .....                               |                                   |   |   |
| Stage-I GT 201.67 MVA for Rihand STPP<br>Bid Doc No.: |   | TECHNICAL SPECIFICATION<br>PART E | Subsection-II<br>Technical Data<br>Requirement (post award) | PAGE 60   |

| CLAUSE NO.  | Technical Data Requirements (Post Award)                       |                                   |  |         |
|---|--|-----------------------------------|---|---------|
| 1.33.00   | c) Conductor area  |                                   |   |         |
|   | i) HV (mm <sup>2</sup> )                                       | .....                             |   |         |
|   | ii) LV (mm <sup>2</sup> )                                      | .....                             |   |         |
|   | d) Magnetising inrush current (Amps)                           | .....                             |   |         |
|   | i) % Component of 2 <sup>nd</sup> harmonic current (max & min) | .....                             |   |         |
|   | e) No load current (Amps) at rated frequency and at            |                                   |   |         |
|   | i) 90% voltage   | .....                             |   |         |
|   | ii) 100% voltage   | .....                             |   |         |
|   | iii) 110% voltage  | .....                             |   |         |
|   | f) Magnetising current at rated frequency and at rated voltage | .....                             |   |         |
|   | g) Leakage reactance   |                                   |   |         |
|   | i) HV (ohms)   | .....                             |   |         |
|   | ii) LV (ohms)  | .....                             |   |         |
|   | h) Resistance  |                                   |   |         |
|   | i) HV (ohms)   | .....                             |   |         |
|   | ii) LV (ohms)  | .....                             |   |         |
|   | i) Air core reactance of HV winding                            | .....                             |   |         |
|   | Tank   |                                   |   |         |
| a) Tank cover-Conventional/Bell Type                  | .....  |                                   |   |         |
| b) Approximate thickness of                           |  |                                   |   |         |
| i) Side (mm)  | .....  |                                   |   |         |
| ii) Bottom (mm)                                       | .....  |                                   |   |         |
| Stage-I GT 201.67 MVA for Rihand STPP<br>Bid Doc No.: |  | TECHNICAL SPECIFICATION<br>PART E | Subsection-II<br>Technical Data<br>Requirement (post award)                         | PAGE 61 |

| CLAUSE NO.  | Technical Data Requirements (Post Award)   |  |
|---|--|---|
| 1.34.00   | iii) Cover .....<br>Vacuum withstand capability of<br>a) Main tank .....<br>b) Coolers and accessories .....<br>1.35.00 Minimum draw bar pull required to<br>move the transformer on level track<br>(kg) .....<br>1.36.00 Size of filter hose .....<br>1.37.00 Fault level ..... |   |
| Stage-I GT 201.67 MVA for Rihand STPP<br>Bid Doc No.: | TECHNICAL SPECIFICATION<br>PART E  | Subsection-II<br>Technical Data<br>Requirement (post award)                         |

## **SPECIAL CONDITIONS OF CONTRACT (SCC)**

### **FOR 201.67 MVA GENERATOR TRANSFORMER RIHAND SUPER THERMAL POWER PROJECT**

The following special conditions of contract shall supplement the conditions of contract Whenever there is a conflict the provision herein shall prevail over those in the Conditions of Contract The corresponding clause numbers of the Condition of Contract indicated in parentheses.

#### **1.00A SCOPE**

The Board scope of Supply under this Package is specified in clause 1.00.00 of Technical specifications & Scope of Supply.

#### **1.0.0 TIME- THE ESSENCE OF CONTRACT**

1.1.0 The Bidder shall include in his proposal his "Work Completion Schedule" for furnishing and erecting (including testing and commissioning the equipment) covered in this 201.67 MVA GT Package.

The "Work Completion Schedule" shall be in the form of master network identifying the key phases in various areas of total work like procurement (including bought out items ), Manufacture, Transportation, dispatch/receipt at site and field activities related to erection & commissioning In addition key milestone dates shall also be identified covering the above areas The master network of the GT shall conform to the following schedule date of completion:

#### **2.0.0 COMPLETION PERIOD & TIME SCHEDULE**

##### **COMPLETION PERIOD:**

| SI No.   | Activity  | Completion Period |
|--|---|-------------------|
| A  | <b><u>Supply Portion</u></b><br>Design, Engineering, Manufacturing, testing, dispatch, receipt and assembly of supplied transformer at site from date of award. Commencement of submission of all drgs./data sheets | 30 Months         |
| B  | <b><u>Erection Portion</u></b><br>Erection, testing and commissioning of supplied transformer.  | 06 Month          |
| The total completion schedule of the work is 36 months from the date of award. |   |                   |

##### **WORK SCHEDULE**

The detail program for supply and commissioning of the equipment covered in the contract shall be in the form of Master Network identifying the key phases in various areas of work, like design, procurement, manufacture and supply. In addition, key milestone dates (10-15 Nos) shall also be identified for the complete work under the subject package. The Master Network shall conform to the following activities and shall be submitted within two weeks from the date of award.

## SPECIAL CONDITIONS OF CONTRACT (SCC)

| SI No. | Activity  | Period from the date of NOA |
|--------|---|-----------------------------|
| A      | Commencement of submission of all drgs./ data sheets  | **                          |
| B      | Completion of all Engg. Drgs./data sheets/ manual etc. which includes QP, drawing submission for NTPC's approval and receiving NTPC approved QP, Drawings etc | **                          |
| C      | Commencement of manufacturing   | 03 Month                    |
| D      | Dispatch of GTs & spares  | 29 Months                   |
| E      | Receipt at site   | 30 Months                   |
| F      | Erection testing & commissioning  | 36 Months                   |

### **Erection, Shifting, testing and commissioning**

Erection, shifting and commissioning of the supplied transformer shall be completed within 06 months from the date of the receipt of transformer at site.

- 1.1.1                However the master network and the various key milestone dates will be discussed and agreed before the issue of Letter of Award Engineering drawing and data submission schedule shall also be discussed and finalized before issue of Letter of Award.
- 1.1.2                After the award of Contract, the Contractor shall plan the sequence of work of manufacture dispatch to meet the above stated dates of successful completion of assembly of Transformer including oil filling and pre-commissioning testing of GT for the project.
- 1.1.3                Within 15 days of acceptance of the Letter of Award the Contractor shall submit to the Engineer for his review and approval two copies (1reproducible 1 print) of detailed network schedules with master Network activities further exploded based on the Master Network (mutually agreed by the Owner & Contractor) showing the logic & duration of the activities covered in both the Supply and Erection Contract in the following areas.

“Design detailed engineering (including bought out items) manufacture dispatch/shipment testing & inspection at Manufacture’s Works, supply, receipt of TRANSFORMER at site, assembly of TRANSFORMER, oil filling ,testing of TRANSFORMER.

## **SPECIAL CONDITIONS OF CONTRACT (SCC)**

- 1.1.4 Detailed manufacturing **PERT network** for all manufacturing activities of contractor's/Sub contractor's work shall also be furnished within Thirty (30) days of Letter of Award.
- 1.1.5 All the networks shall be updated every month of at frequency mutually agreed upon Within seven (7)days following the monthly review a progress meeting shall be held whenever possible at the works where in the major items of the plant or equipment are being produced. The meeting will be attended by the Engineer and responsible representative of the Contractor as & when the Engineer considers necessary for the meeting. The Contractor shall be responsible for minting the proceedings of the meeting, a report of which shall reach the owner or the engineer not later than seven (7) days after the date of meeting.
- 1.1.6 Access to the Contractor's and sub –Contractors Works shall be granted to the Engineer at all reasonable items for the purpose of ascertaining the progress.

### **3.0.0 Payment Terms:**

#### **a) Supply of Transformer:**

After supply of material at NTPC Rihand, Vendor representative should visit the Station and joint inspection of materials supplied will be carried out. A joint protocol will be signed remarking complete set of materials as per BOQ and SOW have been supplied and all the materials supplied are in good condition. Impact recorder will be handed over to the vendor representative. Vendor should submit the report of Impact recorder at the earliest to the Purchaser.

- i. 80% of material payment shall be released to the vendor after submission of impact recorder report by vendor which confirms that Transformer have been supplied and unloaded in good condition.
- ii. 20% Payment will be done after completion of final erection & commissioning of the transformer at designated location (as intimated by EIC) or it will be released on submission of BG, if final E&C will delay due to NTPC account.

b) **Freight & Insurance:** 100% payment shall be released after receipt and acceptance transformer at site.

c) **Supply of Mandatory spares:** 100% payment shall be released after receipt and acceptance of Mandatory Spares at site.

d) **Type test Charges:** 100% payment shall be done on successful conduction of type test on the transformer and submission of its complete report. If transformer failed to pass type test than payment shall be null and void.

e) **Erection & Commissioning and Testing at site:** 50% After successful Erection & testing of transformer at spare bay & remaining 50% after successful dragging, fitting, Installation & Commissioning and Testing of GT at desired unit location at site as per SOW during overhauling period.

## **SPECIAL CONDITIONS OF CONTRACT (SCC)**

SECTION –SCC

PAGE-3

### **4.0.0 CONTRACT PRICE ADJUSTMENT (Payment/Recovery):**

- a) The provision for price adjustment will be as per IEEMA guideline issued vide circular IEEMA/PVC/PWR TRF up to 400 KV/2021 Effective from 01/09/2021(Attached) for transformers only.
- a) **The reference date of PVC calculation shall be actual date of Bid opening.**
- b) All other prices and price components, viz inland transportation charges and insurance charges, mandatory spares, type test, special type test, E&C etc shall not be subjected to any price adjustment.
- c) Any deviation or variation from the scope requirement and/or intent of the specifications shall be asked by the bidder before the last date of query mentioned in NIT irrespective of the fact that such deviation / variations may be standard proactive or a possible interpretation of the specification by the Bidder. This deviations/variation which are accepted by the owner will be communicated to all the bidders before the opening of technical bids. It will be the responsibility of the bidder to fully meet the intent and the requirements of the specification within the quoted price. No other departure of the specifications whatsoever from the specification except for the accepted deviations informed by the owner shall be considered. Bids not complying with requirement shall be treated as non-responsive and hence liable for rejection. The interpretation of the owner in respect of the scope, details and services to be performed by the Bidder shall be binding, unless specifically clarified otherwise by the owner in writing before the technical bid opening date.

IEEMA/PVC/PWR TRF\_Up to 400 KV/2021

Effective from: 1<sup>st</sup> September 2021

**PRICE VARIATION CLAUSE FOR POWER TRANSFORMERS AND REACTORS**  
**COMPLETE WITH ALL ACCESSORIES AND COMPONENTS**  
**of voltage above 33 kV and up to 400 kV**  
**of supplied against domestic contracts**

This price variation clause is applicable for Transformers and Reactors of voltage above 33 kV and up to 400 KV supplied against domestic contracts. A separate price variation clause IEEMA/PVC/PWR TRF\_Up to 400 KV/DE/2021 has been evolved for above types of Transformers and Reactors supplied against export/deemed export contracts.

The price quoted/confirmed is based on the input cost of raw materials/components and labour cost as on the date of quotation and the same is deemed to be related to prices of raw materials and all India average consumer price index number for industrial workers as specified in the price variation clause given below. In case of any variation in these prices and index numbers, the price payable shall be subject to adjustment, up or down in accordance with the following formula:

$$P = \frac{P_0}{100} \left( 6 + 32 \frac{C}{C_0} + 27 \frac{ES}{ES_0} + 12 \frac{IS}{IS_0} + 4 \frac{IM}{IM_0} + 9 \frac{TO}{TO_0} + 10 \frac{W}{W_0} \right)$$

Wherein,

- P = Price payable as adjusted in accordance with the above formula.
- P<sub>0</sub> = Price quoted/confirmed.
- C<sub>0</sub> = Price of CC copper rods (refer notes)  
This price is as applicable for the month, ONE month prior to the date of tendering.
- ES<sub>0</sub> = Price of CRGO Electrical Steel Lamination (refer note)  
This price is as applicable for the month, ONE months prior to the date of tendering.
- IS<sub>0</sub> = Average price of steel Plates 10 mm thick (refer notes)  
This price is as applicable for the month, ONE month prior to the date of tendering.
- IM<sub>0</sub> = Price of Insulating Materials (refer notes)  
This price is as applicable for the month, ONE months prior to the date of tendering.
- TO<sub>0</sub> = Price of Transformer Oil (refer notes)  
This price is as applicable for the month, ONE month prior to the date of tendering.
- W<sub>0</sub> = All India average consumer price index number for industrial workers, as published by the Labour Bureau, Ministry of Labour, Govt. of India (Base: 2016 = 100)  
This index number is as applicable for the month, THREE months prior to the date of tendering.

Page 1 of 12





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**IEEMA/PVC/PWR TRF\_Up to 400 KV/2021****Effective from: 1<sup>st</sup> September 2021**

For example, if date of tendering falls in December 2021, applicable prices of Copper Rods (C<sub>0</sub>), Steel Plates 10 mm thick (IS<sub>0</sub>), CRGO Electrical Steel Laminations (ES<sub>0</sub>) and Insulating material (IM<sub>0</sub>) and Transformer Oil (TO<sub>0</sub>) should be as on 1<sup>st</sup> November 2021 and all India average consumer price index no. (W<sub>0</sub>) should be for the month of 1<sup>st</sup> September 2021.

The above prices and indices are as published by IEEMA vide circular reference number IEEMA(PVC)/PWR\_DIST\_TRF (R-1)/\_/\_ ONE month prior to the date of tendering.

- C     = Price of CC copper rods (refer notes)  
This price is as applicable for the month, TWO months prior to the date of delivery.
- ES     = Price of CRGO Electrical Steel Lamination (refer note)  
This price is as applicable for the month, TWO months prior to the date of delivery.
- IS     = Average price of Steel Plates 10 mm thick (refer notes)  
This price is as applicable for the month, TWO months prior to the date of delivery.
- IM     = Price of Insulating Materials (refer notes)  
This price is as applicable for the month, TWO months prior to the date of delivery.
- TO     = Price of Transformer Oil (refer notes)  
This price is as applicable for the month, ONE month prior to the date of delivery.
- W     = All India average consumer price index number for industrial workers, as published by the Labour Bureau, Ministry of Labour, Govt. of India (Base: 2016 = 100)  
This index number is as applicable for the month, THREE months prior to the date of delivery.

For example, if date of delivery in terms of clause given below falls in December 2022, applicable prices of Copper Rods (C), Insulating material (IM), CRGO Electrical Steel Lamination (ES), Plates 10 mm thick (IS) should be as on 1<sup>st</sup> October 2022 and Transformer Oil (TO) should be 1<sup>st</sup> November 2022 and all India average consumer price index no. (W) should be for the month of September 2022.

The date of delivery is the date on which the transformer is notified as being ready for inspection/dispatch (in the absence of such notification, the date of manufacturer's dispatch note is to be considered as the date of delivery) or the contracted delivery date (including any agreed extension thereto), whichever is earlier.

Page 2 of 12



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**IEEMA/PVC/PWR TRF\_upto 400 KV/2021****Effective from: 1<sup>st</sup> September 2021**

Note: All prices are exclusive of GST and exclusive of any other central, state or local taxes etc.

a) The details of prices are as under:

1. Price of 8 mm CC copper rod (in Rs./MT) is ex-works price as quoted by the primary producer.
2. The price of CRGO is the price of CRGO Electrical Steel Lamination in Rs./MT suitable for Transformers of voltage above 33 kV and up to 400 kV
3. Price of Steel is the average retail price of steel plates 10 mm thick as published by Joint Plant Committee (JPC) in Rs./MT
4. The price of Insulating materials (in Rs./Kg) of pre-compressed pressboards of size 10 mm thick, 3200 mm x 4100 mm is the average C&F price in free currency per MT converted into Indian Rupees with applicable exchange rates prevailing as on 1<sup>st</sup> working day of the month as quoted by primary suppliers. This price is the landed cost, inclusive of applicable customs duty only but exclusive of countervailing duty.
5. The price of Transformer Oil (in Rs./K.Ltr) is the average price on ex-refinery basis as quoted by primary producers for supply in drums.

b) Some purchasers are purchasing oil immersed Transformers from manufacturers without first filling of oil. Oil for first filling is procured and filled by the purchasers. For such supplies PVC formula, excluding Oil will apply as under:

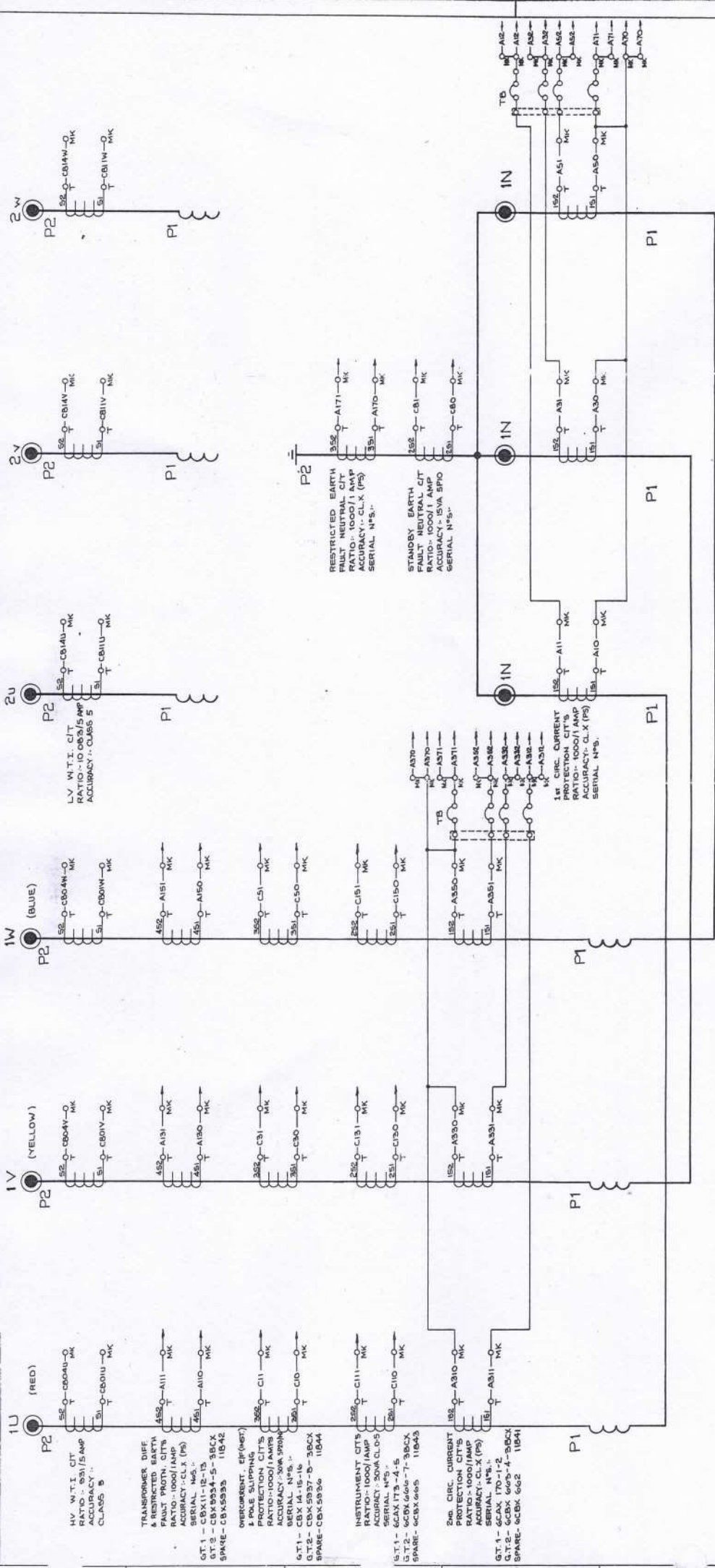
$$P = \frac{P_o}{91} \left( 6 + 32 \frac{C}{C_o} + 27 \frac{ES}{ES_o} + 12 \frac{IS}{IS_o} + 4 \frac{IM}{IM_o} + 10 \frac{W}{W_o} \right)$$

Where description of P, P<sub>o</sub>, C, ES, IS, IM, W etc. remains same as mentioned earlier.

Director

Page 3 of 12





NOTES

- 1. -T- DENOTES TERMINAL IN CIT SECONDARY TERMINAL BOX
- 2. -O- DENOTES TERMINAL IN MARSHALLING KIOSK (KLIPPON TYPE RSP 1)
- 3. -X- DENOTES SHORTING/DISCONNECTING/TESTING FACILITY IN MARSHALLING KIOSK (KLIPPON TYPE RSP 2)
- 4. -E- DENOTES EARTH LINK (BOLTED TYPE)
- 5. TRANSFORMER ORDER NOS AND SERIAL NOS CORRESPOND TO UNITS AS FOLLOWS

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| DATE:    | REV | MODIFICATION   |
|----------|-----|--|
| 8-8-84   | A   | CIT SECONDARY TERMINAL BOX, PEEBLES POWER TRANSFORMERS |
| 11-11-84 | B   | 400V BUSING CITS MODIFIED                              |
| 28-6-85  | C   | 400V BUSING CITS MODIFIED                              |
| 22-10-85 | D   | 400V BUSING CITS MODIFIED                              |
| 24-4-86  | E   | 400V BUSING CITS MODIFIED                              |
| 30-10-86 | F   | 400V BUSING CITS MODIFIED                              |
| 30-10-86 | G   | 400V BUSING CITS MODIFIED                              |
| 30-10-86 | H   | 400V BUSING CITS MODIFIED                              |

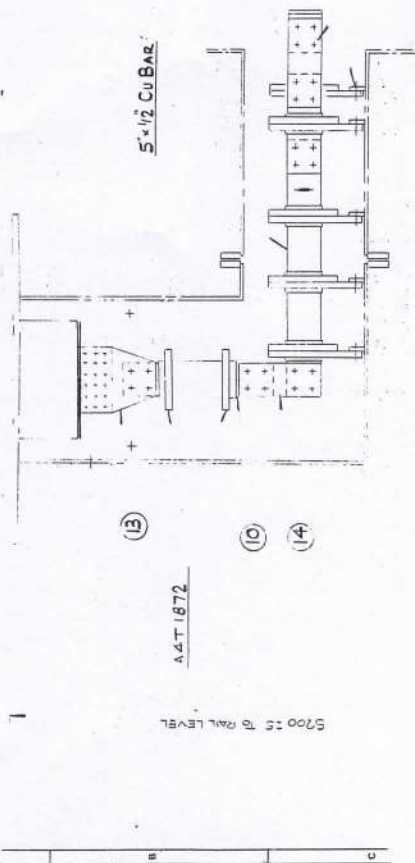
|   |                       |
|---|-----------------------|
| NTPC DRAWING No.                                  |                       |
| NEI PROJECTS LIMITED NEWCASTLE-UPON-TYNE ENGLAND  |                       |
| RIHAND STPP - 2 x 500 MW UNITS STAGE 1            |                       |
| NATIONAL THERMAL POWER CORPORATION LIMITED, INDIA |                       |
| SPEC. TITLE                                       | GENERATOR TRANSFORMER |
| PROJECT DRAWING No.                               | 310/1304/3318         |
| SHEET No.   | REV No.               |
| 05  | 05                    |

| REFERENCE DRAWINGS                    |                                   |
|---------------------------------------|-----------------------------------|
| RIHAND STPP                           | DIAGRAMMATIC ARRANGEMENT OF CITS  |
| FOR A 605 MVA, 20/400 KV, 3 x 1 PHASE | QFWF COOLED GENERATOR TRANSFORMER |
| NEI PROJECTS ORDER No.                |                                   |

PEEBLES POWER TRANSFORMERS EDINBURGH

|              |                    |                   |
|--------------|--------------------|-------------------|
| SCALE: DIAG. | ORDER NO. T0429757 | DRG. NO. CSB 2369 |
|--------------|--------------------|-------------------|



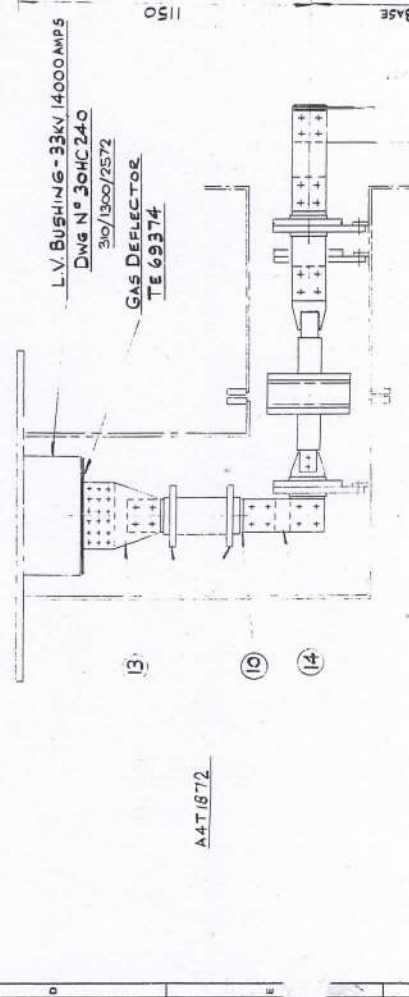


AIT 1872

5700 IS B RAIL LEVEL

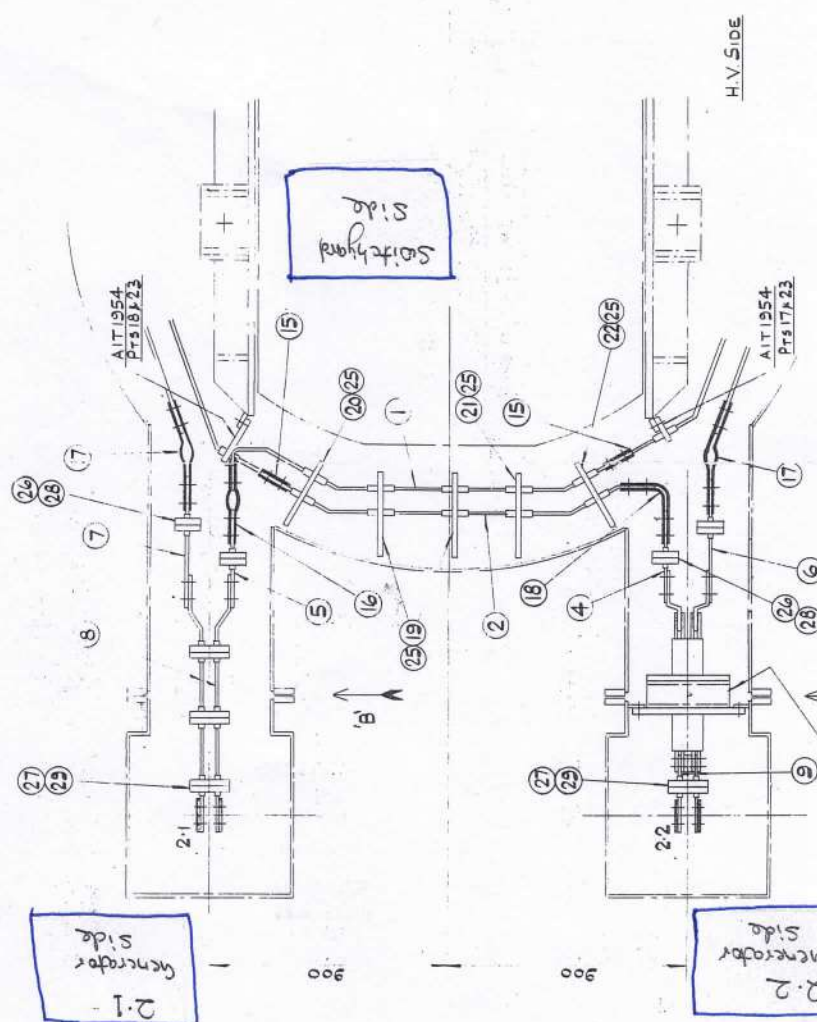
MATERIAL FOR FIXINGS  
AUSTENITIC STEEL

VIEW IN DIRECTION OF ARROW B



AIT 1872

VIEW IN DIRECTION OF ARROW A



For Arrangement Details  
OF V.T.I. C/T  
SEE AIT 2335

|   |  |                                 |  |
|---|--|---------------------------------|--|
| NTPC DRAWING No.                                  |  | NEWCASTLE-UPON-TYNE ENGLAND     |  |
| NEI PROJECTS LIMITED                              |  | RIHAND ST.PP - 2 x 500 MW UNITS |  |
| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  | SPECIFICATION No. CC-72-071     |  |
| PROJECT TITLE                                     |  | GENERATOR TRANSFORMER           |  |
| PROJECT DRAWING No.                               |  | 310/1300/2570                   |  |
| REFERENCE DRAWINGS                                |  | DRAWING TITLE                   |  |
| ARRG OF H.V. L.V. LEADS - AIT 1995                |  | ARRANGEMENT SHOWING L.V. BUSBAR |  |
| ARRG OF LV TAP LEADS - TA316/30                   |  | RUNS TO BUSHINGS                |  |
| ARRG OF LV TAP LEADS - TA316/30                   |  | 310/1300/2580                   |  |
| SHEET No  |  | REV No                          |  |
| 01  |  | 01                              |  |

PEEBLES POWER TRANSFORMERS EDINBURGH

DRG. NO. AIT 1974

SCALE: 1/10

ORDER NO. TON 29757

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NEI PROJECTS LTD.

DATE: 22-10-84

REV

MODIFICATION

REF E8 PAT NOS 1 & 15

MODIFIED

CHECKED: F3 12-3-85

APPROVED: F3 12-3-85

TRACED:

REV

MODIFICATION

DATE

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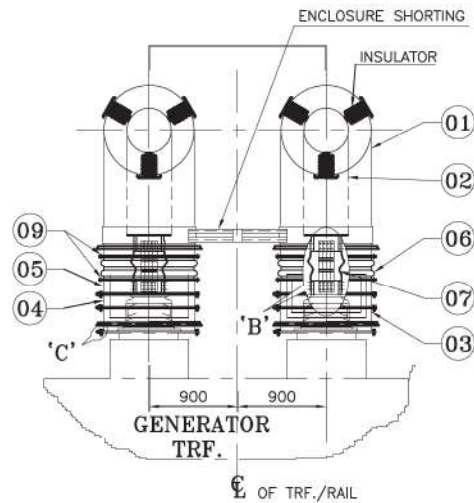
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REV

MODIFICATION

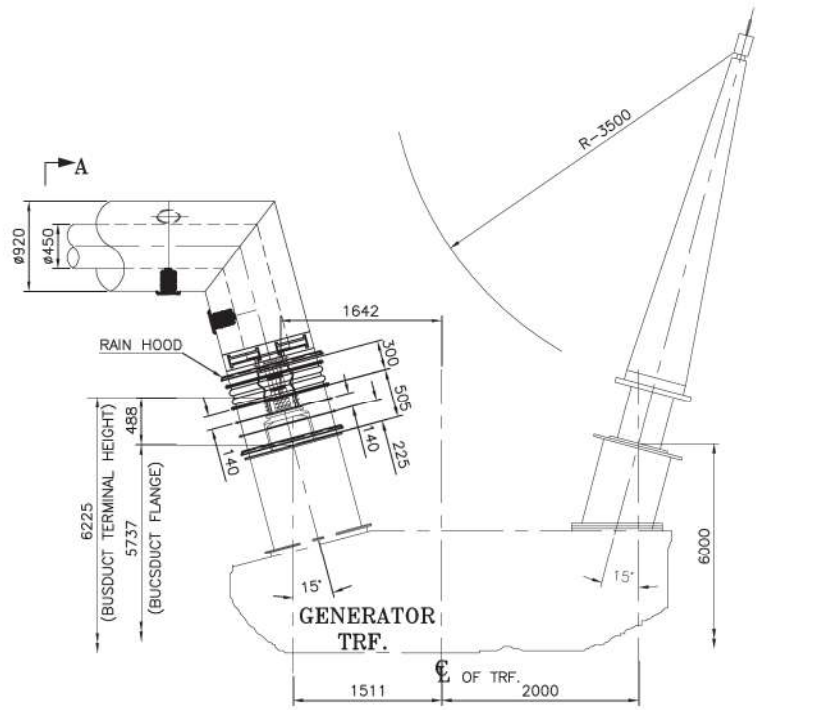
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REV

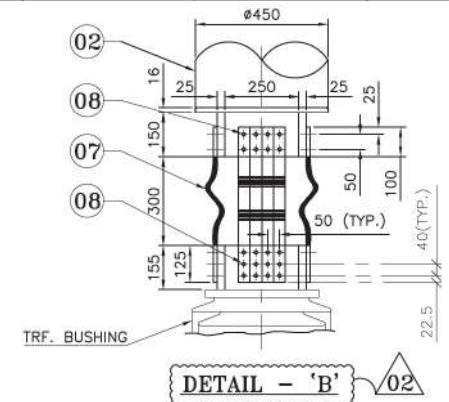


EL. 0.00M  
RAIL LEVEL

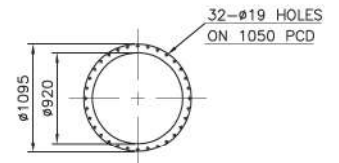
VIEW - AA'



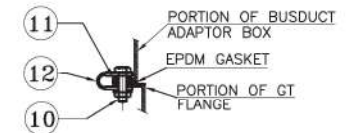
ELEVATION



DETAIL - 'B'



GEN. TRF. FLANGE DETAIL



DETAIL - 'C'  
(ENLARGED VIEW)

**BILL OF MATERIALS-**

| ITEM.NO. | DESCRIPTION                            | MATL.              | QTY.     |
|----------|--|--------------------|----------|
| 1        | ENCLOSURE - 920 OD 6.5 THK.            | AL. ALLOY-19500    | --       |
| 2        | BUSBAR - 450 OD. 12 THK.               | AL. ALLOY-19501    | --       |
| 3,4,5    | ADAPTOR BOX 6.5 THK.                   | AL. ALLOY-19500    | 6 NOS    |
| 6        | RUBBER BELLOW Ø920 (FLANGE (TYPE)      | EPDM               | 2 NOS    |
| 7        | BRAIDED FLEXIBLE (700 SQ MM)           | COPPER             | 32 NOS   |
| 8        | BOLT M12x80+N+1PW+1BVW                 | SS                 | 160 SETS |
| 9        | BOLT M10x50+N+2PW+1SW                  | HTS ELECTRO GALVD. | 160 SETS |
| 10       | BOLT M12x50+N+2PW+1SW                  | HTS ELECTRO GALVD. | 64 SETS  |
| 11       | FRP SLEEVE & WASHER (TO SUIT M12 BOLT) | FRP                | 64 SETS  |
| 12       | EARTHING FLEXIBLE BRAIDED (100 SQ. MM) | COPPER             | 6 NOS    |

This drawing may be referred only for Bus duct flange details

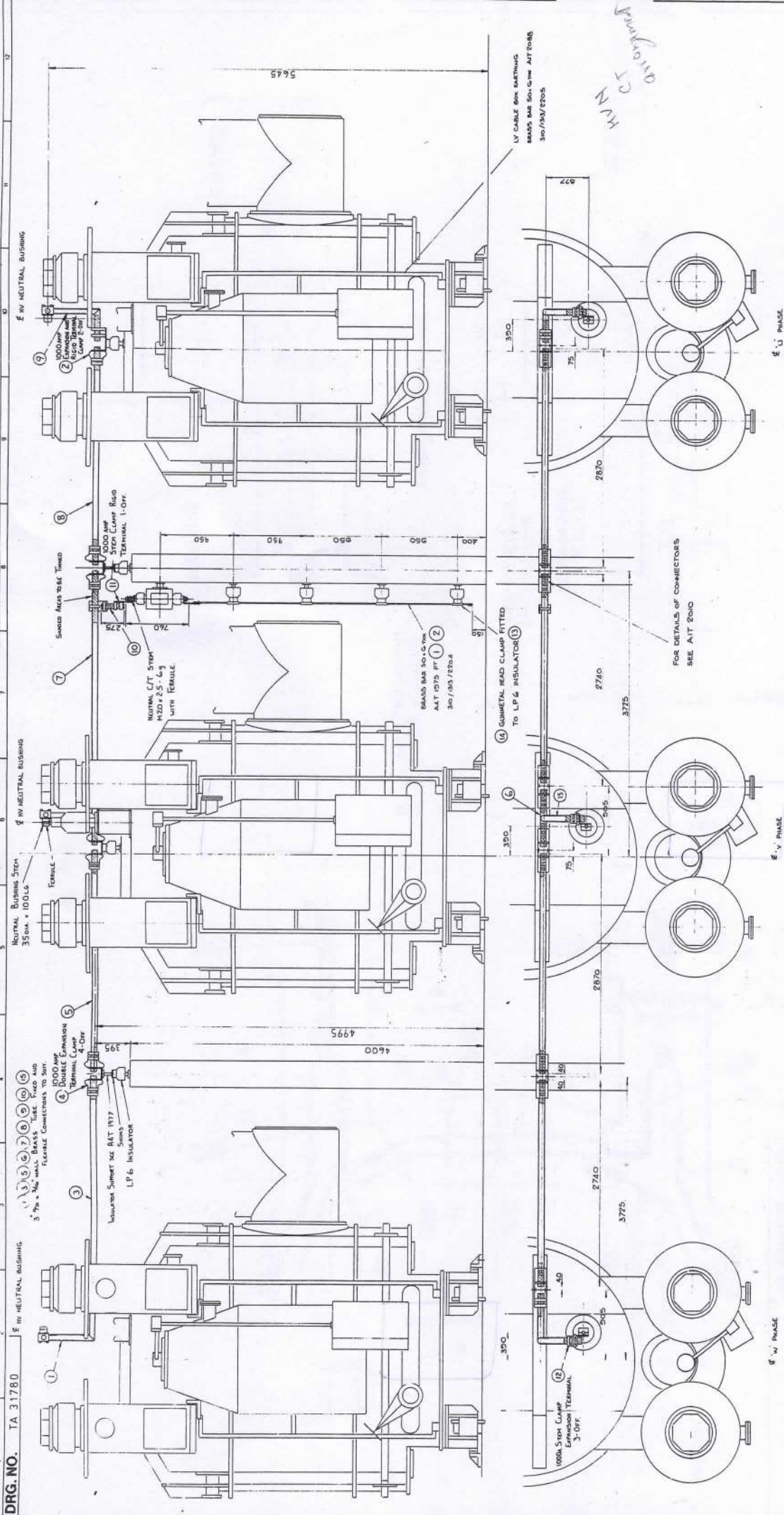
**GEN. NOTE/REF. DRGS.:-**

1. NTPC DRG. NO. 3530-501-PVE-B-001 (GENERAL ARRANGEMENT FOR 200MVA, GSU TRANSFORMER)
2. ABB DRG. NO. 2751312-75 (BUSHING GOH 170-16 LC)
3. CONTACT SURFACE OF BUSBAR JOINTS SHALL BE SILVER PLATED.









|   |  |  |  |  |  |  |  |  |  |                                 |  |  |  |  |  |  |  |  |  |
|---|--|--|--|--|--|--|--|--|--|---------------------------------|--|--|--|--|--|--|--|--|--|
| <div>NEI PROJECTS LIMITED NEWCASTLE-UPON-TYNE ENGLAND</div> <div>RHANG ST.BP.- 2 x 500 MW UNITS</div> <div>NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA</div> <div>SPEC. TITLE GENERATOR TRANSFORMER CC-72-071</div> <div>SHEET NUMBER CC-72-071</div> <div>SHEET NAME HV GR</div> |  |  |  |  |  |  |  |  |  | NTPC DRAWING No.                |  |  |  |  |  |  |  |  |  |
| PROJECT DRAWING No. 310/1313/ 2203  |  |  |  |  |  |  |  |  |  | DRAWING TITLE                   |  |  |  |  |  |  |  |  |  |
| HV NEUTRAL C/T EARTHING ARRANGEMENT   |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK      |  |  |  |  |  |  |  |  |  |
| DRG. NO. TA 31780   |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO |  |  |  |  |  |  |  |  |  |

|   |  |  |  |  |  |  |  |  |  |                                    |  |  |  |  |  |  |  |  |  |
|---|--|--|--|--|--|--|--|--|--|------------------------------------|--|--|--|--|--|--|--|--|--|
| NEI PROJECTS LIMITED NEWCASTLE-UPON-TYNE ENGLAND  |  |  |  |  |  |  |  |  |  | NTPC DRAWING No.                   |  |  |  |  |  |  |  |  |  |
| RANG ST.BP.- 2 x 500 MW UNITS                     |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
| SHEET NAME HV GR                                  |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| HV NEUTRAL C/T EARTHING ARRANGEMENT               |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| NEI PROJECTS LIMITED NEWCASTLE-UPON-TYNE ENGLAND  |  |  |  |  |  |  |  |  |  | NTPC DRAWING No.                   |  |  |  |  |  |  |  |  |  |
| RANG ST.BP.- 2 x 500 MW UNITS                     |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
| SHEET NAME HV GR                                  |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| HV NEUTRAL C/T EARTHING ARRANGEMENT               |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| NEI PROJECTS LIMITED NEWCASTLE-UPON-TYNE ENGLAND  |  |  |  |  |  |  |  |  |  | NTPC DRAWING No.                   |  |  |  |  |  |  |  |  |  |
| RANG ST.BP.- 2 x 500 MW UNITS                     |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
| SHEET NAME HV GR                                  |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| HV NEUTRAL C/T EARTHING ARRANGEMENT               |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| RANG ST.BP.- 2 x 500 MW UNITS                     |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
| SHEET NAME HV GR                                  |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| HV NEUTRAL C/T EARTHING ARRANGEMENT               |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
| SHEET NAME HV GR                                  |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| HV NEUTRAL C/T EARTHING ARRANGEMENT               |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
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| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
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| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
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| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
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| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
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| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
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| HV NEUTRAL C/T EARTHING ARRANGEMENT               |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
| SHEET NAME HV GR                                  |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| HV NEUTRAL C/T EARTHING ARRANGEMENT               |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| NEI PROJECTS LIMITED NEWCASTLE-UPON-TYNE ENGLAND  |  |  |  |  |  |  |  |  |  | NTPC DRAWING No.                   |  |  |  |  |  |  |  |  |  |
| RANG ST.BP.- 2 x 500 MW UNITS                     |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
| SHEET NAME HV GR                                  |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| HV NEUTRAL C/T EARTHING ARRANGEMENT               |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| NEI PROJECTS LIMITED NEWCASTLE-UPON-TYNE ENGLAND  |  |  |  |  |  |  |  |  |  | NTPC DRAWING No.                   |  |  |  |  |  |  |  |  |  |
| RANG ST.BP.- 2 x 500 MW UNITS                     |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
| SHEET NAME HV GR                                  |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| HV NEUTRAL C/T EARTHING ARRANGEMENT               |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| RANG ST.BP.- 2 x 500 MW UNITS                     |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
| SHEET NAME HV GR                                  |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| HV NEUTRAL C/T EARTHING ARRANGEMENT               |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| RANG ST.BP.- 2 x 500 MW UNITS                     |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
| SHEET NAME HV GR                                  |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| HV NEUTRAL C/T EARTHING ARRANGEMENT               |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| RANG ST.BP.- 2 x 500 MW UNITS                     |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
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| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
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| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
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| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
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| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
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| HV NEUTRAL C/T EARTHING ARRANGEMENT               |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
| SHEET NAME HV GR                                  |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| HV NEUTRAL C/T EARTHING ARRANGEMENT               |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| NEI PROJECTS LIMITED NEWCASTLE-UPON-TYNE ENGLAND  |  |  |  |  |  |  |  |  |  | NTPC DRAWING No.                   |  |  |  |  |  |  |  |  |  |
| RANG ST.BP.- 2 x 500 MW UNITS                     |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
| SHEET NAME HV GR                                  |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| HV NEUTRAL C/T EARTHING ARRANGEMENT               |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| NEI PROJECTS LIMITED NEWCASTLE-UPON-TYNE ENGLAND  |  |  |  |  |  |  |  |  |  | NTPC DRAWING No.                   |  |  |  |  |  |  |  |  |  |
| RANG ST.BP.- 2 x 500 MW UNITS                     |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
| SHEET NAME HV GR                                  |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| HV NEUTRAL C/T EARTHING ARRANGEMENT               |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| NEI PROJECTS LIMITED NEWCASTLE-UPON-TYNE ENGLAND  |  |  |  |  |  |  |  |  |  | NTPC DRAWING No.                   |  |  |  |  |  |  |  |  |  |
| RANG ST.BP.- 2 x 500 MW UNITS                     |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
| SHEET NAME HV GR                                  |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| HV NEUTRAL C/T EARTHING ARRANGEMENT               |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| NEI PROJECTS LIMITED NEWCASTLE-UPON-TYNE ENGLAND  |  |  |  |  |  |  |  |  |  | NTPC DRAWING No.                   |  |  |  |  |  |  |  |  |  |
| RANG ST.BP.- 2 x 500 MW UNITS                     |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
| SHEET NAME HV GR                                  |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| HV NEUTRAL C/T EARTHING ARRANGEMENT               |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| NEI PROJECTS LIMITED NEWCASTLE-UPON-TYNE ENGLAND  |  |  |  |  |  |  |  |  |  | NTPC DRAWING No.                   |  |  |  |  |  |  |  |  |  |
| RANG ST.BP.- 2 x 500 MW UNITS                     |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
| SHEET NAME HV GR                                  |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| HV NEUTRAL C/T EARTHING ARRANGEMENT               |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| NEI PROJECTS LIMITED NEWCASTLE-UPON-TYNE ENGLAND  |  |  |  |  |  |  |  |  |  | NTPC DRAWING No.                   |  |  |  |  |  |  |  |  |  |
| RANG ST.BP.- 2 x 500 MW UNITS                     |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
| SHEET NAME HV GR                                  |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| HV NEUTRAL C/T EARTHING ARRANGEMENT               |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| NEI PROJECTS LIMITED NEWCASTLE-UPON-TYNE ENGLAND  |  |  |  |  |  |  |  |  |  | NTPC DRAWING No.                   |  |  |  |  |  |  |  |  |  |
| RANG ST.BP.- 2 x 500 MW UNITS                     |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| SPEC. TITLE GENERATOR TRANSFORMER CC-72-071       |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |
| SHEET NUMBER CC-72-071                            |  |  |  |  |  |  |  |  |  | PROJECT DRAWING No. 310/1313/ 2203 |  |  |  |  |  |  |  |  |  |
| SHEET NAME HV GR                                  |  |  |  |  |  |  |  |  |  | DRAWING TITLE                      |  |  |  |  |  |  |  |  |  |
| HV NEUTRAL C/T EARTHING ARRANGEMENT               |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK         |  |  |  |  |  |  |  |  |  |
| DRG. NO. TA 31780                                 |  |  |  |  |  |  |  |  |  | SCALE 1:20 ORDER NO. TOR Z/N/LO    |  |  |  |  |  |  |  |  |  |

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| NEI PROJECTS LIMITED NEWCASTLE-UPON-TYNE ENGLAND  |  |  |  |  |  |  |  |  |  | NTPC DRAWING No.           |  |  |  |  |  |  |  |  |  |
| RANG ST.BP.- 2 x 500 MW UNITS                     |  |  |  |  |  |  |  |  |  | DRAWING TITLE              |  |  |  |  |  |  |  |  |  |
| NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA |  |  |  |  |  |  |  |  |  | GENERATOR TRANSFORMER BANK |  |  |  |  |  |  |  |  |  |
| SPEC. TITLE GENERATOR TRANSFORMER CC-72-0         |  |  |  |  |  |  |  |  |  |                            |  |  |  |  |  |  |  |  |  |



MACHINED  
LENGTH ALL  
FACES.

Ø14-6 HOLES  
IN EACH PALM

Ø655 NOM.

GAS BUBBLE  
DEFLECTOR  
SUPPLIED BY  
TRANSFORMER  
MANUFACTURER.

CAST COPPER  
PALMS SILVER  
PLATED.

PALMS SILVER PLATED.

MACHINED LENGTH  
ALL FACES.

Ø19-16 HOLES  
EQUALLY SPACED  
AS SHOWN ON  
546 P.C.DIA.

8 CAST COPPER PALMS  
EQUALLY SPACED  
SILVER PLATED

AIR RELEASE PLUG

VIEW WITH PORCELAIN SHEDS REMOVED.

### BUSHING CHARACTERISTICS.

|  |        |
|--|--------|
| NOMINAL SYSTEM VOLTAGE BETWEEN PHASES                    | 36KV.  |
| TEST VOLTAGES.   |        |
| ROUTINE WITHSTAND TEST (1 MIN. POWER FREQUENCY)          | 75KV.  |
| MINIMUM WET WITHSTAND VOLTAGE (1 MIN. POWER FREQUENCY)   | 75KV.  |
| MINIMUM NEGATIVE LIGHTNING IMPULSE WITHSTAND (1/50 WAVE) | 200KV. |
| MAXIMUM HORIZONTAL FORCE (CANTILEVER)                    | 200KG. |
| MINIMUM TOTAL CREEPAGE DISTANCE                          | 870    |

1. OPERATING CONDITIONS SUITABLE FOR OPERATION WITH HOT SPILT TEMPERATURE UP TO 110°C WITH AIR TEMPERATURE OF 50°C OR LOWER AND OIL TEMPERATURE OF 60°C OR LOWER
2. THIS RATING IS ONLY APPLICABLE WHEN THE EXTERNAL CONNECTION ARRANGEMENTS MAKE NO CONTRIBUTION TO THE TEMPERATURE RISE OF THE BUSHING.

WEIGHT OF BUSHING 420 KG.

# BUSHING

The Bushings Company Limited, England

S.R.B.P. TRANSFORMER BUSHING  
CONSERVATOR FILLED 36KV. 14000 AMPS.

## 30HC240B

NTPC DRAWING No.

NEI PROJECTS LIMITED NEWCASTLE-UPON-TYNE ENGLAND

RIHAND S.T.P.P. - 2 x 500 MW UNITS  
NATIONAL THERMAL POWER CORPORATION LIMITED. INDIA

SPEC. TITLE

GENERATOR TRANSFORMER

SPECIFICATION No.

CC-72-071

PROJECT DRAWING No.

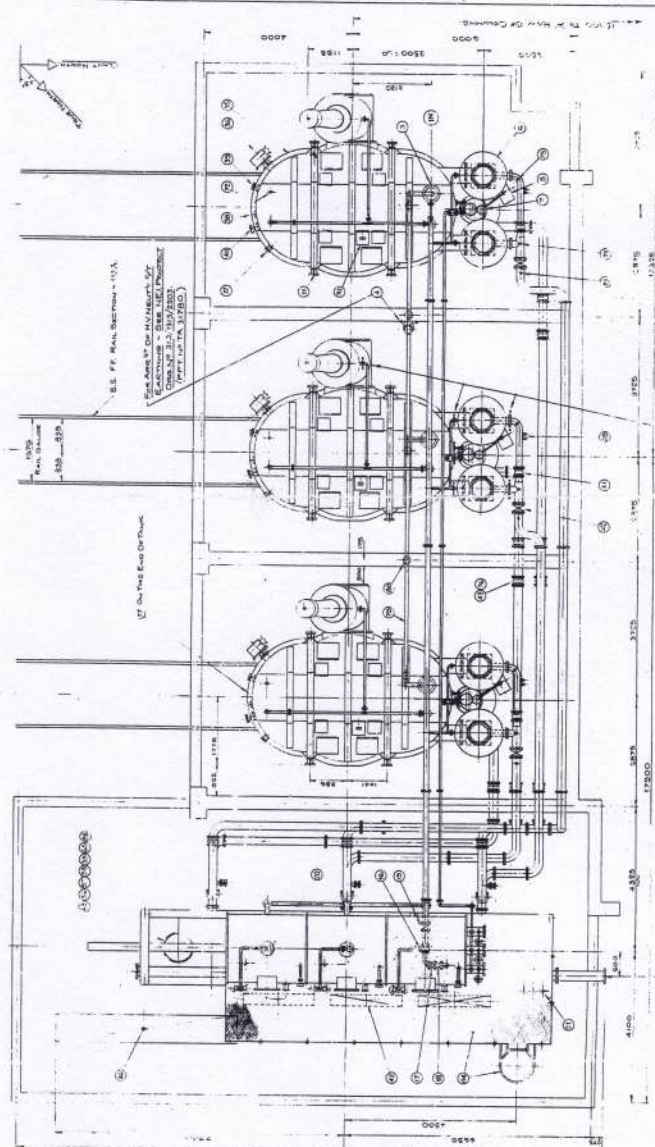
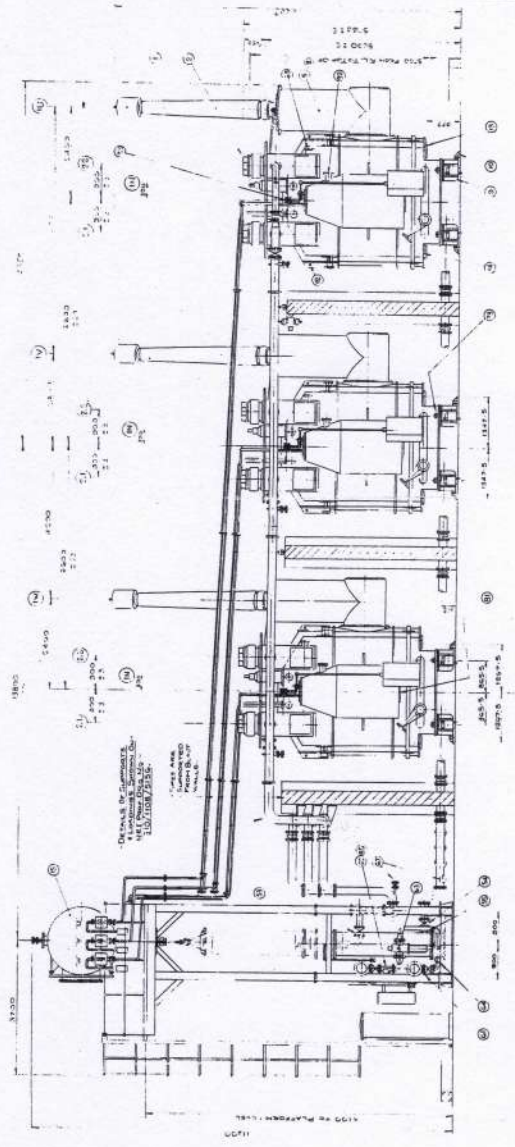
310/1300/2572

SHEET No. REV No.

02

LV Bushing



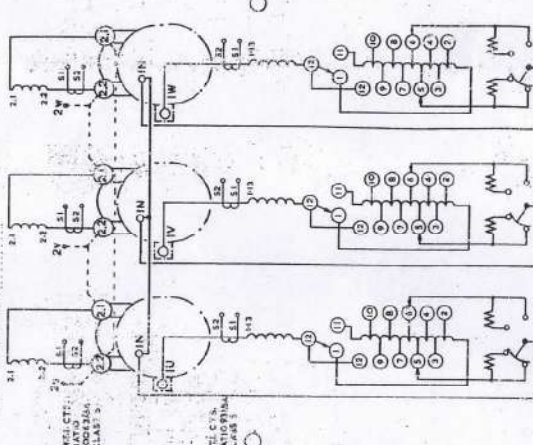


| L.C. 3-2000S PLANT PACKAGE ETC. FOR 3 SINGLE PHASE BANK |       |
|---|-------|
| 3000 KW   | 11800 |
| 3000 KW   | 5000  |
| 3000 KW   | 27000 |
| TOTAL   | 43800 |
| 3000 KW   | 25000 |

[illegible]



Generator Transformer to 15.20kV 1677  
MVA: 405 Vector Symbols Vnd Frequency 50 hertz  
LV (no load) HV 400-0 LV 20-0  
Apparatus HV 873-0 LV 10083  
Phase (bank) HV 3 LV 3  
Impedance volts on position 14 and at 75°C %  
Type of cooling O.F.W.  
Insulation level (kV) LV 1300 LV 170 Bushing HV 1425 LV 200  
Temperature rise oil 55°C Max. Ambient Water temp. 35°C  
Temperature rise oil 50°C  
Oil quantities per single phase unit:  
Transformer 32670 litres 28202 kg  
Cooling plant & conservator 4600 litres 4118 kg  
Tapchanger 1300 litres 1124 kg  
Metal oil 37800 litres 32422 kg  
Mass per single phase unit:  
Core and windings 37000 kg  
Tank and fittings 25000 kg  
Total weight 62000 kg  
Unloading weight (tank cover) 10000 kg  
Transport excluding oil 10000 kg  
Mass of conservator & Gantry 35000 kg  
Water circulation per three phase bank 75 litres/second  
Manufacturer's Serial No. Year of manufacture



| Low voltage across<br>2u, 2v, 2w | kV    | Amps | Indicator<br>position<br>number | Switch connects | High voltage across<br>1u, 1v, 1w<br>with LV constant | Impedance<br>Volts % |
|----------------------------------|-------|------|---------------------------------|-----------------|---|----------------------|
|                                  |       |      |                                 |                 |   |                      |
| 20-0                             | 10083 |      | 1                               | N-2 11-12       | 400-2 752-5   |                      |
|                                  |       |      | 2                               | N-3 11-12       | 400-2 752-5   |                      |
|                                  |       |      | 3                               | N-4 11-12       | 400-2 752-5   |                      |
|                                  |       |      | 4                               | N-5 11-12       | 400-2 752-5   |                      |
|                                  |       |      | 5                               | N-6 11-12       | 400-2 752-5   |                      |
|                                  |       |      | 6                               | N-7 11-12       | 400-2 752-5   |                      |
|                                  |       |      | 7                               | N-8 11-12       | 400-2 752-5   |                      |
|                                  |       |      | 8                               | N-9 11-12       | 400-2 752-5   |                      |
|                                  |       |      | 9                               | N-10 11-12      | 400-2 752-5   |                      |
|                                  |       |      | 10                              | N-11 11-12      | 400-2 752-5   |                      |
|                                  |       |      | 11                              | N-12 11-12      | 400-2 752-5   |                      |
|                                  |       |      | 12                              | N-13 11-12      | 400-2 752-5   |                      |
|                                  |       |      | 13                              | N-14 11-12      | 400-2 752-5   |                      |
|                                  |       |      | 14                              | N-15 11-12      | 400-2 752-5   |                      |
|                                  |       |      | 15                              | N-16 11-12      | 400-2 752-5   |                      |
|                                  |       |      | 16                              | N-17 11-12      | 400-2 752-5   |                      |
|                                  |       |      | 17                              | N-18 11-12      | 400-2 752-5   |                      |
|                                  |       |      | 18                              | N-19 11-12      | 400-2 752-5   |                      |
|                                  |       |      | 19                              | N-20 11-12      | 400-2 752-5   |                      |

Drawing No. 310/1304/2300  
Customer: NTPC India  
Project: Rihand STPP

NOTES:-

- Material:- 2mm (14SWG) THK Stainless Steel Type 304 (18/8/2-5MO) with a No.4 Finish in accordance with BS1449 Part 2.
- Chemically Engraved. Put. Size as Drawn.
- Engraving to be Weatherproof Glossy Black.
- Impedance to be Engraved on Plate after test.

BANK 1

| Order No. | Serial No. | Year of Manf. |
|-----------|------------|---------------|
| TOX 29757 | 44399      | 1985          |
| TOX 29758 | 44400      | 1985          |
| TOX 29759 | 44401      | 1985          |

BANK 2

| Order No. | Serial No. | Year of Manf. |
|-----------|------------|---------------|
| TOX 29762 | 44403      | 1986          |
| TOX 29763 | 44404      | 1986          |
| TOX 29764 | 44405      | 1986          |

SPARE

|           |       |      |
|-----------|-------|------|
| TOX 29761 | 44402 | 1985 |
|-----------|-------|------|

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NEE PEEBLES LTD.

DATE: 20-9-83  
DRAWN: G.B.  
CHECKED: P.12  
APPROVED: P.12  
TRACED:

| REV | MODIFICATION   | SIGN & DATE     | REV | MODIFICATION                    | SIGN & DATE     | REV | MODIFICATION                      | SIGN & DATE    |
|-----|--|-----------------|-----|---------------------------------|-----------------|-----|-----------------------------------|----------------|
| A   | Tank shape, title block & N.Y. voltages modified. LV external delta connections added. | 13-6-84<br>G.B. | C   | Insul. levels (kV RMS) added.   | 4-3-85<br>G.B.  | E   | Sht. 1 of 2 deleted from drg. No. | 7-2-88<br>G.B. |
| B   | Pushing impulse levels Max. ambient water temp., Customer's name & project added.      | 10-1-85<br>G.B. | D   | Oil quantities & weights added. | 1-10-85<br>G.B. | F   |                                   |                |
|     |  |                 |     |                                 |                 | G   |                                   |                |
|     |  |                 |     |                                 |                 | H   |                                   |                |

PEEBLES POWER TRANSFORMERS EDINBURGH

NTPC DRAWING No.  
NEI PROJECTS LIMITED NEWCASTLE-UPON-TYNE ENGLAND  
RIHAND ST.P.P. - 2 x 500 MW UNITS  
NATIONAL THERMAL POWER CORPORATION LIMITED, INDIA  
SPEC TITLE GENERATOR TRANSFORMERS  
PROJECT DRAWING No. 310/1304/2300

REFERENCE DRAWINGS  
WSB017  
SCALE: F.S.  
ORDER NO. TOX 29763/085W1  
TOX 29762/304  
DRAWING TITLE  
RIHAND STPP  
RATING & DIAGRAM PLATE  
405 MVA 20/400 kV 3 x Ø 50-OFWF COOLED  
GENERATOR TRANSFORMER BANK  
DRG. NO. AIT1754

PART 1 : PLANT DESCRIPTION

1.1 RATING

1.2 GENERAL ARRANGEMENT

- 1.2.1 Core Construction
- 1.2.2 Windings
- 1.2.3 Tank and Fittings
- 1.2.4 Cooling Plant
- 1.2.5 On Load Tapchanger

1.3 TECHNICAL DATA SUMMARY

1.4 DRAWINGS LIST



## PART 1 : PLANT DESCRIPTION

The information contained in this manual is applicable to the two 3 phase banks of Generator Transformers and the Single Phase Spare Generator Transformer bearing the following Serial numbers.

Generator Transformer 1 - 44399 - 444401  
Generator Transformer 2 - 44403 - 44405  
Spare Phase - 44402

### 1.1 RATING

Each transformer bank is suitable for continuous primary to secondary loading of 605 MVA, (3 X 201.7 MVA Single Phase Units), each unit has 100% oil forced/water forced (OFWF) cooling capacity +100% standby.

The voltage ratio is 20/400kV, with tapplings on the high voltage windings for a variation of plus 16.25% to minus 6.25% in 18 steps of 1.25% actuated by means of an on-load tapchange gear. (19 Tap Positions).

Winding connections are:

|                  |                      |
|------------------|----------------------|
| L.V. (2-Layer) - | Delta Connected Bank |
| H.V. -           | Star Connected Bank  |
| Tapping -        | Star Connected Bank  |

Vector Group:-

YNd1

### 1.2 GENERAL ARRANGEMENT

#### 1.2.1 Core Construction

The cores are of single phase, 3-limb (1-wound limb) construction with mitred joints. Laminations of high-grade cold-reduced grain-oriented core steel are used, annealed before and after cutting. The laminations are insulated by a phosphate coating applied during the manufacture of the sheet and an additional coating of varnish.

The limbs are secured with bands of resin-bonded glass tape wound on under tension and cured by heat treatment. The yokes are securely clamped between top and bottom core clamps, which in turn are fitted with steel tie rods to relieve the strain on the core during lifting.

The cores and clamps are securely earthed to the tank at one point only.

#### 1.2.2 Windings

These are arranged in the following order, proceeding outwards from

| <u>Winding</u> | <u>Type</u>                     |
|----------------|---------------------------------|
| L.V.           | - Two Layer, Spiral             |
| H.V.           | - Continuous & Interleaved Disc |
| Tapping        | - Inter Spiral                  |

The HV windings are arranged with axial and radial ducts so that each turn of the windings is in contact with the cooling oil. The flow of oil through the windings is directed in both axial and radial directions. (L.V. & Tap Windings Excluded).

Windings conductors are insulated with paper for the LV/HV/TAP windings and the windings are clamped between the top and bottom clamp rings, adjustment of pressure being possible by means of clamping screws.

### 1.2.3 Tanks and Fittings

Each phase of the transformer core and winding assembly is contained in a steel plate tank adequately stiffened to allow full vacuum (760 mm of mercury) to be applied during filling and drying out operations. It should, however, be noted that during such operations the tapchanger diverter compartments should be equalised in pressure to that of each transformer tank.

(3-Phase Bank) Other fittings include:

- HV 3 Bushings (420 kV 1250Amp)
- LV 3 Bushings 33 kV 14000Amp
- HV Neutral Bushing 44 kV 1400 Amp
- Winding temperature indicator (6 off)
- Gas detector relay (Main Transformer) (3 off)
- || Surge Relay (O.L.T.C.) 3 off
- 3-Compartment main oil conservator, each fitted with rubber bag, prismatic and magnetic oil level gauges, low oil level alarm, and rapid pressure relay.
- 3 - Tapchanger oil conservators with prismatic oil gauges.
- Silica-gel dehydrating breathers with dust filters. (Main & OLTC Conservators).
- Drain and filter valves
- || Pressure relief device (1 off/Phase. Main tank and OLTC).
- Rating diagram plate
- Marshalling Box
- Cooler Control Cubicle
- Oil sampling device
- Oil Flow Indicator (6 off)
- Tap changer & Drive Mechanism (1 off/Phase)
- Jacking & Haulage Lugs
- Lifting Bollards
- Bi-Directional Flanged Wheels (1-Set/Phase)
- Oil Pumps
- Differential Pressure Gauges



The general arrangement is shown in the outline 310/1300/2550.

(Spare Generator Transformer) other Fittings Include:

H.V. Bushing (1 off)  
L.V. Bushing (2 off)  
Neutral Bushing (1 off)  
Conservator for storage complete with rubber bag and prismatic oil level gauge  
Silica Gel Breather  
Drain & Filter Valves  
Pressure Relief Device  
Rating & Diagram Plate  
Oil Sampling Device  
Jacking and Haulage Lugs  
Lifting Bollards  
Bi-Directional Flanged Wheels

#### 1.2.4 Cooling Plant (OFWF)

Cooling of the transformer is effected by a bank of oil/water coolers. The cooling plant will withstand full vacuum (760 mm of mercury) and consists of a bank of 6-coolers each of 100% rating, arranged as 2-100% units/phase. (1-unit in service, the other on standby) mounted on a support frame. Similarly 2-100% oil pumps are also mounted in the oil outlet pipework from each transformer tank (1-pump in service the other on standby). The conservator which maintains a head of oil on the system is mounted on top of the cooler assembly.

In the event of one oil pump for any phase failing, the other is automatically capable of maintaining the transformer at its full rating.

#### 1.2.5 On-Load Tapchanger

The on-load tapchangers are located in pockets at the end of each single phase transformer tank and are operated by a motor drive with step-by-step operation with local and remote control, mechanical and electrical position limitation. There is also a hand crank facility for emergency operation and adjustment purposes. For full details of the tapchanger operation, please refer to the on load tapchange operating instructions contained in Part 4 of this document.

1.3

TECHNICAL DATA SUMMARY

|                 |     |                               |
|-----------------|-----|-------------------------------|
| B.S. rating     | ... | 605 MVA (3-single phase bank) |
| Type of cooling | ... | OFWF                          |
| Voltage ratio   | ... | 400/20 kV                     |
| Tappings        | ... | HV + 16.25% to -6.25% steps   |

## Winding connections

|         |     |                      |
|---------|-----|----------------------|
| L.V.    | ... | Delta Connected Bank |
| H.V.    | ... | Star Connected Bank  |
| Tapping | ... | Star Connected Bank  |

|                           |     |      |
|---------------------------|-----|------|
| Vector Group (BS171/1959) | ... | YNd1 |
|---------------------------|-----|------|

## Coolers:

|      |     |          |
|------|-----|----------|
| Make | ... | GEA      |
| Type | ... | WKDS/800 |

## Bushings:

|            |     |                                   |
|------------|-----|-----------------------------------|
|            |     | Make and Type No                  |
| HV         | ... | Bushing Company<br>310/1300/2571. |
| LV         | ... | Bushing Company<br>310/1300/2572  |
| HV neutral | ... | Doulton 310/1300/2573             |

## Gas and oil operated relays: (Main Unit)

|                 |     |                                       |
|-----------------|-----|---------------------------------------|
| Make            | ... | Weir Electrical<br>Instrument Co. Ltd |
| Serial No.      | ... | FF929 FF801 FF802                     |
| Type            | ... | MK10/HF 3DE                           |
| No. of Switches | ... | 2                                     |

## Tapchanger Oil Protection Relay:

|      |     |                                |
|------|-----|--------------------------------|
| Type | ... | RS 2001<br>(supplied with OLG) |
|------|-----|--------------------------------|

Breathers: Tapchanger

|      |     |       |
|------|-----|-------|
| Make | ... | Hawke |
| Type | ... | HB1   |

Main Unit:

|      |     |       |
|------|-----|-------|
| Make | ... | Hawke |
| Type | ... | HB66  |

Winding Temperature Indicators:

|                                      |     |                       |
|--------------------------------------|-----|-----------------------|
| Make                                 | ... | Accurate Controls Ltd |
| Type                                 | ... | C102                  |
| Serial Nos                           | ... | 8207/1/2/3/7/8/9      |
| Capillary length                     | ... | 55 m                  |
| Number of switches                   | ... | 3 type B115.          |
| Potentiometer<br>(Remote Indication) | ... | 3000 Ohms             |

Pressure Relief Valves

|                    |     |                            |
|--------------------|-----|----------------------------|
| Make               | ... | Qualitrol Instruments Ltd. |
| Type               | ... | 208-002-05.                |
| Number of Switches | ... | 1- Type MT-4R. (Honeywell) |
| Operating Pressure | ... | 830 mbar $\pm$ 70 mbar     |

Sudden Pressure Relay

|                 |     |                            |
|-----------------|-----|----------------------------|
| Make            | ... | Qualitrol Instruments Ltd. |
| Model           | ... | 900-003-01                 |
| No. of Switches | ... | 1 Trip                     |



#### Oil Pumps:

|            |     |                          |
|------------|-----|--------------------------|
| Make       | ... | Sigmund Pulsometer Pumps |
| Serial No. | ... | 8/431004/A/B/C/D/E/F     |
| Type       | ... | AT06P                    |
| Rating     | ... | 7.6 kW (415 volts)       |
| F.L.C.     | ... | 14.4 Amps (SC.6 x FLC)   |
| Oil Flow   | ... | 50L/Sec                  |
| Head       | ... | 11 Metres                |
| RPM        | ... | 1420 RPM                 |

#### Liquid Level Switch

|                 |     |                          |
|-----------------|-----|--------------------------|
| Make            | ... | Bayham                   |
| Ref No          | ... | 55708/8                  |
| Type            | ... | 6" - A2 BAYDEE           |
| No. of Switches | ... | 2 - Micro (Make on fall) |

#### On-Load Tapchanger

|  |     |                             |
|--|-----|-----------------------------|
| Make   | ... | Associated Tapchangers Ltd. |
| Serial No.   | ... | 845404/5/6                  |
| Type   | ... | M1-1200-60D 10 19 1W        |
| Oil Quantities/<br>Single Phase Unit                   |     | Litres                      |
| Transformer  | ... | 32870                       |
| Cooling Plant<br>(Including Conservator<br>and piping) | ... | 4800                        |
| Tapchanger   | ... | 130                         |
| TOTAL  | ... | 37800                       |

Weights/Single  
Phase Unit

Tonnes

|   |     |         |             |
|---|-----|---------|-------------|
| Core and Windings                                     | ... | 137     |             |
| Tank and Fittings                                     | ... | 68      |             |
| TOTAL (excluding<br>Conservator and<br>Gantry)        | ... | 205     |             |
| Weight of Cooling<br>Plant for 3-Single<br>Phase Bank |     |         | Tonnes      |
| Gantry (with lifting<br>beam) and platform            | ... | 14.8    |             |
| Conservator<br>(excluding oil)                        | ... | 5       |             |
| Cooler Package<br>(excluding oil)                     | ... | 27      |             |
| TOTAL   | ... | 46.8    |             |
| Total Weight<br>(in service)                          | ... | 760     | Tonnes      |
| Total Oil Quantity<br>(in service)                    | ... | 1134000 | Litres (34) |

Permissible vacuum:

|         |     |             |
|---------|-----|-------------|
| Tank    | ... | full vacuum |
| Coolers | ... | full vacuum |