



## TECHNICAL QUALIFICATION REQUIREMENT

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### QUALIFYING CONDITIONS FOR FIRE FIGHTING SYSTEM

| DESCRIPTION OF BHEL REQUIREMENT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | TO BE SUPPLIED/<br>CONFIRMED/<br>SUBMITTED BY | OFFERED | DEVIATION | REMARKS |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|---------|-----------|---------|
| <p>The bidder should have designed, supplied, erected, tested and commissioned at least one number of Fire Protection System of each type described in (i) &amp; (ii) below in installations such as power plants, sub-stations, refineries, fertilizer plants or any other industrial/commercial installations:</p> <p>(i) Fire Hydrant system.</p> <p>(ii) High Velocity Water (HVW) Spray system.</p> <p>The systems mentioned above should have been designed to the recommendations of Tariff Advisory Committee of India or Oil Industry Safety Directorate (OISD) or any other International reputed authority (like LPC-UK or NFPA, USA) and <b>these systems should have been in #satisfactory operation for at least two (2) years as on date of NOA i.e. 05.11.2019.</b></p> <p><b>(#) satisfactory operation means certificate issued by the Employer/Utility certifying the operation without any adverse remark.</b></p> <p>The following information should be submitted by the vendor about the companies where FFS have been supplied. This is required from all the vendors for qualification of their offer.</p> | Vendor to accept & confirm.                   |         |           |         |
| 1. Name of the customer / company alongwith complete postal address where referred FFS is commissioned.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Vendor to inform                              |         |           |         |
| 2. Month & Year of Commissioning.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Vendor to inform                              |         |           |         |
| 3. Break up of Firefighting systems supplied.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Vendor to inform                              |         |           |         |
| 4. Name & designation, Phone and email address of the contact person of the customer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Vendor to inform                              |         |           |         |
| 5. Copy of purchase order and supporting acceptance papers or MOM of commissioning or Completion Certificate of FFS from the customers will be required                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Vendor to submit                              |         |           |         |
| 6. Letter/ Certificate/ MOM from customer/ end user for satisfactory operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Vendor to submit                              |         |           |         |
| 7. BHEL reserves the right to verify the information provided by vendor. In case the information provided by vendor is found to be false/ incorrect, the offer shall be rejected.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Vendor to accept & confirm                    |         |           |         |

*Agarwal*  
26/6/20

*Agarwal*  
26/6/20

*Singh*  
29/06/2020

|                                                                                   |                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                        |          |           |               |                                                                                                                                                                                                                                                             |                   |                         |        |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-----------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------------|--------|
|  |                                                                                                                                                                                                                                                                                             | <b>भारत हैवी इलेक्ट्रिकल्स लिमिटेड</b><br><b>BHARAT HEAVY ELECTRICALS LIMITED</b><br><b>पारेषण व्यापार अभियांत्रिकी प्रबंधन</b><br><b>TRANSMISSION BUSINESS ENGINEERING MANAGEMENT</b> |          |           |               |                                                                                                                                                                                                                                                             |                   |                         |        |
| प्रलेख संख्या<br>DOC. No                                                          | <b>TB-409-552-01</b>                                                                                                                                                                                                                                                                        |                                                                                                                                                                                        | Rev. No. | <b>01</b> |               | बनाया/<br>Prepared                                                                                                                                                                                                                                          | जांचा/<br>Checked | स्वीकृती/ Ap-<br>proved |        |
| TYPE/ प्रकार<br>OF DOC.                                                           | <b>TECHNICAL SPECIFICATION</b>                                                                                                                                                                                                                                                              |                                                                                                                                                                                        |          |           | हस्ता. / SIGN |    |                   |                         |        |
| TITLE/ शीर्षक<br><br><b>FIRE FIGHTING SYSTEM</b>                                  |                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                        |          |           | नाम / NAME    | <b>AJ</b>                                                                                                                                                                                                                                                   | <b>AR</b>         | <b>SKS</b>              |        |
|                                                                                   |                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                        |          |           | दिनांक/ DATE  | 18/06/20                                                                                                                                                                                                                                                    | 18/06/20          | 18/06/20                |        |
|                                                                                   |                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                        |          |           | समूह/ GROUP   | <b>TBEM</b>                                                                                                                                                                                                                                                 |                   |                         |        |
| ग्राहक/<br>CUSTOMER                                                               | <b>POWERGRID CORPORATION OF INDIA LTD. (POWERGRID)</b>                                                                                                                                                                                                                                      |                                                                                                                                                                                        |          |           |               |                                                                                                                                                                                                                                                             |                   |                         |        |
| परियोजना/<br>PROJECT                                                              | Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route |                                                                                                                                                                                        |          |           |               |                                                                                                                                                                                                                                                             |                   |                         |        |
| प्रपत्र संख्या/<br>NOA NO.                                                        | FTL/765kV/SS02/NOAI/2(I) For Supply of Goods Contract Dated 05-11-19 & FTL/765kV/SS02/NOAI/2(II) For Supply of Service Contract Dated 05-11-2019                                                                                                                                            |                                                                                                                                                                                        |          |           |               |                                                                                                                                                                                                                                                             |                   |                         |        |
| स्थान/<br>STATIONS                                                                | Fatehgarh-2, Rajasthan                                                                                                                                                                                                                                                                      |                                                                                                                                                                                        |          |           |               |                                                                                                                                                                                                                                                             |                   |                         |        |
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|                                                                                   | ❖ Enclosures to Sec - 5 - Schedule 5 - Drawings (7 pages)                                                                                                                                                                                                                                   |                                                                                                                                                                                        |          |           |               |                                                                                                                                                                                                                                                             |                   |                         |        |
|                                                                                   |                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                        |          |           |               |                                                                                                                                                                                                                                                             |                   |                         |        |
| <b>REVISION DETAILS</b>                                                           |                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                        |          |           |               |                                                                                                                                                                                                                                                             |                   |                         |        |
| Rev<br>No.                                                                        | Date                                                                                                                                                                                                                                                                                        | Altered                                                                                                                                                                                | Checked  | Approved  | To            | TBEM                                                                                                                                                                                                                                                        | TBMM              | TBQM                    | Vendor |
| Distribution                                                                      |                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                        |          |           | Copies        | 1                                                                                                                                                                                                                                                           | 1                 | 1                       | 4      |

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TB-409-552-01  
Rev 01



**System** FIRE FIGHTING SYSTEM

**Owner** POWERGRID CORPORATION OF INDIA LTD.

**Purchaser** BHARAT HEAVY ELECTRICALS LTD  
(Transmission Business Group)

## SECTION 1

### INTENT, SYSTEM REQUIREMENT, DESIGN CRITERIA AND SCOPE

#### 1.0.0 INTENT OF SPECIFICATION

- 1.1.0 This specification is intended to specify the requirements for design, engineering, manufacture, assembly, stage testing, inspection, testing before supply, packing, forwarding, transportation at site, complete erection of all equipment and accessories, testing of the system, trial run, commissioning of the system, final painting and carrying out acceptance test of Fire Fighting System along with its accessories and auxiliary equipments / instruments etc. as mentioned in this section and in various other sections of this specification for **765kV Fatehgarh-2 (PG) S/S Extension of Power Grid Corporation of India Limited (POWERGRID)**.
- 1.2.0 The system shall be designed, erected & commissioned in accordance with TAC/ NFPA guidelines.
- 1.3.0 Requirements pertaining to type, make, quality, testing & inspection of equipments as laid down in various clauses of CUSTOMER (POWERGRID) Specification, enclosed in Section 2, shall be full & final. In the event of any contradiction w.r.t. other sections of this specification, technical requirements of Section 1 & 2 shall prevail.
- 1.4.0 Overall scope is broadly defined in the section-1, however the typical information regarding scheme, equipment specification related to particular system asked for design shall be referred from section-2 as well. Customer specification attached to section-2 is having detailed about different system in general and bidders are requested to follow the same (specifically all relevant clauses pertain to hydrant and HVWS system for reactors/transformers) while quoting for the scope covered in the section-1.
- 1.5.0 The Bidder shall be deemed to have understood completely all the tender drawings, documents and this complete technical specification and quoted accordingly.
- 1.6.0 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respect to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to Purchaser / Owner, who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material, which in his/their judgment is not in full accordance with the specifications
- 1.7.0 The Bidder to note carefully that parameters, estimated capacities of equipment indicated and the tender drawings in the specification are only for the guidance of the Bidder. The system shall be designed as per relevant standards/ codes and exact capacities and quantities are to be estimated by the Bidder. All such estimations and design calculations shall be submitted for Purchaser's/customer approval during detailed engineering.
- 1.8.0 **The Contract shall be on unit rate basis for the quantities furnished by BHEL. Variations (upward/ downward) in quantities during contract stage shall be settled on the basis of unit rates furnished in the bid. During contract stage, quantities of various items of BOQ may vary to any extent and same rates will be applicable so far the resultant variation in total contract value is within  $\pm 30\%$ . Variations beyond  $\pm 30\%$  shall be negotiated mutually.**

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- 1.9.0 The term ‘**Owner**’ appearing in this specification shall refer to **POWERGRID**, the term ‘**Purchaser**’ shall refer to **BHEL** and the term ‘**Contractor**’ shall refer to the **successful Bidder**.
- 1.10.0 There shall preferably be no deviation on technical specification. The bidder shall sign and stamp the “Certificate for No Deviation” enclosed in Schedule-3, Section-5 towards confirmation. *Deviations in any other form including clarifications / assumptions / observations, input data in the GTP etc will not be considered and it will be construed that the bid conforms strictly to the specification.* Except for deviations/variations covered under Deviation Schedules which are accepted by the Purchaser before the award of the Contract, it will be the responsibility of the Bidder to fully meet the intent and the requirements of the specification within the quoted price.

## 2.0 TYPE OF FIRE PROTECTION REQUIRED

### 765kV Fatehgarh-2 (PG) S/s Extension

- i) Hydrant system for *06Nos. 80 MVAR Reactors*,
- ii) HVW spray system for *06Nos. 80 MVAR Reactors*

*(OGA of 80MVAR- BTW-China Make Reactor is enclosed for reference and estimation purpose only)*

6 nos. 80MVAR Reactors under present scope would be installed in adjacent to existing Reactors as shown in the layout.

250NB existing pipe header is running on either side of the road in front of existing reactors.

Bidder shall extend this existing header of 250NB upto the reactors under present scope. Hydrant shall be provided for each reactor on the same header and also individual water tap-off (100NB upto deluge valve) for spray system of each reactor shall be taken from this main pipe header (250NB) as per Powergrid standard P&I drawing.

(Locations of 80 MVAR Reactors are shown in the layout drg. attached to this spec.).

Tap-off (Existing 250NB) header shall further run upto the last reactor under present scope as defined above for HVWS and hydrant system for each reactor.

Note:

1. DC input for DVLCP shall be taken from existing DCDB of firefighting system installed in the Pump House. Bidder shall do all necessary cabling (laying and termination) for HVWS for the reactors under present scope.
2. All annunciations as per standard scheme defined in the POWERGRID spec shall be available in the existing annunciation panel (firefighting system) in pump house and control room. Contractor shall do all necessary cabling (laying and termination) for HVWS for the reactors under present scope.
3. All HVWS annunciation/signals for reactors under present scope as per POWERGRID standard scheme for repetition in existing SCADA shall be done by contractor. Contractor shall have responsibilities to identify the relevant terminal blocks corresponding to HVWS signals in the existing firefighting panel and do all cabling (laying and termination) between existing firefighting panels to SCADA. Termination at firefighting panel shall only be done by contractor, however termination shall be under other scope at SCADA end.

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4. Remote start/stop of DVLCP operation shall be done from existing SAS in control room. Hence it shall be contractor responsibility to provide sufficient potential free contacts in the DVLCP scheme to enable these remote operations as per POWERGRID standard scheme. Contractor shall have responsibilities to provide relevant terminal blocks corresponding to remote start/stop of deluge valve operations under HVWS system in the DVLCP and do all cabling (laying and termination) between DVLCP to SAS. Termination at DVLCP shall only be done by contractor; however termination at SAS end shall be under other scope. 20% Spare Terminal blocks (minimum one no.) shall be provided in DVLCP.

### 3. DESIGN CRITERIA

- 3.1 The equipment offered shall comply with the relevant Indian Standards. The equipment conforming to any other approved international standards shall meet the requirement called for in the latest revision of relevant Indian Standard or shall be superior. The Deluge valves, HVW spray nozzles & quartzoid bulb detectors shall have the approval of any of the following agencies;
  - a. UL of USA.
  - b. FM of USA
  - c. LPCB of UK or
  - d. VDS of Germany,
- 3.2 Light Hazard occupancy shall be considered for hydrant protection.
- 3.3 *All the requirements regarding supplies, provisions of control, interlocks, indications, annunciations, alarms etc, stipulated in various clauses of Powergrid specification (Section 2) shall be satisfied by the contractor in totality.*
- 3.4 *The scope also includes to prepare the standard HVW spray drawing of 80MVar reactor (BTW China make) and get approval on the same from Powergrid.*
- 3.5 **Interfacing Requirement**  
Provision of sufficient potential free contacts/TB's in each DVLCP under present scope for remote start/stop of deluge valve operation from existing SAS (Substation automation system) as per Powergrid standard specification attached in sec-2.

### 4. SCOPE OF SUPPLIES & SERVICES

#### 4.1.0 SCOPE OF SUPPLY

- a) **Bill of Quantities as Annexure-X to Section - 1 clearly indicates list of material and its quantity required at site.**
- b) **Bidder is required to quote in his offer for the supply & ETC of items listed in Annexure-X.**
- c) The Bill of Quantities shall be read in conjunction with the Instructions to Bidders, General and Special Conditions of Contract, Technical Specifications, and Drawings.

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- d) The quantities given in the Bill of Quantities are estimated and provisional, and are given to provide a common basis for bidding. The exact quantity of each items shall be finalized during detailed engineering.
- e) A rate or price shall be entered against each item in the priced Bill of Quantities. Cost of items against which the Contractor has failed to enter a rate or price shall be deemed to be covered **by other rates and prices entered in the Bill of Quantities.**
- f) The whole cost of complying with the provisions of the Contract shall be included in the Items provided in the priced Bill of Quantities, and where no Items are provided, the cost shall be deemed to be distributed among the rates and prices entered for the related Items of Work.
- g) General directions and descriptions of work and materials are not necessarily repeated nor summarized in the Bill of Quantities. References to the relevant sections of the Contract documentation shall be made before entering prices against each item in the priced Bill of Quantities.
- h) Miscellaneous items like hardware, fixtures etc. shall be deemed to be included under the relevant BOQ items and bidders shall consider the same while quoting for BOQ items.

Besides, the Bidder shall take a note of the following while preparing his offer:

- i) Power & Control cables for fire protection system shall be supplied on free issue basis to contractor. BHEL shall procure various sizes of cables (as per Annexure 'A' of this section) for the complete requirement of sub-station. Contractor shall have to choose their cables from the available sizes only and necessary modifications in their equipment for termination of these cables shall be made by contractor.
- j) Since laying & termination of all power & control cables is in contractor's scope, supply of cable accessories such as lugs, glands, cable tags & markers etc. shall be included by the bidders in their offers
- k) Necessary cable trays will be supplied on free issue basis to the contractor, however necessary hardware for fixing the same on walls or elsewhere shall be included by the bidders in their offers.
- l) Earthing material viz. GS flat & wire will also be supplied on free issue basis to contractor, however requirement shall be given by the bidders in their respective bids.
- m) Pipe structure for pylon support around reactor/ transformer shall be fixed to the bottom of sump with the help of Anchor fasteners. The structure will be in two pieces with a flanged joint at around Zero level above chequered plate. Pipe size for pylon, size of Anchor

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fasteners etc. shall be adequate for the support to provide sufficient rigidity against vibration & load during operation. The whole arrangement shall be in bidder's scope. The contractor shall justify adequacy of design during engineering.

- n) All the necessary fixing hardware like bolts, nuts, flanges & insert plates etc. required for fitting/ laying of pipes etc. shall be supplied by the contractor.
- o) Contractor shall submit valid Type test report for approval by owner. Fresh type test of equipment is not envisaged. It is presumed that equipments offered are duly type tested.
- p) **Type Test Certificate for degree of protection shall be submitted for the following:**

Deluge Valve local control panel (IP-55)

In case the type test reports are found unsatisfactory, tests shall be carried out afresh by contractor without any additional cost implication to BHEL and getting approval from Powergrid on the fresh type test report shall be of contractor's responsibility.

- q) Bidder shall choose the makes from Powergrid's "compendium of approved vendors", which is available on the internet. In case, no vendor is specified in compendium against a particular item, only reputed makes available in the market shall be considered. All such makes shall be subjected to acceptance of Powergrid. No additional price implication shall be made to BHEL on account of non-acceptance of proposed makes by POWERGRID.
- r) *A list of makes is attached to the section-2 of this spec for ready reference.*
- s) Any spares required for commissioning purpose shall be supplied separately by the contractor.

#### **4.2.0 SCOPE OF SERVICES**

##### **4.2.1 Erection, Testing & Commissioning (ETC) requirements**

- a) The scope of ETC shall include handling of equipment/ material at site, erection of equipment /material at site including fabrication, equipment and system testing, commissioning of the entire system at all sites.
- b) Erection of pipe pylon supports, with pipe hangers and other pipe supports corresponding to HVW Spray system.
- c) Painting of aboveground piping (for hydrant system & HVW spray system in the switchyard), pylon support pipes etc. as per customer specification.
- d) *Type of Protective coating/Painting applied on the outside of pipe shall be One coat of Red Lead Primer+2 coats of Synthetic Enamel for A/G Pipes & PYPKOTE or equivalent tape type protection of min 4 mm thick As per IS:10221 for ungrounded pipes.*

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- e) Land excavation, laying of underground piping for hydrant/ spray system with wrapping & coating & backfilling, if required.
- f) Laying and termination of power and control cables for the equipment under the scope this specification.
- g) Laying & fixing of cable trays on walls or elsewhere, if applicable.
- h) All the installations in the switchyard and pump house shall be properly earthed by the contractor to the nearest earthmat riser of the Owner / Purchaser.
- i) The contractor shall arrange all machinery - tools & tackles and consumables required for erection of the system.
- j) Contractor shall ensure that sufficient quantity of commissioning spares is made available for timely completion of commissioning of the system. The contractor shall furnish a list of commissioning spares that will be brought by him. The unused commissioning spares shall be returnable to the Contractor.
- k) Conducting Performance Guarantee tests to the satisfaction of Owner / Purchaser.
- l) It is the responsibility of the successful Bidder to obtain necessary approval/ clearance from statutory organizations wherever applicable for the equipment/ systems under the scope specified.
- m) After completion of erection and commissioning of the system, the contractor shall train site engineers of Purchaser/Owner so that they are fully conversant with both electrical and mechanical part of the package.
- n) The contractor shall furnish the operation and maintenance manual specifically compiled for each of the sub-stations. The draft O&M manual shall be submitted within 20 weeks after award of contract. The O&M manual shall contain the following information:
  - i) Description of the system and equipment with design particulars
  - ii) Instruction for erection.
  - iii) Instruction for operation, maintenance and repair.
  - iv) Recommended inspection practices and inspection schedule.
  - v) Ordering information for all replaceable parts

#### 4.2.2 Inspection & Testing

All the equipments shall be inspected prior to dispatch in line with relevant IS, approved GTP/ drawing and technical specification.

### 5. EXCLUSIONS

- a) Supply of power & control cables for the firefighting system.
- b) Supply of necessary cable trays for laying power and control cables, wherever required.
- c) Supply of GI flat for earthing of equipments.
- d) Construction of RCC pedestals to support the above ground piping for hydrant & spray system wherever required.
- e) Supply & laying of hume pipes.

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- f) Construction of housing for deluge valve and painting the same on outside & inside. The housing shall have RCC roof.
- g) Unloading and storage of material at site.

#### 6. HANDING & TAKING OVER

It is the responsibility of the Contractor to run and maintain the plant till it is handed over to the owner. Contractor shall assist purchaser to hand over the complete firefighting system under this scope to owner.

#### 7. UTILITIES AVAILABLE

As per terms and conditions in the tender / purchase order/work order.

#### 8. VARIOUS HEADS TO BE QUOTED FOR:

| BILL OF QUANTITY                                                                                         |                                  |      |       | (ANNEXURE-X)                                                            |
|----------------------------------------------------------------------------------------------------------|----------------------------------|------|-------|-------------------------------------------------------------------------|
| FIRE FIGHTING SYSTEM FOR SWITCHYARD, 765kV Fatehgarh-2 (PG) S/S Extension AS PER TECHNICAL SPECIFICATION |                                  |      |       |                                                                         |
| A) Supply and ETC of Items as listed below:                                                              |                                  |      |       |                                                                         |
| Sl. No.                                                                                                  | Item Description                 | Qty. | Unit  | Remarks                                                                 |
| 1                                                                                                        | MS ERW pipe 250NB (Medium Grade) | 100  | Meter | As per IS:3589:Gr410, Above/Underground pipes alongwith accessories*    |
| 2                                                                                                        | MS ERW pipe 100NB (Medium Grade) | 105  | Meter | As per IS:1239 (Part-1), Above/Underground pipes alongwith accessories* |
| 3                                                                                                        | MS ERW pipe 80NB (Medium Grade)  | 12   | Meter | As per IS:1239 (Part-1), Above/Underground pipes alongwith accessories* |
| 4                                                                                                        | Gate Valve-100NB                 | 12   | Nos.  | (MOC-Cast Iron) alongwith accessories*                                  |
| 5                                                                                                        | Single Headed hydrant Valve      | 6    | Nos.  | (MOC-Gun Metal), 63NB alongwith accessories*                            |
| 6                                                                                                        | Hose Box                         | 6    | Nos.  | (MOC-M.S.), 63NB alongwith accessories*                                 |
| 7                                                                                                        | Hose pipe-15m long               | 12   | Nos.  | Alongwith coupling (63mm dia. & 15 meter long)                          |
| 8                                                                                                        | Branch pipe with nozzle          | 6    | Nos.  | (MOC-Gun Metal) alongwith accessories*                                  |

**Project** Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route

**TB-409-552-01**  
**Rev 01**



**System** FIRE FIGHTING SYSTEM

**Owner** POWERGRID CORPORATION OF INDIA LTD.

**Purchaser** BHARAT HEAVY ELECTRICALS LTD  
(Transmission Business Group)

|    |                                      |     |       |                                                       |
|----|--------------------------------------|-----|-------|-------------------------------------------------------|
| 9  | Deluge valve-100NB                   | 6   | No.   | Alongwith complete trim connection-100NB (Cast Iron)  |
| 10 | Y-type strainer-100NB                | 6   | Nos.  | (MOC-M.S.) alongwith accessories*                     |
| 11 | Spray Nozzle                         | 540 | Nos.  | (K-23*120/ K-32*90)- 20Ø Brass alongwith accessories* |
| 12 | QB detector                          | 175 | Nos.  | 15Ø Brass alongwith accessories*                      |
| 13 | Solenoid Valve                       | 6   | Nos.  |                                                       |
| 14 | Local control panel for Deluge valve | 6   | Nos.  | Compliance to (IP:55)                                 |
| 15 | Pressure switch                      | 6   | Nos.  |                                                       |
| 16 | GI Pipe-100NB (Medium Grade)         | 72  | Meter | As per IS:1239 (Part-1), pipes alongwith accessories* |
| 17 | GI Pipe-80NB (Medium Grade)          | 60  | Meter | As per IS:1239 (Part-1), pipes alongwith accessories* |
| 18 | GI Pipe-65NB (Medium Grade)          | 480 | Meter | As per IS:1239 (Part-1), pipes alongwith accessories* |
| 19 | GI Pipe-50NB (Medium Grade)          | 120 | Meter | As per IS:1239 (Part-1), pipes alongwith accessories* |
| 20 | GI Pipe-25NB (Medium Grade)          | 750 | Meter | As per IS:1239 (Part-1), pipes alongwith accessories* |
| 21 | MS ERW pipe 80NB (Light Grade)       | 600 | Meter | For Pylon Support as per IS:1239 Part -1(Light)       |

#### Section 1

**Project** Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route

TB-409-552-01

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(Transmission Business Group)

### B) Items which are covered under ETC only are given below:

|    |                                              |      |       |                                                                                                                                                                    |
|----|----------------------------------------------|------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 01 | All cabling & termination between the panels | 1000 | Meter | (For the functioning of DVLCP, annunciations in pump-house & control room and upto SAS panel as per scope defined in the different sections of this specification) |
|----|----------------------------------------------|------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Bidder should note the following points while quoting the tender:

**\*Accessories:**

All Bolts, Nuts, Gasket, Bends, Union, Support structure & Anchoring Material, wrapping & coating material (in case of underground piping), fixing hardware etc. as required for complete erection & Commissioning of the above mentioned equipments.

**Project** Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route

TB-409-552-01

Rev 01



**System** FIRE FIGHTING SYSTEM

**Owner** POWERGRID CORPORATION OF INDIA LTD.

**Purchaser** BHARAT HEAVY ELECTRICALS LTD  
(Transmission Business Group)

## ANNEXURE- 'A'

## Cable Sizes being procured by BHEL for Sub-Station

| Sl. No.    | Item Description                         | Length (Mtrs.) | Remark |
|------------|------------------------------------------|----------------|--------|
| <b>1.0</b> | <b>Power Cables (PVC) (1100 V Grade)</b> |                |        |
| A          | 3.5C x 70 sq mm PVC/ Al. Aux Power Cable |                |        |
| B          | 3.5C x 35 sq mm PVC/ Al. Aux Power Cable |                |        |
| C          | 4C x 16 sq mm PVC/ Al. Aux Power Cable   |                |        |
| D          | 4C x 6 sq mm PVC/ Al. Aux Power Cable    |                |        |
|            |                                          |                |        |
| <b>2.0</b> | <b>Control Cables (Cu)</b>               |                |        |
| A          | 2C x 2.5 sq mm PVC/Cu. Control Cable     |                |        |
| B          | 5C x 2.5 sq mm PVC/ Cu. Control Cable    |                |        |
| C          | 7C x 2.5 sq mm PVC/ Cu. Control Cable    |                |        |
| D          | 10C x 2.5 sq mm PVC/ Cu. Control Cable   |                |        |
| E          | 14C x 2.5 sq mm PVC/ Cu. Control Cable   |                |        |
| F          | 19C x 2.5 sq mm PVC/ Cu. Control Cable   |                |        |

**Project** Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route

**TB-409-552-01**  
**Rev 01**



**System** FIRE FIGHTING SYSTEM  
**Owner** POWERGRID CORPORATION OF INDIA LTD.  
**Purchaser** BHARAT HEAVY ELECTRICALS LTD  
(Transmission Business Group)

## SECTION 2

### EQUIPMENT SPECIFICATION

Refer the enclosed customer's specifications (Doc ref: C/ENGG/SPEC/FP Rev-6) for Fire Protection System for overall understanding of the system and equipment specific informations.

All the requirements pertaining to Hydrant and HVWS system viz. type, make, quality, testing & inspection of equipments, provisions of control, interlocks, indications, annunciations, alarms etc, as laid down in various clauses of this specification shall be satisfied by the contractor in totality in conjunction with the scope clarified in various clauses of section-1.

Since we have already existing switchyard wherein pump hose and its associated equipments are already available. Contractor shall extend pipe line from it's tap-off for the scope defined in the section-1.

**TECHNICAL SPECIFICATION FOR****FIRE PROTECTION SYSTEM****TABLE OF CONTENTS**

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## TECHNICAL SPECIFICATION FOR

### FIRE PROTECTION SYSTEM

#### 1.00.00 INTENT OF SPECIFICATION

This section covers the design and performance requirements of the following types of fire protection systems;

- a. Hydrant System
- b. High Velocity Water (H.V.W) Spray System
- c. Fire Detection and alarm System
- d. Portable Fire Extinguishers
- e. Wheel/ Trolley mounted Fire Extinguishers

1.00.01 It is not the intent to completely specify all details of design and construction. Nevertheless, the system design and equipment shall conform in all respects to high standard of engineering, design and workmanship and shall be capable of performing in continuous commercial operation in a manner acceptable to the Owner. The system design shall also conform to TAC/ NFPA norms.

1.00.02 The scope of work include complete earthwork (i.e. excavation, backfilling etc.) for the entire buried piping for the system, valve pits and pipe supports for buried, entrenched and overground piping.

1.00.03 The equipment offered shall comply with the relevant Indian Standards **unless specified otherwise**. The equipment conforming to any other approved international standards shall meet the requirement called for in the latest revision of relevant Indian Standard or shall be superior. The Deluge valves, HVW spray nozzles & quartzoid bulb detectors shall have the approval of any of the following agencies;

- a. UL of USA.
- b. F M of USA
- c. LPCB of UK or
- d. VDS of Germany,

1.00.04 Ambient temperature for design of all equipment shall be considered as 50°C.

1.00.05 The piping and instruments diagram for Hydrant and HVW spray system for 765kV/400kV substations **and for 220kV&132kV substation** is

enclosed at Appendix-I and Appendix-VI respectively. The successful bidder shall prepare detailed layout and piping drawing based on this drawing and other drawings such as road, drainage, cable trench, switch yard layout, etc. as furnished by the Employer during detailed engineering.

The typical drawings for location of fire detectors and fire extinguishers in control cum administrative building attached in Appendix-II with this section shall be followed for execution.

- 1.00.06 Equipment under the fire protection system should be supplied from the suppliers approved by POWERGRID (A list of approved vendors is enclosed at Appendix-V). All equipment shall conform to the data sheets attached in Appendix-IV and/or relevant subsections/clauses of this specification. In case of contradiction between data specification sheets and relevant subsections/clauses, then stipulations of the data sheets will prevail.

## 2.00.00 DESIGN AND CONSTRUCTION

### 2.01.00 Hydrant System

Hydrant system of fire protection essentially consists of a large network of pipe, both under ground and over ground which feeds pressurised water to a number of hydrant valves, indoor (if applicable) as well as outdoor. These hydrant valves are located at strategic locations near buildings, Transformers and Reactors. Hose pipes of suitable length and fitted with standard accessories like branch pipes, nozzles etc., are kept in Hose boxes. In case of emergency, these hoses are coupled to the respective hydrant valves through instantaneous couplings and jet of water is directed on the equipment on fire. Hydrant protection shall be provided for the following in all substations of voltage levels 132kV and above (This is not applicable for extension of existing 220kV and 132kV substations where Hydrant system is not available). At least one hydrant post shall be provided for every 60m of external wall measurement of buildings.

- a) Control room building
- b) L.T. Transformer area.
- c) Fire Fighting pump House.
- d) Stores
- e) Transformers

f) Shunt Reactors/ Bus Reactors.

2.01.01 A warning plate shall be placed near the hydrant points for the transformers and reactors substations to clearly indicate that water shall be sprayed only after ensuring that the power to the transformer/ reactor which is on fire is switched off and there are no live parts within 20metres of distance from the personnel using the hydrant.

## 2.02.00. **HIGH VELOCITY WATER (H.V.W) SPRAY SYSTEM**

H.V.W. spray type fire protection essentially consists of a network of projectors and an array of heat detectors around the Transformer/Reactor to be protected. On operation of one or more of heat detectors, Water under pressure is directed to the projector network through a Deluge valve from the pipe network laid for this system. This shall be provided for transformers and reactors in all 132kV & above substations (This is not applicable for extension of existing 220kV and 132kV substations where HVWS system is not available). Wet detection initiation system shall be employed for automatic operation.

The system shall be designed in such a way that the same can be extended to protect additional Transformer/ Reactor to be installed in future. However, for the purpose of design it shall be assumed that only one Transformer/ Reactor will be on fire. The main header pipe size in the yard shall be 250mmNB (for 400kV and above level substations) and 200mmNB(for 220kV & 132kV substations). Branch to the equipment (shall not be more than 20metres length) shall be of the same size as of deluge valve.

2.02.01 The Electrical clearance between the Emulsifier system pipe work and live parts of the protected equipment shall not be less than the values given below :

|    |                |         |
|----|----------------|---------|
| 1. | 765 kV bushing | 4900 mm |
| 2. | 420 kV bushing | 3500 mm |
| 3. | 245 kV bushing | 2150 mm |
| 4. | 145 kV bushing | 1300 mm |
| 5. | 52 kV bushing  | 630 mm  |
| 6. | 36 kV bushing  | 320 mm  |

2.02.02 System shall be designed in such a way that the Water pressure available at any spray nozzle shall be between 3.5bar and 5.0bar and shall be demonstrated through hydraulic calculations. Water shall be applied at a minimum rate of 10.2 LPM/M<sup>2</sup> of the surface area of the transformer / Reactor including radiator, conservator, oil pipes, bushing turrets, etc. (including bottom surface for transformer). The nozzle arrangement shall ensure direct impingement of water on all exterior surfaces of transformer tank, bushing turrets, conservator and oil pipes, except underneath the transformer, where horizontal spray may be provided. Typical drawings of HVW spray system of a transformer and a reactor is enclosed at Annexure-III for reference.

#### 2.02.03 **Deluge Valve**

Deluge Valve shall be water pressure operated manual reset type. The Deluge valve shall be closed water tight when water pressure in the heat detector pipe work is healthy and the entire pipe work shall be charged with water under pressure upto the inlet of the Deluge valve. On fall of water pressure due to opening of one or more heat detectors, the valve shall open and water shall rush to the spray water network through the open Deluge valve. The valves shall be manually reset to initial position after completion of operation. Each Deluge Valve shall be provided with a water motor gong which shall sound an alarm when water after passing through the Deluge valve, is tapped through the water motor.

Each Deluge valve shall be provided with a local panel with provision of opening of Deluge valve from local and remote from control room/ remote centre. In addition to this, each valve shall be provided with local operation latch.

Deluge valves of 100mmNB size shall be used if the flow requirement is  $\leq 200\text{m}^3/\text{hr}$  and 150mmNB size shall be used for flow requirement  $>200\text{m}^3/\text{hr}$ .

Test valves shall simulate the operation of Deluge valves and shall be of quick opening type. The general construction shall conform to requirements under clause no.7.00.00 for piping, valves and specialities.

#### 2.02.04 **High Velocity Spray Nozzles (Projectors)**

High velocity spray system shall be designed and installed to discharge water in the form of a conical spray consisting of droplets of water travelling at high velocity, which shall strike the burning surface with sufficient impact to ensure the formation of an emulsion. At the same time the spray shall efficiently cut off oxygen supply and provide sufficient cooling.

- 2.02.05 Minimum set point of the heat detectors used in the HVW spray system shall be 79°C. The optimum rating shall, however, be selected by the Bidder, keeping in mind the maximum and minimum temperature attained at site.

#### 2.05.00 Water Supply System

For 400kV and above level substations water for hydrant & HVW system shall be supplied by one electrical motor driven pump of rated capacity 410m<sup>3</sup>/hr. at 70MWC head & for 220kV and 132kV substations water for hydrant & HVWS system shall be supplied by one electrical motor driven pump of rated capacity 273m<sup>3</sup>/hr. at 70MWC head, with another pump of same capacity , driven by diesel engine, shall be used as standby. Water storage tank with two compartments of adequate capacity shall be provided. Pumps shall work under positive suction head. Annunciations of the hydrant & HVW spray systems shall be provided in fire water pump house and repeated in control room. Provision for sending data to remote control centre shall also be available.

The outdoor piping for the system in general shall be laid above ground on concrete pedestals with proper supporting arrangement. However, at

road/rail crossings, in front/access of buildings, places where movement of cranes/vehicles is expected and at any other place where above ground piping is not advisable, the pipes shall be laid underground. Such locations shall be finalised during detailed engineering.

The whole system will be kept pressurised by providing combination of air vessel and jockey pump of 10.8M<sup>3</sup>/hr. capacity at 80MWC. The capacity of air vessel shall not be less than 3m<sup>3</sup>. Minor leakage will be met by Jockey pump. One additional jockey pump shall be provided as standby. All pumps shall be of horizontal centrifugal type. Pumps and air vessel with all auxiliary equipment will be located in firewater pump house. A pressure relief valve of suitable rating shall be provided in water header to release excess pressure due to atmospheric temperature variations.

Operation of all the pumps shall be automatic and pumps shall be brought into operation at preset pressure. Fire pumps shall only be stopped manually. Manual start/stop provision shall be provided in local control panel.

- 2.05.01 The general design of the fire fighting pump sets shall meet the requirements under clauses no.5.00.00 for Horizontal centrifugal pumps, no.6.00.00 for Diesel engines and no.12.00.00 for Electrical motors.
- 2.05.02 Each pump shall be provided with a nameplate indicating suction lift/delivery head, capacity and number of revolutions per minute.
- 2.05.03 Design, construction, erection, testing and trial operation of piping, valves, strainers, hydrant valves, hoses, nozzles, branch pipes, hose boxes, expansion joints etc. shall conform to the requirements of clause no. 7.00.00.
- 2.06.00 **Instrumentation and Control System**
- 2.06.01 All instruments like pressure indicators, differential pressure indicators, pressure switches, level indicators, level switches, temperature indicators, alarms and all other instruments and panels as indicated in the specification and drawings and those needed for safe and efficient operation of the whole system shall be furnished according to the requirements of clause 11.00.00. Pump running/ fails to start signal shall be taken from the pressure switch immediately after the discharge of the pump.
- 2.06.02 **Control Panel**

Power feeder for motors will be from switchgear board located in control

building but control supply for all local control panels, annunciation panels, battery charger units, space heaters etc. shall be fed from the AC and DC distribution boards located in pump house. These AC & DC distribution boards will be fed from the switchgears and DCDBs located in control building.

a) Panel for motor driven fire water pump

The panel shall be provided with the following:

- |    |                                                    |       |
|----|----------------------------------------------------|-------|
| 1. | TPN switch                                         | 1 No. |
| 2. | <b>Auto/manual selection facility</b>              |       |
| 3. | <b>Start/Stop facility</b><br>with indication lamp | 1 Set |
| 4. | DOL starter with<br>thermal O/L relay              | 1 Set |
| 5. | Indicating lamp showing<br>power ON                | 1 Set |
| 6. | Indication lamp with drive<br>ON/OFF               | 1 Set |
| 7. | Indication lamp showing<br>Motor Trip              | 1 No. |

**Additional provisions shall be made for controlling the following from the remote control centre:**

**1. Auto/manual selection facility**

**2. Start/Stop facility**

Main power cable from breaker feeder of main switchboard shall be terminated in this panel and another cable shall emanate from this panel which shall be terminated at motor terminals.

b) Panel for Two nos. Jockey Pump 1No.

The panel shall be provided with the following :

- |    |                                   |                     |
|----|-----------------------------------|---------------------|
| 1. | Fuse-switch unit for Jockey pumps | 1 Set for each pump |
|----|-----------------------------------|---------------------|

- |    |                                                                                                            |                     |
|----|------------------------------------------------------------------------------------------------------------|---------------------|
| 2. | <b>Auto/manual selection facility for each pump</b>                                                        |                     |
| 3. | Selector switch for selecting either jockey pump                                                           | 1 No.               |
| 4. | D.O.L. starter with overload relay self-resetting type, for all the drives.                                | 1 No. each          |
| 5. | Start/stop push button for Jockey Pump with indication lamp with pad-locking arrangements in stop position | 1 Set for each pump |
| 6. | Indication lamp for trip indication                                                                        | 1 No. each for pump |

**Additional provisions shall be made for controlling the following from the remote control centre:**

**1. Auto/manual selection facility for each pump.**

- |    |                                                                         |       |
|----|-------------------------------------------------------------------------|-------|
| c) | Panel for 2 Nos. battery charger & Diesel Engine driven fire water pump | 1 No. |
|----|-------------------------------------------------------------------------|-------|

The panel shall be provided with the following :

- |    |                                                                     |            |
|----|---------------------------------------------------------------------|------------|
| 1. | <b>Auto/Manual selection facility</b> for Diesel Engine driven pump | 1 No.      |
| 2. | <b>Start/Stop facility</b> with indication lamp                     | 1 Set      |
| 3. | Indicating lamp showing drive ON/OFF                                | 1 Set      |
| 4. | D.C. Voltmeter/Ammeter in the battery charger circuit               | 1 No. each |
| 5. | Battery charger will be as per specification described              | 1 Set      |
| 6. | Selector switch for selecting                                       | 1 No.      |

either of battery chargers  
for the battery sets.

- |    |                                                                                   |       |
|----|-----------------------------------------------------------------------------------|-------|
| 7. | Selector switch for selecting either set of batteries for Diesel engine starting. | 1No.  |
| 8. | Selector switch for boost charging/Trickle charging of battery set.               | 1 Set |

**Additional provisions shall be made for controlling the following from the remote control centre:**

#### **1. Manual Start/Stop of Diesel Engine**

- d) Individual local control panel is to be considered for each transformer/Reactor deluge system wherever these equipment are envisaged. This panel shall contain push buttons with indicating lamps for spray ON/OFF operation in the valve operation circuit. Push buttons shall be concealed behind glass covers, which shall be broken to operate the buttons. Provision shall be made in the panel for the field signal for the annunciations such as spray ON and fire in the Transformer/Reactor. A signal for spray ON shall also be provided in the control room fire alarm panel for employer's event logger. Remote operation facility to open the Deluge valve from control room/ remote centre shall also be provided.

#### **2.06.03 Annunciation Panels**

##### **a) Location: Fire Water Pump House**

- i) Indicating lamps showing power supply "ON".
- ii) Annunciation windows complete with buttons. Details are as follows:

| Sl.No. | Description                                          | Number |
|--------|------------------------------------------------------|--------|
| 1.     | Electric motor driven fire water pump running        | 1      |
| 2.     | Electric motor driven fire water pump fails to start | 1      |
| 3.     | Diesel engine driven fire water pump running.        | 1      |
| 4.     | Diesel engine driven water pump fails                | 1      |

|     |                                                          |                      |
|-----|----------------------------------------------------------|----------------------|
|     | to start                                                 |                      |
| 5.  | Jockey pump-1 running                                    | 1                    |
| 6.  | Jockey pump-1 fails to start                             | 1                    |
| 7.  | Jockey pump-2 running                                    | 1                    |
| 8.  | Jockey pump-2 fails to start                             | 1                    |
| 9.  | Fire in Transformer/ Reactor                             | 1 for each equipment |
| 10. | Deluge system operating for Transformer/Reactor          | 1 for each equipment |
| 11. | Header pressure low                                      | 1                    |
| 12. | Fire in smoke detection system zone (Common Fire Signal) | 1                    |
| 13. | Water storage tank water level low                       | 2                    |
| 14. | High speed diesel tank level low                         | 1                    |
| 15. | Spare                                                    | 10                   |

b) **Location: Substation Control Room**

- i) Indication lamp showing power supply 'ON'
- ii) Provision shall be made in the panel for a signal for spray ON for each Transformer/Reactor for owner's use for event logger.
- iii) Each Switchyard panel room shall be considered as separate zone for fire detection and alarm system.
- iv) Following annunciations shall be provided.

| Sl.No. | Description | Number |
|--------|-------------|--------|
|--------|-------------|--------|

|    |                                                    |                                                                         |
|----|----------------------------------------------------|-------------------------------------------------------------------------|
| 1. | Fire in Transformer/ Reactor                       | 1 for each equipment                                                    |
| 2. | Diesel engine driven fire water pump in operation  | 1                                                                       |
| 3. | Motor driven fire water pump in operation          | 1                                                                       |
| 4. | Jockey pump in operation                           | 1                                                                       |
| 5. | Fire fighting Water storage tank level Low         | 2                                                                       |
| 6. | Fire/Fault (zone alarm module)                     | 1+1(duplicate) For each zone as applicable                              |
| 7. | Spare windows complete in all respect, with relays | 10                                                                      |
| 8. | Spare zone alarm modules                           | Number of future A/c Kiosks required for the bays identified as per SLD |

c) Each annunciation panel shall be provided with a hooter. **A hooter in parallel to the hooter in fire panel shall be provided in the security room of substation for alert in case of fire.**

d) Indication for fault in respective areas shall also be provided. Each zone alarm module shall exhibit 'FIRE' and 'FAULT' conditions separately.

**e) Provision for sending data to Remote Control Unit for the following**

**(i) Fire in Switchyard Panel Room (Switchyard Panel room shall be considered as separate zone for fire detection and alarm system).**

**(ii) Fire in Transformer/Reactor (1 for each equipment)**

**(iii) Diesel engine driven fire water pump in operation.**

**(iv) Motor driven fire water pump in operation**

**(v) Fire/Fault in Control Room.**

**(vi) Water Storage tank level (low and very low for each storage tank).**

**(vii) High Speed Diesel tank level (low & very low)**

**(viii) AC Mains Supply Healthy/Fail for Main Pump & Jockey Pump**

**(ix) DC Control Supply Healthy/Fail for Main Pump & Jockey Pump**

**(x) DC Control Supply Healthy/Fail for Diesel Engine driven pump.**

2.06.04 The control and interlock system for the fire protection system shall meet the following requirements:

**1. Electric Motor Driven Fire water Pump**

Pump should start automatically when the System header pressure is low.

Pump should be stopped manually only. Pump should also be started manually if required from local control panel.

**2. Diesel Engine Driven Standby Pump**

The pump should automatically start under any of the following conditions:

- a) System Header pressure low.
- b) Electric motor operated fire water pump fails to start.

Pump should be stopped manually only. Pump should also be started manually if required from the local control panel. The battery set which is connected for starting of Diesel engine shall not be subjected to boost charge.

**3. Jockey Pump**

It shall be possible to select any one of the Jockey pumps as main and the other as standby. Main Jockey pump shall start automatically when water pressure in header falls below the set value. If the main jockey pump fails to start then the standby should start. Jockey pump shall stop automatically when the pressure is restored to its normal value.

Manual starting/stopping shall be possible from the local control

panel.

### 3.00.00 TESTS

#### 3.01.00 Shop Tests

3.01.01 Shop tests of all major equipment centrifugal pumps, diesel engines, electrical drive motors, piping, valves and specialties, pressure and storage vessels, MCC, electrical panels, controls, instrumentation etc. shall be conducted as specified in various clauses and as per applicable standards/codes.

3.01.02 Shop tests shall include all tests to be carried out at Contractor's works, works of his sub-contractor and at works where raw materials supplied for manufacture of equipment are fabricated. The tests to be carried out shall include but not be limited to the tests described as follows :

- a) Materials analysis and testing.
- b) Hydrostatic pressure test of all pressure parts, piping, etc.
- c) Dimensional and visual check.
- d) Balancing test of rotating components.
- e) Response of heat/smoke detectors.
- f) Performance characteristics of HVW spray nozzles (projectors).
- g) Flow rate and operational test on Flow control valves.
- h) Operational test of alarm valve (water-motor gang).
- i) Calibration tests on instruments and tests on control panel.
- j) Destruction/burst tests on 2% or minimum one (1) no. of hoses and portable type fire extinguishers for each type as applicable. Any fraction number shall be counted as next higher integer.
- k) Performance test on fire extinguishers as required in the code.

3.01.03 In the absence of any Code/Standard, equipment shall be tested as per mutually agreed procedure between the supplier and the Employer.

3.01.04 A comprehensive visual and functional check for panels would be conducted and will include a thorough check up of panel dimensions,

material of construction, panel finish, compliance with tubing and wiring specifications, quality of workmanship, proper tagging & locations of instruments/accessories. The wiring check shall be complete point to point ring out and check for agreement with installation drawings and equipment vendor prints of the complete system and an inspection of all field connection terminals and levelling.

3.01.05 All test certificates and reports shall be submitted to the Employer for approval.

3.01.06 The Employer's representative shall be given full access to all tests. The manufacturer shall inform the Employer allowing adequate time so that, if the Employer so desires, his representatives can witness the test.

### 3.02.00 **Pre-commissioning Tests**

#### 3.02.01 **General**

- a) All piping and valves, after installation will be tested hydraulically at a pressure of  $16\text{kg/cm}^2$  for a period of 30 minutes to check against leak tightness.
- b) All manually operated valves/gates shall be operated throughout 100% of the travel and these should function without any trouble whatsoever, to the satisfaction of the Employer.
- c) All pumps shall be run with the specified fluid from shut off condition to valve wide open condition. Head developed will be checked from the discharge pressure gauge reading. During the test, the pumps and drives shall run smoothly without any undue vibration, leakage through gland, temperature rise in the bearing parts, noise, flow pulsation etc.
- d) All pressure vessels should be tested hydraulically at the specified test pressure, singly or in the system.
- e) Painting shall be checked by dry type thickness gauges.
- f) Visual check on all structural components, welding, painting etc. and if doubt arises, these will be tested again.
- g) All test instruments and equipment shall be furnished by the Contractor to the satisfaction of the Employer.
- h) Automatic starting of all the fire pumps by operating the test valves.

- i) Automatic operation of the Jockey pump
- j) Operation of the Deluge valve by breaking a detector as well as manual and remote operation of the deluge valve.
- k) Operation of entire annunciation system.

Replacement of fused/damaged quartzoid bulb detectors during the test shall be responsibility of contractor.

- 3.02.02 After erection at site, the complete HVW spray protection and hydrant system shall be subject to tests to show satisfactory performance for which detailed procedure shall be submitted for Employer's approval.

Full flow tests with water shall be done for the system piping as a means of checking the nozzle layout, discharge pattern and coverage, any obstructions and determination of relation between design criteria and actual performance, also to ensure against clogging of the smaller piping and the discharge devices by foreign matter carried by the water.

Rigidity of pipe supports shall also be checked during the water flow.

- 3.02.03 All the detectors installed shall be tested for actuation by bringing a suitable source of heat/smoke near the detector and creating a stream of hot air/ smoke over the detector. The exact procedure of this test shall be detailed out by the Employer to the successful Bidder.

#### 4.00.00 **SPARE PARTS**

The Contractor shall indicate in his scope of supply all the mandatory spares in the relevant schedules. The list of mandatory spares is indicated in 'Section - Projects'.

#### 5.00.00 **HORIZONTAL CENTRIFUGAL PUMPS**

This clause covers the design, performance, manufacturing, construction features and testing of horizontal centrifugal pumps used for the purpose of fire fighting.

- 5.01.00 The materials of the various components shall conform to the applicable IS/BS/ASTM/DIN Standards.

- 5.01.01 In case of any contradiction with the aforesaid standards and the stipulations as per the technical specification as specified hereinafter, the stipulations of the technical specification shall prevail.

#### 5.02.00 **General Performance Requirements**

- 5.02.01 The pump set shall be suitable for continuous operation at any point within the "Range of operation".
- 5.02.02 Pumps shall have a continuously rising head capacity characteristics from the specified duty point towards shut off point, the maximum being at shut off.
- 5.02.03 Pumps shall be capable of furnishing not less than 150% of rated capacity at a head of not less than 65% of the rated head. The shut off head shall not exceed 120% of rated head. Range of operation shall be 20% of rated flow to 150% of rated flow.
- 5.02.04 The pump-motor set shall be designed in such a way that there is no damage due to the reverse flow through the pump which may occur due to any mal-operation of the system.

5.02.05 **Drive Rating**

The drive rating shall not be less than the maximum power requirement at any point within the "Range of Operation" specified.

During starting under reverse flow condition, the motor shall be capable of bringing the pump to rated speed at normal direction with 90% rated voltage at motor terminals.

- 5.02.06 Pump set along with its drive shall run smooth without undue noise and vibration. Acceptable peak to peak vibration limits shall generally be guided by Hydraulic Institute Standards.
- 5.02.07 The Contractor under this specification shall assume full responsibility in the operation of the pump and drive as one unit.

5.03.00 **Design & Construction**

- 5.03.01 Pump casing may be axially or radially split. The casing shall be designed to withstand the maximum pressure developed by the pump at the pumping temperature.
- 5.03.02 Pump casing shall be provided with adequate number of vent and priming connections with valves, unless the pump is made self-venting & priming. Casing drain, as required, shall be provided complete with drain valves.
- 5.03.03 Under certain conditions, the pump casing nozzles will be subjected to reactions from external piping. Pump design must ensure that the nozzles are capable of withstanding external reactions not less than those specified in API-610.
- 5.03.04 Pump shall preferably be of such construction that it is possible to

service the internals of the pump without disturbing suction and discharge piping connections.

#### 5.03.05 **Impeller**

The impeller shall be secured to the shaft and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft impellers shall be secured to the shaft by an additional locknut or cap screw. All screwed fasteners shall tighten in the direction of normal rotation.

#### 5.03.06 **Wearing Rings**

Replaceable type wearing rings shall be furnished to prevent damage to impeller and casing. Suitable method of locking the wearing ring shall be used.

#### 5.03.07 **Shaft**

Shaft size selected shall take into consideration the critical speed, which shall be at least 20% away from the operating speed. The critical speed shall also be atleast 10% away from runaway speed.

#### 5.03.08 **Shaft Sleeves**

Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing or seal and plate so as to distinguish between the leakage between shaft & shaft sleeve and that past the seals/gland.

5.03.09 Shaft sleeves shall be securely fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.

#### 5.03.10 **Bearings**

Bearings of adequate design shall be furnished for taking the entire pump load arising from all probable conditions of continuous operation throughout its "Range of Operation" and also at the shut-off condition. The bearing shall be designed on the basis of 20,000 working hours minimum for the load corresponding to the duty point.

Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearing housing.

#### 5.03.11 **Stuffing Boxes**

Stuffing box design shall permit replacement of packing without

removing any part other than the gland. Stuffing boxes shall be sealed/cooled by the fluid being pumped and necessary piping, fittings, valves, instruments, etc. shall form an integral part of the pump assembly.

#### 5.03.12 **Shaft Couplings**

All shafts shall be connected with adequately sized flexible couplings of suitable design. Necessary guards shall be provided for the couplings.

#### 5.03.13 **Base Plates & Sole Plate**

A common base plate mounting both for the pump and drive shall be furnished.

The base plate shall be of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the pumping unit so mounted as to minimise misalignment caused by mechanical forces such as normal piping strain, hydraulic piping thrust etc. Suitable drain taps and drip lip shall be provided.

#### 5.03.14 **Material of Construction**

All materials used for pump construction shall be of tested quality. Material of construction of the major parts of the pumps shall be as given below :

|    |              |                                                                                      |
|----|--------------|--------------------------------------------------------------------------------------|
| a) | Casing       | Casting Grade FG: 260 of IS 210                                                      |
| b) | Impeller     | Bronze Grade LTB 2 of IS:318                                                         |
| c) | Wearing ring | Bronze Grade LTB 2 of IS:318                                                         |
| d) | Shaft        | Grade 40C8 of IS 1570<br>(Part 2, section 1.): 1979.                                 |
| e) | Shaft sleeve | Bronze Grade LTB 2 of IS:318 or<br>Chrome steel 07Cr13 of<br>IS 1570 (part 5) :1985. |
| f) | Stuffing box | 2.5% Nickel CI Grade FG 260 of<br>IS:210                                             |
| g) | Gland        | --- do ---                                                                           |

#### 5.03.15 **Balancing**

All rotating components shall be statically and dynamically balanced at

shop.

- 5.03.16 All the components of pumps of identical parameters supplied under this specification shall be interchangeable.

**5.04.00 Tests and Inspection**

- 5.04.01 The manufacturer shall conduct all routine tests required to ensure that the equipment furnished conform to the requirements of this specification and are in compliance with the requirements of applicable Codes and Standards. The particulars of the proposed tests and the procedures for the tests shall be submitted to the Employer/Engineer for approval before conducting the tests.

- 5.04.02 Where stage inspection is to be witnessed by Employer, in addition to above, the Bidder shall submit to the Employer/Engineer at the beginning of the contract, the detailed PERT-Chart showing the manufacturing programme and indicating the period where Employer or his authorised inspecting agency are required at the shop.

**5.04.03 Material of Construction**

All materials used for pump construction shall be of tested quality. Materials shall be tested as per the relevant standards and test certificates shall be made available to the Employer/Engineer.

- 5.04.04 Where stage inspection is to be witnessed by Employer, all material test certificates shall be correlated and verified with the actual material used for construction before starting fabrication, by Employer's Inspector who shall stamp the material. In case mill test certificates for the material are not available, the Contractor shall carry out physical and chemical tests at his own cost from a testing agency approved by the Employer, as per the requirements of specified material standard. The samples for physical and chemical tests shall be drawn up in presence of Employer's inspector who shall also witness the tests.

- 5.04.05 Shaft shall be subjected to 100% ultrasonic test and machined portion of the impeller shall be subject to 100% DP test. On finished shaft DP test will also be carried out.

**5.04.06 Hydraulic test at shop**

All pressure parts shall be subjected to hydraulic testing at a pressure of 150% of maximum pressure generated by the pump at rated speed or 200% of total dynamic head whichever is higher, for a period not less than one (1) hour.

**5.04.07 Performance test at shop**

Pumps shall be subjected to routine tests to determine the performance of the pumps. These tests shall be conducted in presence of

Employer/Engineer's representative as per the requirements of the Hydraulic Institute Standards/ASME Power Test Code PTC 8.2/BS-599/I.S.S., latest edition. Routine tests shall be done on all the pumps.

- 5.04.08 Performance tests shall be conducted to cover the entire range of operation of the pumps. These shall be carried out to span 150% of rated capacity upto pump shut-off condition. A minimum of five combinations of head and capacity are to be achieved during testing to establish the performance curves, including the design capacity point and the two extremities of the Range of operation specified.
- 5.04.09 Tests shall preferably be conducted alongwith the actual drives being supplied.
- 5.04.10 The Bidders shall submit in his proposal the facilities available at his works to conduct performance testing. If because of limitations of available facilities, a reduced speed test or model test has to be resorted to establish pump performance, the same has to be highlighted in the offer.
- 5.04.11 In case of model testing, the stipulations of latest edition of Hydraulic Institute Standards shall be binding. Prototype or model tests, however, shall be conducted with the suction condition identical to the field conditions i.e. sigma values of prototype and model is to be kept same.
- 5.04.12 Prior to conducting model testing, calculations establishing model parameters, sizes and test procedure will be submitted to Employer/Engineer for approval.
- 5.04.13 All rotating components of the pumps shall be subjected to static and dynamic balancing tests.
- 5.04.14 The Employer or his authorised representative shall have full access to all tests. Prior to performance tests, the Contractor shall intimate the Employer allowing adequate time so that if the Employer so desires, his representative can witness the test.
- 5.04.15 Report and test certificates of the above tests shall be submitted to the Employer/Engineer for approval.
- 5.04.16 **Pre commissioning tests.**

After installation, pumps offered may be subjected to testing at field also by Employer. If the performances at field are not found to meet the requirement, then the equipment shall be rectified by the Contractor without any extra cost. Prior to performance testing, the procedure for such tests will be mutually agreed between Employer and Contractor. The Contractor shall furnish all necessary instruments, accessories and personnel for testing. Prior to testing, the calibration curves of all instruments and permissible tolerance limit of instruments shall be mutually agreed upon.

## 6.00.00 **DIESEL ENGINES**

This Clause covers the design, performance, manufacturing construction features and testing of compression ignition diesel engines, used primarily for driving centrifugal pumps, used for the purpose of fire fighting.

### 6.01.00 **Design and Construction**

#### **General**

6.01.01 The diesel engine shall be of multicylinder type four-stroke cycle with mechanical (airless) injection, cold starting type.

6.01.02 The continuous engine brake horse power rating (after accounting for all auxiliary power consumption) at the site conditions shall be atleast 20% greater than the requirement at the duty point of pump at rated RPM and in no case, less than the maximum power requirement at any condition of operation of pump.

6.01.03 Reference conditions for rated output of engine shall be as per IS:10000, part II or ISO:3046, part I.

6.01.04 The engine shall be designed with regard to ease of maintenance, repair, cleaning and inspection.

6.01.05 All parts subjected to substantial temperature changes shall be designed and supported to permit free expansion and contraction without resulting in leakage, harmful distortion or misalignment.

### 6.01.06 **Starting**

The engine shall be capable of both automatic and manual start. The normal mode of starting is automatic but in the event of failure of automatic start or at the discretion of the operator, the engine can be started manually from the LCP.

Since the fire pumping unit driven by the diesel engine is not required to run continuously for long periods and the operation will not be frequent, special features shall be built into the engine to allow it to start within a very short period against full load even if it has remained idle for a considerable period.

6.01.07 If provision for manual start (cranking) is provided, all controls/mechanisms, which have to be operated during the starting process, shall be within easy reach of the operator.

6.01.08 Automatic cranking shall be effected by a D.C. motor having high starting torque to overcome full engine compression. Starting power will

be supplied from either of the two (2) sets of storage batteries. The automatic starting arrangement shall include a 'Repeat Start' feature for 3 attempts. The battery capacity shall be adequate for 3 (three) consecutive starts without recharging with a cold engine under full compression.

- 6.01.09 The batteries shall be used exclusively for starting the diesel engine and be kept fully charged all the time in position. Arrangement for both trickle and booster charge shall be provided.

Diesel engine shall be provided with two (2) battery charger units of air-cooled design. The charger unit shall be capable of charging one (1) set of battery at a time. Provision shall, however, be made so that any one of the charger units can be utilised for charging either of the two (2) batteries.

- 6.01.10 For detail design of battery and battery charger, sub- section Electrical may be referred to.

6.01.11 **Governing System:**

The engine shall be fitted with a speed control device, which will control the speed under all conditions of load.

- 6.01.12 The governor shall offer following features:

- a) Engine should be provided with an adjustable governor capable of regulating engine speed within 5% of its rated speed under any condition of load between shut-off and maximum load conditions of the pumps. The governor shall be set to maintain rated pump speed at maximum pump load.
- b) Engine shall be provided with an over speed shut- down device. It shall be arranged to shut-down the engine at a speed approximately 20% above rated engine speed and for manual reset, such that the automatic engine controller will continue to show an over speed signal until the device is manually reset to normal operating position (Vol.II, NFPA, 1978).

- 6.01.13 The governor shall be suitable for operation without external power supply.

6.01.14 **Fuel System**

The diesel engine will run on High Speed Diesel.

- 6.01.15 The engine shall be provided with fuel oil tank of 250 litres capacity. The fuel oil tank shall preferably be mounted near the engine. No fuel oil tank will be provided by the Employer.

- 6.01.16 The fuel oil tank shall be of welded steel constructed to relevant standards for mild steel drums. The outlet of the tank shall be above the inlet of fuel injection pump of the diesel engine to ensure adequate pressure at suction of injection pump.
- 6.01.17 The fuel oil tank shall be designed in such a way that the sludge and sediment settles down to the tank bottom and is not carried to the injection pump. A small sump shall be provided and fitted with drain plug to take out sludge/sediment and to drain oil. Adequate hand holes (greater than 80 mm size) shall be provided to facilitate maintenance.
- 6.01.18 Pipeline carrying fuel oil shall be gradually sloped from the tank to the injection pump. Any valve in the fuel feed pipe between the fuel tank and the engine shall be placed adjacent to the tank and it shall be locked in the open position. A filter shall be incorporated in this pipeline, in addition to other filters in the fuel oil system. Pipe joints shall not be soldered and plastic tubing shall not be used. Reinforced flexible pipes may also be used.
- 6.01.19 The complete fuel oil system shall be designed to avoid any air pocket in any part of the pipe work, fuel pump, sprayers/injectors, filter system etc. No air relief cock is permitted. However, where air relief is essential, plugs may be used.
- 6.01.20 A manual fuel pump shall be provided for priming and releasing of air from the fuel pipelines.

#### 6.01.21 **Lubricating Oil System**

Automatic pressure lubrication shall be provided by a pump driven by the crank shaft, taking suction from a sump and delivering pressurised oil through cooler and fine mesh filters to a main supply header fitted in the bed plate casing. High pressure oil shall be supplied to the main and big end bearings, cam-shaft bearings, cam-shaft chain and gear drives, governor, auxiliary drive gears etc. Valve gear shall be lubricated at reduced pressure through a reducing valve and the cams by an oil bath.

#### 6.01.22 **Cooling Water System**

Direct cooling or heat exchanger type cooling system shall be employed for the diesel engine. Water shall be tapped from the fire pump discharge. This water shall be led through duplex strainer, pressure breakdown orifice and then after passing through the engine, the water at the outlet shall be taken directly to the sump through an elevated funnel.

#### 6.02.00 **Testing & Inspection**

- 6.02.01 The manufacturer shall conduct all tests required, to ensure that the equipment furnished conforms to the requirement of this sub-section

and in compliance with requirements of applicable codes. The particulars of the proposed tests and the procedure for the tests shall be submitted to the Employer for approval before conducting the tests.

- 6.02.02 At manufacturer's works, tests shall be carried out during and after completion of manufacture of different component/parts and the assembly as applicable. Following tests shall be conducted.
- 6.02.03 Material analysis and testing.
- 6.02.04 Hydrostatic pressure testing of all pressure parts.
- 6.02.05 Static and dynamic balance tests of rotating parts at applicable over-speed and determination of vibration level.
- 6.02.06 MPI/DPT on machined parts of piston and cylinder.
- 6.02.07 Ultrasonic testing of crankshaft and connecting rod after heat treatment.
- 6.02.08 Dimensional check of close tolerance components like piston, cylinder bore etc.
- 6.02.09 Calibration tests of all fuel pumps, injectors, standard orifices, nozzles, instruments etc.
- 6.02.10 Over speed test of the assembly at 120% of rated speed.
- 6.02.11 Power run test.
- 6.02.12 Performance test of the diesel engine to determine its torque, power and specific fuel consumption as function of shaft speed. Performance test of the engine shall be carried for 12 hours out of which 1 hour at full load and one hour at 110% overload.
- 6.02.13 Measurement of vibration & noise.

(i) Measurement of vibration

The vibration shall be measured during full load test as well as during the overload test and limit shall be 100 microns.

(ii) Measurement of noise level

The equivalent 'A' weighted sound level measured at a distance of 1.5 M above floor level in elevation and 1.0 M horizontally from the base of the equipment, expressed in dB to a reference of 0.0002 microbar shall not exceed 93 dBA.

Above tests for vibration shall be repeated at site as pre-commissioning

tests.

6.02.14 Adjustment of speed governor as per BS:5514.

6.02.15 Diesel engine shall be subjected to routine tests as per IS:10000/BS:5514.

#### 7.00.00 **PIPING, VALVES AND SPECIALITIES**

This clause covers the design, manufacture, shop testing, erection, testing and commissioning of piping, valves and specialities.

##### 7.02.00 **Scope**

The piping system which shall include but not be limited to the following:

7.02.01 Plain run of piping, bends, elbows, tees, branches, laterals, crosses, reducing unions, couplings, caps, expansion joints, flanges, blank flanges, thrust blocks, anchors, hangers, supports, saddles, shoes, vibration dampeners, sampling connections, hump pipes etc.

7.02.02 Gaskets, ring joints, backing rings, jointing material etc. as required. Also all welding electrodes and welding consumables including special ones, if any.

7.02.03 Instrument tapping connections, stubs etc.

7.02.04 Gate and globe valves to start/stop and regulate flow and swing check valves for one directional flow.

7.02.05 Basket strainers and Y-type strainers

7.02.06 Bolts, nuts, fasteners as required for interconnecting piping, valves and fittings as well as for terminal points. For pipe connections into Owner's R.C.C. works, Bidder will furnish all inserts.

7.02.07 Painting, anti-corrosive coatings etc. of pipes and equipment.

Adequate number of air release valves shall be provided at the highest points in the piping system to vent any trapped air in the system.

##### 7.03.00 **Design**

7.03.01 Material of construction of various pipes shall be as follows :

###### (a) **Buried Pipes**

Mild steel black pipes as per IS:1239, Part-I medium grade (for pipes of sizes 150 NB and below) or IS:3589, Fe 410 grade (for pipes of sizes 200 NB and above) suitably lagged on the outside to

prevent soil corrosion, as specified elsewhere.

(b) **Overground Pipes normally full of water**

Mild steel black pipes as per IS:1239, Part-I medium grade (for pipes for sizes 150 NB and below) or IS:3589, Fe 410 grade (for pipes of sizes 200 NB and above).

(c) Overground pipes normally empty, but periodic charge of water and for detector line for HVW System.

Mild steel galvanised pipes as per IS:1239, Part-I medium grade (for pipes of sizes 150 NB and below) or IS:3589, Fe 410 grade (for pipes of sizes 200 NB and above).

- 7.03.02 All fittings to be used in connection with steel pipe lines upto a size of 80 mm shall be as per IS:1239. Part-II Mild steel tubulars and other wrought steel pipe fittings, Heavy grade. Fittings with sizes above 80 mm upto 150 mm shall be fabricated from IS:1239 Heavy grade pipes or steel plates having thickness not less than those of IS:1239 Part-I Heavy grade pipes. Fittings with sizes above 150 mm shall be fabricated from IS:3589 Class-2 pipes. All fitting used in GI piping shall be threaded type. Welding shall not be permitted on GI piping.
- 7.03.03 Pipe sizes shall not be less than the sizes indicated in the attached drawings.
- 7.03.04 For steel pipeline, welded construction should be adopted unless specified otherwise.
- 7.03.06 All piping system shall be capable of withstanding the maximum pressure arising from any condition of operation and testing including water hammer effects.
- 7.03.09 Gate/sluice valve shall be used for isolation of flow in pipe lines and **construction** shall be as per IS:778 (for size up to 40 mm) and IS:14846 (for sizes above 40 mm) except **for valve spindle movement**. Valves shall be of rising spindle type and of PN 1.6 class
- 7.03.10 Gate Valves shall be provided with the following :
- (a) Hand wheel.
  - (b) Position indicator.
  - (c) Locking facility (where necessary).
- 7.03.11 Gate valves shall be provided with back seating bush to facilitate gland removal during full open condition.

- 7.03.12 Globe valves shall be provided with contoured plug to facilitate regulation and control of flow. All other requirements should generally follow those of gate valve.
- 7.03.13 Non-return valves shall be swing check type. Valves will have a permanent "arrow" inscription on its body to indicate direction of flow of the fluid. These valves shall generally conform to IS:5312.
- 7.03.14 Whenever any valve is found to be so located that it cannot be approached manually from the nearest floor/gallery/platform hand wheel with floor stand or chain operator shall be provided for the same.
- 7.03.15 Valves below 50 mm size shall have screwed ends while those of 50 mm and higher sizes shall have flanged connections.

**7.03.14 Basket Strainer**

- a) Basket strainers shall be of 30mesh and have the following materials of construction :  
  
Body: Fabricated mild steel as per IS:2062 (Tested Quality).  
Strainer Wires: stainless steel (AISI : 316), 30 SWG, suitably reinforced.
- b) Inside of basket body shall be protected by two (2) coats of heavy duty bitumastic paint.
- c) Strainers shall be Simplex design. Suitable vent and drain connections with valves shall be provided.
- d) Screen open area shall be at least 4 times pipe cross sectional area at inlet.
- e) Pressure drop across strainer in clean condition shall not exceed **1.5 MWC at 410M3/hr (for 765kV/400kV substations) and 1 MWC at 273M3/hr flow (for 220kV & 132kV substations).** Pressure drop test report of strainer of same design shall be furnished.

**7.03.15 Y-type On-line Strainer**

Body shall be constructed of mild steel as per IS:2062 (tested quality). Strainer wires shall be of stainless steel AISI:316, 30 SWG, 30 mesh.

Blowing arrangement shall be provided with removable plug at the outlet. Screen open area shall be atleast 4 times pipe cross-sectional area at inlet.

Pressure drop test report of strainer of same design shall be furnished.

**7.03.16 Hydrant Valve (Outdoor) and Indoor Hydrant Valves (Internal**

**Landing Valves).**

The general arrangement of outdoor stand post assembly, consisting of a column pipe and a hydrant valve with a quick coupling end shall be as per TAC requirement.

Materials of construction shall be as follows :

- |                              |                                                   |
|------------------------------|---------------------------------------------------|
| a) Column pipe               | M.S. IS:1239 med. grade.                          |
| b) Hydrant Valve             |                                                   |
| i) Body                      | <b>Stainless steel.</b>                           |
| ii) Trim                     | Leaded tin bronze as per IS:318, Grade-LTB 2.     |
| iii) Hand Wheel              | Cast Iron as per IS:210, Grade FG:200.            |
| iv) Washer, gasket, etc.     | Rubber as per IS:638.                             |
| v) Quick coupling connection | Leaded tin bronze as per IS:318, Grade-LTB 2.     |
| vi) Spring                   | Phosphor Bronze as per IS:7608.                   |
| vii) Cap and chain           | Leaded tin bronze as per IS:318, Grade-LTB etc.2. |

The general design of hydrant valve shall conform to IS:5290.

**7.03.17 Hoses, Nozzles, Branch pipes and Hose boxes**

- (a) Hose pipes shall be of reinforced rubber-lined canvas construction as per type A of IS:636 with nominal size of 63 MM (2 1/2") and lengths of 15 metre or 7.5 metre, as indicated elsewhere. All hoses shall be ISI marked.
- (b) Hosepipes shall be capable of withstanding an internal water pressure of not less than 35.7 kg/cm<sup>2</sup> without bursting. It must also withstand a working pressure of 8.5 kg/cm<sup>2</sup> without undue leakage or sweating.
- (c) Each hose shall be fitted with instantaneous spring lock type couplings at both ends. Hose shall be fixed to the coupling ends by copper rivets and the joint shall be reinforced by 1.5 mm galvanised mild steel wires and leather bands.

- (d) Branch pipes shall be constructed of copper and have rings of leaded tin bronze (as per IS:318 Grade-2) at both ends. One end of the branch pipe will receive the quick coupling while the nozzles will be fixed to the other end.
- (e) Nozzles shall be constructed of leaded tin bronze as per IS:318, Grade-2.
- (f) Suitable spanners of approved design shall be provided in adequate numbers for easy assembly and dismantling of various components like branch pipes, nozzles, quick coupling ends etc.
- (g) Hose pipes fitted with quick coupling ends, branch pipes, nozzles spanner etc. will be kept in a hose box, which will be located near point of use. The furnished design must meet the approval of Tariff Advisory Committee.
- (h) All instantaneous couplings, as mentioned under clause Nos.3.03.19, 3.03.20 and 3.03.21 above shall be of identical design (both male and female) so that any one can be interchanged with another. One male, female combination shall get locked in by mere pushing of the two halves together but will provide leak tightness at a pressure of 8 kg/cm<sup>2</sup> of water. Designs employing screwing or turning to have engagement shall not be accepted.

#### 7.04.00 **Fabrication & Erection**

7.04.01 The contractor shall fabricate all the pipe work strictly in accordance with the related approved drawings.

#### 7.04.02 **End Preparation**

- (a) For steel pipes, end preparation for butt welding shall be done by machining.
- (b) Socket weld end preparation shall be sawing/machining.
- (c) For tees, laterals, mitre bends, and other irregular details cutting templates shall be used for accurate cut.

#### 7.04.03 **Pipe Joints**

- (a) In general, pipes having sizes over 25 mm shall be joined by butt welding. Pipes having 25 mm size or less shall be joined by socket welding/screwed connections. Galvanised pipes of all sizes shall have screwed joints. No welding shall be permitted on GI pipes. Screwed joints shall have tapered threads and shall be assured of leak tightness without using any sealing compound.
- (b) Flanged joints shall be used for connections to vessels, equipment,

flanged valves and also on suitable straight lengths of pipe line of strategic points to facilitate erection and subsequent maintenance work.

#### 7.04.04 **Overground Piping**

- (a) Piping to be laid overground shall be supported on pipe rack/supports. Rack/supports details shall have to be approved by Employer/Engineer.
- (b) Surface of overground pipes shall be thoroughly cleaned of mill scale, rust etc. by wire brushing. Thereafter one (1) coat of **red oxide primer** shall be applied. Finally two (2) coats of synthetic enamel paint of approved colour shall be applied.

#### 7.04.05 **Buried Pipe Lines**

- (a) Pipes to be buried underground shall be provided with protection against soil corrosion by coating and wrapping with two coats of coal tar hot enamel paint and two wraps of reinforced fibre glass tissue. The total thickness of coating and wrapping shall not be less than 3 mm. Alternatively corrosion resistant tapes can also be used for protection of pipes against corrosion.
- (b) Coating and wrapping and holiday testing shall be in line with IS:10221.
- (c) Buried pipelines shall be laid with the top of pipe one meter below ground level.
- (d) At site, during erection, all coated and wrapped pipes shall be tested with an approved Holiday detector equipment with a positive signalling device to indicate any fault hole breaks or conductive particle in the protective coating.

#### 7.05.00 **General Instruction for Piping Design and Construction**

7.05.01 While erecting field run pipes, the contractor shall check, the accessibility of valves, instrument tapping points, and maintain minimum headroom requirement and other necessary clearance from the adjoining work areas.

7.05.02 Modification of prefabricated pipes, if any, shall have to be carried out by the contractor at no extra charge to the Employer.

#### 7.05.03 **Welding**

- (i) Welding shall be done by qualified welders only.

- (ii) Before welding, the ends shall be cleaned by wire brushing, filing or machine grinding. Each weld-run shall be cleaned of slag before the next run is deposited.
- (iii) Welding at any joint shall be completed uninterrupted. If this cannot be followed for some reason, the weld shall be insulated for slow and uniform cooling.
- (iv) Welding shall be done by manual oxyacetylene or manual shielded metal arc process. Automatic or semi-automatic welding processes may be done only with the specific approval of Employer/ Consultant.
- (v) As far as possible welding shall be carried out in flat position. If not possible, welding shall be done in a position as close to flat position as possible.
- (vi) No backing ring shall be used for circumferential butt welds.
- (vii) Welding carried out in ambient temperature of 5°C or below shall be heat-treated.
- (viii) Tack welding for the alignment of pipe joints shall be done only by qualified welders. Since tack welds form part of final welding, they shall be executed carefully and shall be free from defects. Defective welds shall be removed prior to the welding of joints.

Electrodes size for tack welding shall be selected depending upon the root opening.

- (ix) Tacks should be equally spaced as follows :
  - for 65 NB and smaller pipes : 2 tacks
  - for 80 NB to 300 NB pipes : 4 tacks
  - for 350 NB and larger pipes : 6 tacks
- (x) Root run shall be made with respective electrodes/filler wires. The size of the electrodes/filler wires. The size of the electrodes shall not be greater than 3.25 mm (10 SWG) and should preferably be 2.3 mm (12 SWG). Welding shall be done with direct current values recommended by the electrode manufacturers.
- (xi) Upward technique shall be adopted for welding pipes in horizontally fixed position. For pipes with wall thickness less than 3 mm, oxyacetylene welding is recommended.

- (xii) The root run of butt joints shall be such as to achieve full penetration with the complete fusion of root edges. The weld projection shall not exceed 3 mm inside the pipe.
- (xiii) On completion of each run craters, weld irregularities, slag etc. shall be removed by grinding or chipping.
- (xiv) Fillet welds shall be made by shielded metal arc process regardless of thickness and class of piping. Electrode size shall not exceed 10 SWG. (3.25 mm). At least two runs shall be made on socket weld joints.

#### 7.06.00 Tests at Works

##### 7.06.01 Pipes

- (i) Mechanical and chemical tests shall be performed as required in the codes/standards.
- (ii) All pipes shall be subjected to hydrostatic tests as required in the codes/standards.
- (iii) 10% spot Radiography test on welds of buried pipes shall be carried out as per ASME VIII.

##### 7.06.02 Valves

- (i) Mechanical and chemical tests shall be conducted on materials of the valve as required in the codes/standards.
- (ii) All valves shall be tested hydrostatically for the seat as well as required in the code/standards for a period of ten minutes.
- (iii) Air test shall be conducted to detect seat leakage.
- (iv) Visual check on the valve and simple operational test in which the valve will be operated thrice from full open to full close condition.
- (v) No repair work on CI valve body, bonnet or wedge shall be allowed.

##### 7.06.03 Strainers

- (i) Mechanical and chemical tests shall be conducted on materials of the strainer.
- (ii) Strainers shall be subjected to a hydrostatic test pressure of 1.5 times the design pressure or 10 kg/cm<sup>2</sup>g whichever is higher for a period of one hour.

#### 7.06.04 **Hydrant valves and Indoor Hydrant Valves (Internal Landing Valves)**

- (i) The stand post assembly along with the hydrant valve (valve being open and outlet closed) shall be pressure tested at a hydrostatic pressure of 21 kg/cm<sup>2</sup>g to detect any leakage through defects of casting.
- (ii) Flow test shall be conducted on the hydrant valves at a pressure of 7 kg/cm<sup>2</sup>g and the flow through the valve shall not be less than 900 litres/min.
- (iii) Leak tightness test of the valve seat shall be conducted at a hydrostatic test pressure of 14 kg/cm<sup>2</sup>g.

#### 7.06.05 **Hoses, Nozzles, Branch Pipes and Hose Boxes**

Reinforced rubber-lined canvas hoses shall be tested hydrostatically. Following tests shall be included as per IS:636.

- a) Hydrostatic proof pressure test at 21.4 kgf/cm<sup>2</sup>g
- b) Internal diameter

The branch pipe, coupling and nozzles shall be subjected to a hydrostatic test pressure of 21 kg/cm<sup>2</sup>g for a period of 2<sup>1</sup>/<sub>2</sub> minutes and shall not show any sign of leakage or sweating.

Dimensional checks shall be made on the hose boxes and nozzle spanners.

#### 8.00.00 **AIR VESSELS**

8.01.00 Air vessels shall be designed and fabricated of mild steel as class-II vessels as per IS:2825 for a pressure of 14kg/cm<sup>2</sup> and shall be minimum 3 m<sup>3</sup> capacity.

8.02.00 Inside surface of the tank shall be protected by anti-corrosive paints/coatings/linings as required.

8.03.00 Outside surfaces of the vessels shall be provided with one (1) coat of red lead primer with two (2) coats of synthetic enamel paint of approved colour and characteristics.

#### 8.04.00 **Tests & Inspection**

8.04.01 Air vessels shall be hydraulically tested at 21kg/cm<sup>2</sup> for a period not less than one (1) hour.

8.04.02 All materials used for fabrication shall be of tested quality and test

certificates shall be made available to the Owner.

8.04.03 Welding procedure and Welder's qualification tests will be carried out as per relevant IS Standard.

8.04.04 NDE tests, which will include 100% Radiography on longitudinal seams and spot Radiography for circumferential seams, for pressure vessel will be carried out.

## 9.00.00 **HEAT DETECTORS/FIRE DETECTORS AND SPRAY NOZZLES**

### 9.00.01 **Intent of Specification**

This specification lays down the requirements of the smoke detectors, heat detectors and spray nozzles for use in various sub-systems of the fire protection system.

### 9.00.02 **Codes and Standards**

All equipment supplied shall conform to internationally accepted codes and standards. All equipment offered by Bidders should be TAC approved or have been in use in installations which have been approved by TAC.

### 9.01.00 **Heat Detectors, Quartzoid bulb type. (Used in HVW spray system)**

- a) Heat detectors shall be of any approved and tested type. Fusible chemical pellet type heat detectors are however not acceptable.
- b) Temperature rating of the heat detector shall be selected by the Bidder taking into consideration the environment in which the detectors shall operate. Minimum set point shall, however, be 79oC.
- c) Heat detectors shall be guaranteed to function properly without any maintenance work for a period of not less than twenty five (25) years.
- d) The heat detectors shall be mounted on a pipe network charged with water at suitable pressure. On receipt of heat from fire, the heat detector will release the water pressure from the network. This drop in water pressure will actuate the Deluge valve.

### 9.02.00 **HVW Spray Nozzles (Projectors)**

High velocity water spray system shall be designed and installed to discharge water in the form of a conical spray consisting of droplets of water travelling at high velocity which shall strike the burning surface with sufficient impact to ensure the formation of an emulsion. At the same time the spray shall efficiently cut off oxygen supply and provide

sufficient cooling. Integral non-ferrous strainers shall be provided in the projectors ahead of the orifice to arrest higher size particle, which are not allowed to pass through the projectors.



## 11.00.00 INSTRUMENTS

### 11.00.01 Intent of Specification

The requirements given in the sub-section shall be applicable to all the instruments being furnished under this specification.

- 11.00.02 All field mounted instruments shall be weather and dust tight, suitable for use under ambient conditions prevalent in the subject plant. All field mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance can be achieved.

### 11.01.00 Local Instruments

Pressure/ Differential Gauges & Switches.

- 11.01.01 The pressure sensing elements shall be continuous 'C' bourdon type.
- 11.01.02 The sensing elements for all gauges/switches shall be properly aged and factory tested to remove all residual stresses. They shall be able to withstand atleast twice the full scale pressure/vacuum without any damage or permanent deformation.
- 11.01.03 For all instruments, connection between the pressure sensing element and socket shall be braced or hard soldered.
- 11.01.04 Gauges shall be of 150 mm diameter dial with die-cast aluminium, stoved enamel black finish case, aluminium screwed ring and clear plastic crystal cover glass. Upper range pointer limit stop for all gauges shall be provided.
- 11.01.05 All gauges shall be with stainless steel bourdon having rotary geared stainless steel movements.
- 11.01.06 Weatherproof type construction shall be provided for all gauges. This type of construction shall be fully dust tight, drip tight, weather resistant and splash proof with anti-corrosive painting conforming to NEMA- 4.
- 11.01.07 All gauges shall have micrometer type zero adjuster.
- 11.01.08 Neoprene safety diaphragm shall be provided on the back of the instruments casing for pressure gauges of ranges 0-10 Kg/cm<sup>2</sup> and above.
- 11.01.09 Scales shall be concentric, white with black lettering and shall be in metric units.
- 11.01.10 Accuracy shall be  $\pm 1.0$  percent of full range or better.

- 11.01.11 Scale range shall be selected so that normal process pressure is approximately 75 percent of full scale reading. For pressure gauges and pressure switches, the range shall not be less than 0 -16 Kg/cm<sup>2</sup>
- 11.01.12 All gauges shall have 1/2 inch NPT bottom connection.
- 11.01.13 All instruments shall conform to IS: 3624 - 1966.
- 11.01.14 All instruments shall be provided with 3 way gauge isolation valve or cock. Union nut, nipple and tail pipe shall be provided wherever required.
- 11.01.15 Switch element contact shall have two (2) NO and two (2) NC contacts rated for 240 Volts, 10 Amperes A.C. or 220 Volts, 5 Amperes D.C. Actuation set point shall be adjustable throughout the range. ON-OFF differential (difference between switch actuation and de-actuation pressures) shall be adjustable. Adjustable range shall be suitable for switch application.
- 11.01.16 Switches shall be sealed diaphragm, piston actuated type with snap action switch element. Diaphragm shall be of 316 SS.
- 11.01.18 Necessary accessories shall be furnished.
- 11.02.00 **Timers**
- 11.02.01 The timers shall be electro-mechanical type with adjustable delay on pick-up or reset as required.
- 11.02.02 Each timer shall have two pairs of contacts in required combination of NO and NC.
- 11.03.00 **Level Gauges/Indicator/Switches**
- 11.03.01 **Level Gauges**
- i) Gauge glasses shall be used for local level indication wherever shown in the flow diagram.
  - ii) Gauge glasses, in general, shall be flag glass type with bolted cover. Body and cover material shall be of carbon steel with rubber lining.
  - iii) Level coverage shall be in accordance with operating requirements. Maximum length of a single gauge glass shall not exceed 1.4 M. Should a larger gauge glass be required, multiple gauges of preferably equal length shall be used with 50 mm overlap in visibility.
  - iv) Reflex type gauge glasses shall be used for colourless liquids and

transparent type gauge glasses shall be used for all liquids having colour.

- v) Each gauge glass shall be complete with a pair of offset valves. Valves shall have union bonnet, female union level connection, flanged tank connection, and vent and drain plug.
- vi) Offset valves shall have corrosion resistant ball-check to prevent fluid loss in the event of gauge glass breakage. Valve body shall have a working pressure of 200 percent of the maximum static pressure at the maximum process fluid temperature. Valve body materials shall be of carbon steel with rubber lining.

#### 11.03.02 Level Indicators

- i) Float type mechanical level gauges with linear scale type indicator shall be offered for measuring level of tanks wherever shown in the flow diagram.
- ii) AISI-316 stainless steel float, guide rope and tape shall be used. Housing shall be of mild steel painted with anti-corrosive painting.
- iii) The scale indicator shall be provided at a suitable height for ease of reading.
- iv) Accuracy shall be + 1% of scale range or better.

#### 11.03.03 Level Switches

- i) Level switches shall be of ball float operated magnetic type complete with cage.
- ii) Materials of construction shall be suitable for process and ambient conditions. The float material shall be AISI-316 stainless steel.
- iii) Actuating switches shall be either hermetically sealed mercury type or snap acting micro-switches. Actuation set point shall be adjustable. ON-OFF differential (difference between switch actuation and de-actuation levels) shall be adjustable. Adjustable range shall be suitable for switch application. All switches shall be repeatable within + 1.0 percent of liquid level change required to activate switch. Contacts shall be rated for 50 watts resistive at 240 V A.C. Number of contacts shall be two NO and two NC for each level switch.

#### 11.04.00 Solenoid Valves

11.04.01 The body of the valves shall be Forged brass or stainless steel.

11.04.02 The coil shall be continuous duty, epoxy moulded type Class-F, suitable for high temperature operation.

11.04.03 The enclosure shall be watertight, dust-tight and shall conform to NEMA-4 Standard.

11.04.04 The valves shall be suitable for mounting in any position.

**11.05.00 Switches, Lamps, Meters Etc.**

All electrical components on the panel namely push buttons, switches, lamps, meters etc. shall meet the requirements of sub-section Electrical enclosed with the specification.

11.06.00 All local instruments shall be inspected by Employer/Consultant as per the agreed quality plan.

11.07.00 Makes of control panel and local instruments, accessories shall be as per Employer's approval.

**12.00.00 ELECTRIC MOTORS**

**12.01.00 General**

12.01.01 This clause covers the requirements of three phase squirrel cage induction motors and single-phase induction motors.

12.01.02 The motors to be furnished, erected and commissioned as covered under this specification shall be engineered, designed, manufactured, erected, tested as per the requirements specified herein. These requirements shall however be read along with the requirements of the respective driven equipment being supplied under the specification of which this specification forms a part.

12.01.03 The motor supplied under this specification shall conform to the standards specified in Section-3

12.01.04 Terminal point for all motors supplied under this specification shall be at the respective terminal boxes.

12.01.05 Materials and components not specifically stated in this specification but are necessary for satisfactory operation of the motor shall be deemed to be included in the scope of supply of this specification.

12.01.06 Notwithstanding anything stated in this motor specification, the motor has to satisfy the requirement of the mechanical system during normal and abnormal conditions. For this the motor manufacturer has to co-ordinate with the mechanical equipment supplier and shall ensure that the motor being offered meets the requirements.

**12.02.00 Codes & Standards**

- 12.02.21 The design, manufacture, installation and performance of motors shall conform to the provisions of latest Indian Electricity Act and Indian Electricity Rules. Nothing in these specifications shall be construed to relieve the Contractor of his responsibility.
- 12.02.22 In case of contradiction between this specifications and IS or IEC, the stipulations of this specification shall be treated as applicable.
- 12.02.23 National Electrical code for hazardous location and relevant NEMA standard shall also be applicable for motors located in hazardous location.

### 12.03.00 Design Features

#### 12.03.01 Rating and type

- (i) The induction motors shall be of squirrel cage type unless specified otherwise.
- (ii) The motors shall be suitable for continuous duty in the specified ambient temperature.
- (iii) The MCR KW rating of the motors for 50°C ambient shall not be less than the power requirement imposed at the motor shaft by the driven equipment under the most onerous operation conditions as defined elsewhere, when the supply frequency is 51.5 Hz (and the motor is running at 103% of its rated speed).
- (iv) Motors shall be capable of giving rated output without reduction in the expected life span when operated continuously in the system having the following particulars :
  - a) Rated terminal voltage
 

|                    |                                  |
|--------------------|----------------------------------|
| From 0.2 to 200 KW | 415V (3 Phase, solidly earthed)  |
| Below 0.2 KW       | 240 V (1 Phase, solidly earthed) |

Variation in voltage  $\pm 6\%$ .
  - b) Frequency      50 Hz  $\pm 3\%$ .
  - c) Any combination of (a) & (b)

#### 12.03.02 Enclosure

Motors to be installed outdoor and semi-outdoor shall have hose proof enclosure equivalent to IP-55 as per IS: 4691. For motors to be installed indoor, the enclosure shall be dust proof equivalent to IP-54 as

per IS: 4691.

#### 12.03.03 **Cooling method**

Motors shall be TEFC (totally enclosed fan cooled) type.

#### 12.03.04 **Starting requirements**

##### (i) **Induction motor**

- a) All induction motors shall be suitable for full voltage direct on-line starting. These shall be capable of starting and accelerating to the rated speed alongwith the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 80% of the rated voltage.
- b) Motors shall be capable of withstanding the electro-dynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.
- c) The starting current of the motor at rated voltage shall not exceed six (6) times the rated full load current subject to tolerance as given in IS : 325.
- d) Motors when started with the driven equipment imposing full starting torque under the supply voltage condition specified under Clause 12.03.01 (iv) (a) shall be capable of withstanding at least two successive starts with coasting to rest between starts and motor initially at the rated load operating temperature. The motors shall also be suitable for three equally spread starts per hour, the motor initially at a temperature not exceeding the rated operating temperature.
- e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than the starting time with the driven equipment at minimum permissible voltage (clause 12.03.04 (i) (a) by at least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement the Bidder shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speeds lower than 20% and open for speeds above 20% of the rated speed. The speed switch shall be capable of withstanding 120% of the rated speed in either direction of rotation.

#### 12.03.05 **Running requirements**

- (i) When the motors are operating at extreme condition of voltage and frequency given under clause no.12.03.01 (iv) the maximum permissible temperature rise over the ambient temperature of 50°C shall be within the limits specified in IS : 325 after adjustment due

to increase ambient temperature specified herein.

- (ii) The double amplitude of motor vibration shall be within the limits specified in IS: 4729. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.
- (iii) All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes with rated load commencing from hot condition.
- (iv) Induction motors shall be so designed as to be capable of withstanding the voltage and torque stresses developed due to the difference between the motor residual voltage and incoming supply voltage during fast changeover of buses. The necessary feature incorporated in the design to comply with this requirement shall be clearly indicated in the proposal.
- (v) Motors shall be capable of developing the rated full load torque even when the supply voltage drops to 70% of rated voltage. Such operation is envisaged for a period of one second. The pull out torque of the induction motors to meet this requirement shall not be less than 205% of full load torque.
- (vi) The motors shall be capable of withstanding for 10 seconds without stalling or abrupt change in speed (under gradual increase of torque) an excess torque of 60 percent of their rated torque, the voltage and frequency being maintained at their rated value.
- (vii) Guaranteed performance of the motors shall be met with tolerances specified in respective standards.

#### 12.04.00 **Construction Features**

##### 12.04.01 **Stator**

###### (i) **Stator frame**

The stator frames and all external parts of the motors shall be rigid fabricated steel or of casting. They shall be suitably annealed to eliminate any residual stresses introduced during the process of fabrication and machining.

###### (ii) **Stator core**

The stator laminations shall be made from suitable grade magnetic sheet steel varnished on both sides. They shall be pressed and clamped adequately to reduce the core and teeth vibration to minimum.

###### (iii) **Insulation and winding**

All insulated winding conductor shall be of copper. The overall motor winding insulation for all 415 volts motors shall be of epoxy thermosetting type i.e., class 'F' but limited to class-B operating from temperature rise consideration. Other motors may be of conventional class-B type. The windings shall be suitable for successful operation in hot, humid, tropical climate with the ambient temperature of 50oC.

#### 12.04.02 **Rotor**

- (i) Rotors shall be so designed as to keep the combined critical speed with the driven equipment away from the running speed by atleast 20%.
- (ii) Rotors shall also be designed to withstand 120% of the rated speed for 2 minutes in either direction of rotation.

#### 12.04.03 **Terminal box leads**

- (i) For motors of 415 Volts and below a single terminal box may be provided for power and accessories leads.
- (ii) Terminal boxes shall be of weatherproof construction designed for outdoor service. To eliminate entry of dust and water, gaskets of neoprene or approved equivalent shall be provided at cover joints and between box and motor frame.
- (iii) Terminal box shall be suitable for top and bottom entry of cables.
- (iv) Unless otherwise approved, the terminal box shall be capable of being turned through 360o in steps in 90o.
- (v) The terminals shall be complete with all accessories for connecting external cables. They shall be designed for the current carrying capacity and shall ensure ample phase to phase to ground clearances.
- (vi) Suitable tinned brass compression type cable glands and cable lugs shall be supplied by the Contractor to match Employer's cable.
- (vii) Terminal box for single core cable shall be of non- magnetic material.
- (viii) Marking of all terminals shall be in accordance with IS : 4728.

#### 12.04.04 **Rating Plates**

- (i) Rating plates shall be provided for all motors giving the details as called for in IS:325 (for three phase squirrel cage induction

motors).

- (ii) In addition to above, the rating plate shall indicate the following :
  - a) Temperature rise in oC under normal working conditions.
  - b) Phase sequence corresponding to the direction of rotation for the application.
  - c) Bearing identification number (in case of ball/ roller bearing) and recommended lubricants.

#### 12.04.05 **Other Constructional Features**

- (i) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of Employer's earthing conductor to be specified to the successful Bidder.
- (ii) Motor weighing more than 25 kg. shall be provided with eyebolts, lugs or other means to facilitate lifting.

#### 12.05.00 **Paint and Finish**

12.05.01 Motor external parts shall be finished and painted to produce a neat and durable surface, which would prevent rusting and corrosion. The equipment shall be thoroughly degreased, all sharp edges and scales removed and treated with one coat of primer and two coats of grey enamel paint.

12.05.02 Motor fans shall also be painted to withstand corrosion.

12.05.03 All fasteners used in the construction of the equipment shall be either of corrosion resistant material or heavy cadmium plated.

12.05.04 Current carrying fasteners shall be either of stainless steel or high tensile brass.

#### 12.06.00 **Tests at Manufacturers Works**

12.06.01 Motors shall be subject to routine tests in accordance with IS : 325 & IS : 4029 standards.

12.06.02 In addition, the following tests shall also be carried out :

- a) 20% over speed test for 2 minutes on all rotors.
- b) Measurement of vibration.
- c) Measurement of noise level.

- d) Phase sequence and polarity checks relative to mechanical rotation.

#### 12.06.03 Tests after installation at site

- (i) After installation and commissioning at site, the motors alongwith the driven equipment shall be subject to tests to ascertain their conformity with the requirement of this specification and those of the driven equipment specification and the performance data quoted by the Bidder.
- (ii) In case of non-conformity of the motor with these specifications and performance requirement, the Engineer may at his discretion reject or ask for necessary rectification/replacement as detailed in general Terms and Conditions of Contract (GCC) Volume-I.

#### 13.00.00 BATTERY & BATTERY CHARGERS

This clause covers the design, performance, manufacturing, construction features and testing of Battery and Battery charger used primarily for starting the diesel engine driving the fire water pumps. Battery Chargers shall be housed in Diesel Engine Panel.

##### 13.01.00 General Information

- 13.01.01 The equipment specified hereinafter are required for starting the diesel engines and other operation of the plant as required.
- 13.01.02 For each diesel engine there shall be two (2) sets of Battery and two (2) sets of Battery Charger.
- 13.01.03 The D.C. voltage shall be obtained normally after necessary rectification by battery charger. The Battery Charging system shall be capable of meeting the following requirements :
- 13.01.04 Float charging the Battery.
- 13.01.05 Boost Charging the Battery.
- 13.01.06 The battery shall be large enough to crank the engine **3** times without charging in between and without getting drained to an extent which will affect its life.
- 13.01.07 The Bidder shall indicate the battery voltage and battery capacity in Ampere- Hour at ten (10) hour discharge rate. The battery voltage at any time during operation shall not be less than the minimum voltage required for operation of the D.C. loads.

##### 13.02.00 General Design

The Battery shall be located indoor

#### 13.02.01 **Battery**

- (i) The cells shall be lead-acid type. The Battery shall be automotive type.
- (ii) The cells shall be sealed in type with anti-splash type vent plug.
- (iii) The cell terminal posts shall be provided with connector bolts and nuts, effectively coated with lead to prevent corrosion. Lead or lead coated copper connectors shall be furnished to connect up cells of battery set.
- (iv) Positive and Negative terminal posts shall be clearly and indelibly marked for easy identification.
- (v) The electrolyte shall be of battery grade Sulphuric Acid conforming to IS : 226-2962. Water for storage batteries conforming to IS : 1069 shall be used in the preparation of the electrolyte.

#### 13.02.02 **Battery Charger**

- (i) The Bidder shall furnish the battery charging scheme complete with all necessary accessories such as transformers, switches, fuses, starters, contactors, diodes, ammeters, voltmeters and other devices as required for trouble free operation. All devices and equipment shall conform to relevant Indian Standard or shall be Superior to it.
- (ii) The scheme of the battery charger shall be such that the battery can be charged automatically as well as manually.
- (iii) The boost charger shall have sufficient capacity to restore a fully discharged Battery to a state of full charge in eight (8) hours with some spare margin over maximum charging rate. Suitable provision shall be kept so that, for a particular engine, any of the two (2) charger units can be used for charging any of the two (2) batteries.
- (iv) The instruments, switches and lamps shall be flush/semi-flush mounted on the front panel. Name plate of approved type shall be provided for each of these equipment.
- (v) The panel shall be complete with internal wiring and input-output terminal block. Terminal blocks shall be clip on type of suitable rating. All equipment and wire terminals shall be identified by symbols corresponding to applicable schematic/wiring diagram.

- (vi) Space heaters of adequate capacity shall be provided to prevent moisture condensation in the panel.

#### 13.03.00 **Testing**

- 13.03.01 The Battery Charger shall also be subjected to the following tests at manufacturer's works as per IS - 4540
- 13.03.02 Insulation test.
- 13.03.03 Connection checking.
- 13.03.04 Measurement of voltage regulation.
- 13.03.05 Auxiliary of devices.
- 13.03.06 Alternating current measurement.
- 13.03.07 Performance test.
- 13.03.08 Temperature rise test.
- 13.03.09 Following acceptance tests shall be carried out in batteries as per IS:1651.
  - a) Marking and packing
  - b) Verification of dimensions
  - c) Test for capacity
  - d) Test for voltage during discharge

Battery and battery charger shall be checked for auto charging and providing sufficient power for three consecutive starting kicks to diesel engine within five minutes with A.C. supply switched off.

#### 14.00.00 **CONTROL & ANNUNCIATION PANELS**

##### 14.01.00 **Intent of Specification**

The following requirement shall be applicable to the control and annunciation panels furnished under these specifications.

##### 14.02.00 **General Information**

- 14.02.01 The equipment specified herein are required for controlling, metering, monitoring and indication of electrical systems of the plant offered.

14.02.02 The selection and design of all the equipment shall be so as to ensure reliable and safe operation of the plant and shall be subjected to approval by the Employer.

14.02.03 The reference ambient temperature outside the panel shall be taken as 50oC and relative humidity 100%.

#### 14.03.00 **Equipment to be Furnished**

Control & annunciation panels shall be furnished complete with all accessories and wiring for safe and trouble free operation of the plant. Details are included in sub-section General.

#### 14.04.00 **Constructional Details**

14.04.01 The panel frames shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness not less than 2.5 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary.

14.04.02 Panels shall be of free standing type and shall be provided with hinged door with locking arrangement. The access doors, cutest and covers shall be equipped with neoprene/synthetic rubber gaskets (conforming to IS 11149-1984) all around and the latches sufficiently strong to hold them in alignment when closed. The panels to be installed outdoor or semi outdoor shall have a degree of protection of IP:55 and those installed indoor shall have a degree of protection of IP:52 as per IS:13947 Part-1.

14.04.03 If a panel consists of a number of panels, each panel should be mounted side by side and bolted together to form a compact unit, when two panels meet, the joints shall be smooth, close fittings and un-obstructive.

14.04.04 Removable eye bolt or lifting lugs shall be provided on all panels to facilitate easy lifting.

14.04.05 The heights of all operating equipment on the panel shall be between 800 mm to 1600 mm from the finished floor level. The proper supporting arrangement shall be provided by the Contractor.

14.04.06 Cable entries to the panel may be from bottom or top. The cable entry required will be intimated to the successful Bidder. A suitable removable gland plate of 3 mm thick shall be mounted not less than 200 mm above the floor level.

14.04.07 All equipment mounted on the front face of the panels shall be flush or semi-flush type. All equipment shall be so located that their terminal

and adjustment are readily accessible for inspection or maintenance and their removal and replacement can be done without interruption of service to other equipment. The contractor shall submit the panel general arrangement drawings clearly bringing out internal mounting details, dimensions of equipment, clearance between the equipment and the edges of the panel, for approval.

#### 14.05.00 **Name Plates and Labels**

- 14.05.01 Each panel shall be provided with prominent, engraved identification plates for all front mounted equipment. Panel identification name plate shall be provided at front and rear as required.
- 14.05.02 All name plates shall be of non-rusting metal or 3 ply lamicold, with white engraved lettering on black background. Inscription and lettering sizes shall be subjected to Employer's approval.
- 14.05.03 Suitable plastic sticker labels shall be provided for easy identification of all equipment located inside the panel. These labels shall be positioned so as to be clearly visible and shall give the device number, as mentioned in the wiring drawings.

#### 14.06.00 **AC/DC Power Supply**

- 14.06.02 The Employer will provide one feeder each for AC and DC to the panel. The Contractor shall make for his own arrangements for providing these power supplies to different panels.
- 14.06.02 The Contractor shall provide suitable isolating switch fuse unit in the control panel for receiving the above incoming AC and DC supplies. Fuse and link shall be provided for isolating of individual circuit without disturbing other circuits.

#### 14.07.00 **Wiring**

- 14.07.01 All inter panel wiring and connections between panels (if there is group of panels) including all bus wiring for AC & DC supplies shall be provided by the Contractor.
- 14.07.02 All internal wiring shall be carried out with 1100 V grade, single core, 1.5 square mm or larger stranded copper wires having colour-coded PVC insulation. CT circuits shall be wired with 2.5 square mm copper wires, otherwise similar to the above.
- 14.07.03 Extra-flexible wire shall be used for wiring to devices mounted on moving parts such as doors.
- 14.07.04 Spare contacts of auxiliary relays, timers and switches shall be wired out to the terminal blocks as required by the Employer/Engineer at the time of detailed engineering.

**14.08.00 Terminal Blocks**

14.08.01 Terminal Blocks shall be of 650V grade, rated for 10 Amps and in one-piece moulding. It shall be complete with insulating barriers, clip-on-type terminals, and identification strips. Marking on terminal strip shall correspond to the terminal numbering on wiring diagrams. It shall be similar to 'Elmex-Standard' type terminals.

14.08.02 Terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal block.

14.08.03 The terminal blocks shall have at least 20% spare terminals.

**14.09.00 Grounding**

A continuous copper bus 25 x 3 mm size shall be provided along the bottom of the panel structure. It shall run continuously throughout the length of the panel and shall have provision at both ends for connection to the station grounding grid (25 x 6 mm MS Flat).

**14.10.00 Space Heater and Lighting**

14.10.01 Space heaters shall be provided in the panels for preventing harmful moisture condensation.

14.10.02 The space heaters shall be suitable for continuous operation on 240V AC, 50 Hz, single phase supply and shall be automatically controlled by thermostat. Necessary isolating switches and fuses shall also be provided.

14.10.03 Free standing panel shall have a 240V AC, plug point and a fluorescent light operated by door switch.

**14.11.00 Control and Selector Switches**

14.11.01 Control and selector switches shall be of rotary type, with escutcheon plates clearly marked to show the function and positions.

14.11.02 Control/selector switches shall be spring return or stay put type as per the requirements. Handles of control/selector switches shall be black in colour. Shape and type of handles shall be to the approval of the Employer.

14.11.03 The contact ratings shall be at least the following :

- i) Make and carry continuously      10 Amp.
- ii) Breaking current at 240V DC      1Amp. (Inductive)

iii) Breaking current at 240V DC 5 Amp. at 0.3 p.f. lagging

#### 14.12.00 **Push Buttons**

14.12.01 Push buttons shall be spring return, push to actuate type and rated to continuously carry and break 10A at 240V AC and 0.5A (Inductive) at 220V DC. The push buttons shall have at least 1 NO and 1 NC contact. All contact faces shall be of silver or silver alloy.

14.12.02 All push buttons shall be provided with integral escutcheon plates marked with its function.

14.12.03 The colour of buttons shall be as follows :

Green For motor START, Breaker CLOSE, Valve/ damper OPEN.

Red For motor TRIP, Breaker OPEN, Valve/ damper CLOSE.

Black For all annunciation functions, overload reset and miscellaneous.

14.12.04 Red push buttons shall always be located to the left of green push buttons. In case of clinker grinder etc. the push buttons would be black-red-green from left to right.

#### 14.13.00 **Indicating Lamps**

14.13.01 Indicating lamps shall be of the panel mounting, filament type and of low-watt consumption. Lamps shall be provided with series resistors preferably built-in- the lamps assembly. The lamps shall have escutcheon plates marked with its function, wherever necessary.

14.13.02 Lamp shall have translucent lamp covers of the following colours :

Red for motor OFF, Valve/damper OPEN, Breaker CLOSED.

Green for motor ON, Valve/damper CLOSED, Breaker OPEN.

White for motor AUTO-TRIP.

Blue for all healthy conditions (e.g. control supply, lub oil pressure and also for spring charged).

Amber for all ALARM conditions (e.g. pressure low, over load and also for 'service' and 'Test' position indication).

14.13.03 Bulbs and lamps covers shall be easily replaceable from the front of the panel.

14.13.04 Indicating lamps should be located directly above the associated push

button/control switches. Red lamps shall variably be located to the right of the green lamp. In case a white lamp is also provided, it shall be placed between the red and green lamps. Blue and amber lamps should normally be located above the red and green lamps.

#### 14.14.00 **Fuses**

14.14.01 All fuses shall be of HRC cartridge plug-in-type and shall be of suitable rating, depending upon circuit requirements.

14.14.02 All fuses shall be mounted on fuse carriers, which shall be mounted on fuse-bases.

#### 14.15.00 **Contactors**

14.15.01 Contactors shall be of air break, electromagnetic type rated as per requirement. These shall be of utilisation category AC 3 as per IS:2959.

14.15.02 Operating coils of AC contactors shall be of 240V AC or 220V DC as required. AC contactors shall operate satisfactorily between 85% to 110% of the rated voltage. The Contactor shall not drop out at 70% of the rated voltage.

14.15.03 DC contactors shall have a coil voltage of 220V DC and shall be suitable for satisfactory continuous operation at 80% to 110% of the rated voltage.

#### 14.16.00 **Relays and Timers**

14.16.01 All auxiliary relays & timers shall be of proven design and of reputed make. Contacts of relays and timers shall be of solid silver or silver cadmium oxide or solid silver faced. Timers shall have the provision to adjust the delay on pick-up or reset as required.

14.16.02 All relays and timers shall have at least two NO and two NC contacts.

14.16.03 All relays and timers shall be suitable for 240V AC and 220V DC as required. DC relays shall operate satisfactorily between 70% to 110% and AC relays shall be suitable for voltage variation between 80% to 110%.

#### 14.17.00 **Indication Instruments**

14.17.01 All indicating and integrating meters shall be flush mounted on panel front. The instruments shall be of at least 96 mm square size with 90 degree scales and shall have an accuracy class of 2.0 or better. The covers and cases of instruments and meters shall provide a dust and vermin proof construction.

14.17.02 All instruments shall be compensated for temperature errors and factory

calibrated to directly read the primary quantities. Means shall be provided for zero adjustment removing or dismantling the instruments.

14.17.03 All instruments shall have white dials with black numerals and lettering. Black knife edge pointer with parallax free dials will be preferred.

14.17.04 Ammeters provided on motor feeders shall have a compressed scale at the upper current region to cover the starting current.

#### 14.18.00 **Annunciation System**

14.18.01 The annunciation system shall be complete with all necessary relays, flashers and other accessories required for the proper operation of the equipment and shall be completely solid state. The control circuit shall be mounted on plug-in type glass epoxy printed circuit boards. Audible alarms for the system shall be mounted inside the panel. One set of acknowledge, test and reset push buttons shall be mounted on the panel.

14.18.02 Indications shall be engraved on Acrylic inscription plate window and shall be visible clearly when the indication lamp is lighted (black letters on white background). Each window shall be provided with two lamps.

14.18.03 Audible hooter shall sound when a trouble contact operates and shall continue to sound until the acknowledge button is pressed. In addition to the hooters provided on annunciation panels, a hooter shall be provided outside FFPH which shall sound in any fire alarm condition.

14.18.04 Indication lamps shall flash when trouble contact operates and shall continue flashing until acknowledge button is pressed.

14.18.05 After acknowledge button is pressed, the hooter and flashing shall stop but the indication lamp shall remain lighted.

14.18.06 After trouble is cleared indication lamps shall be ready and shall go off only when reset.

14.18.07 Silencing the hooter in conjunction with one trouble contact shall not stop and hooter sounding if another trouble contact operates.

14.18.08 When test button is pressed, all lamps shall flash and hooter shall sound.

14.18.09 Annunciator systems shall operate on 220V DC Systems.

14.18.10 The annunciation system shall include alarm for AC control system failure (working on DC supply), DC supply failure (working on AC supply) and test facilities for these alarms.

14.18.11 List of annunciations required on the panels has been listed elsewhere.

The Contractor shall also provide additional annunciations if desired by the Employer/Engineer during Vendor drawing review stage and for such additional annunciations no extra charges shall be claimed by the Contractor, if the number of such additions are within 10% of the number stipulated in this specification.

14.18.12 20% spare windows shall be provided on the panel.

#### 14.19.00 **Painting**

14.19.01 **Painting procedure adopted shall conform to requirements given in Section-3 The paint thickness shall not be less than 60 microns.** Finished parts shall be coated by peelable compound by spraying method to protect the finished surface from scratches, grease, dirt and oily spots during testing, transportation handling and erection.

#### 14.20.00 **Tests**

14.20.01 Following tests/inspection shall be carried out by the Contractor in the presence of Employer's representative :

##### (A) Factory Tests

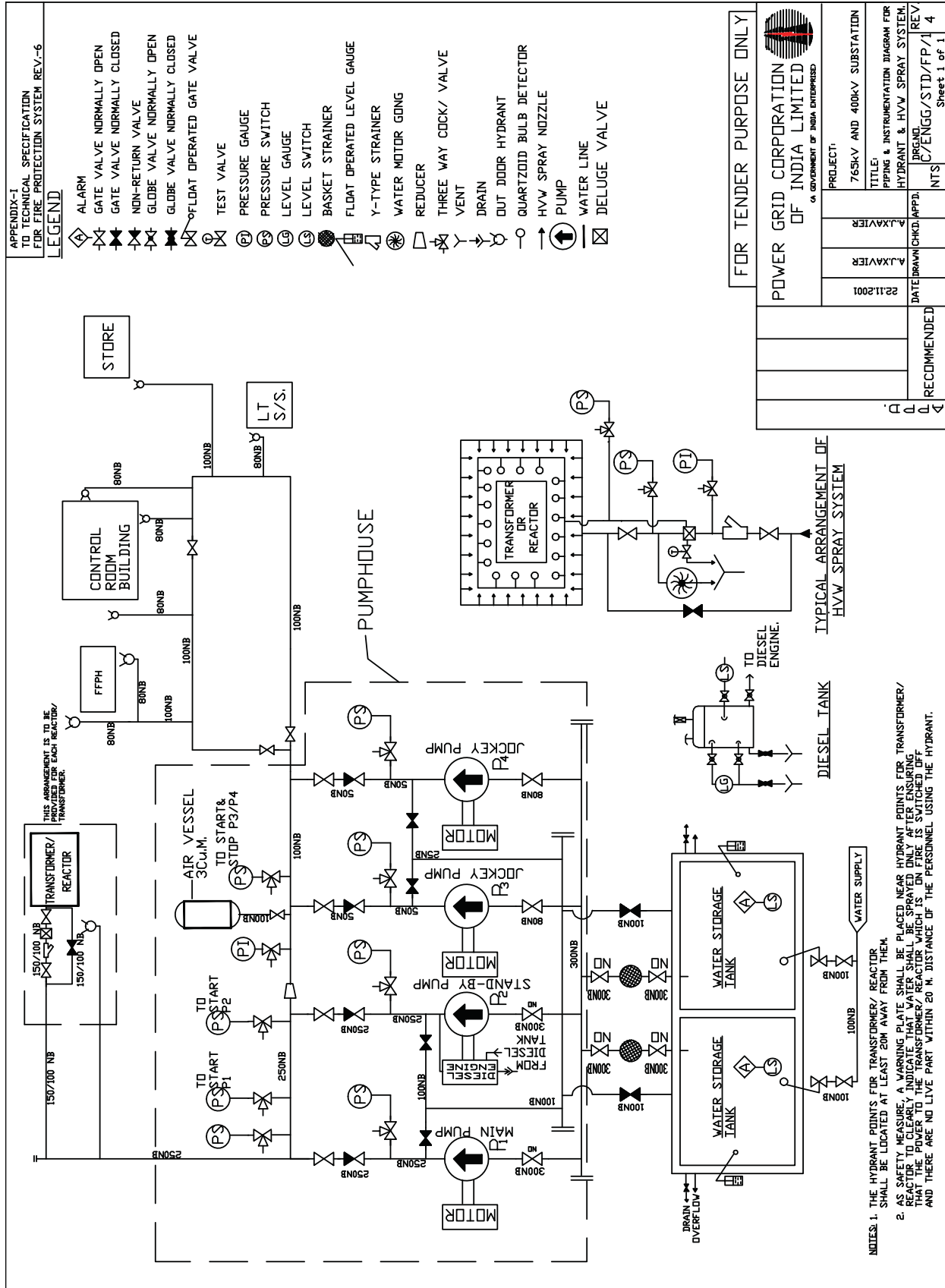
1. Compliance with approved drawings, data and specification.
2. Visual check for workmanship.
3. Wiring continuity and functional checks.
4. Calibration of instruments, relays and metres wherever required by inspector.
5. HV test
6. Insulation resistance measurement before and after HV test.

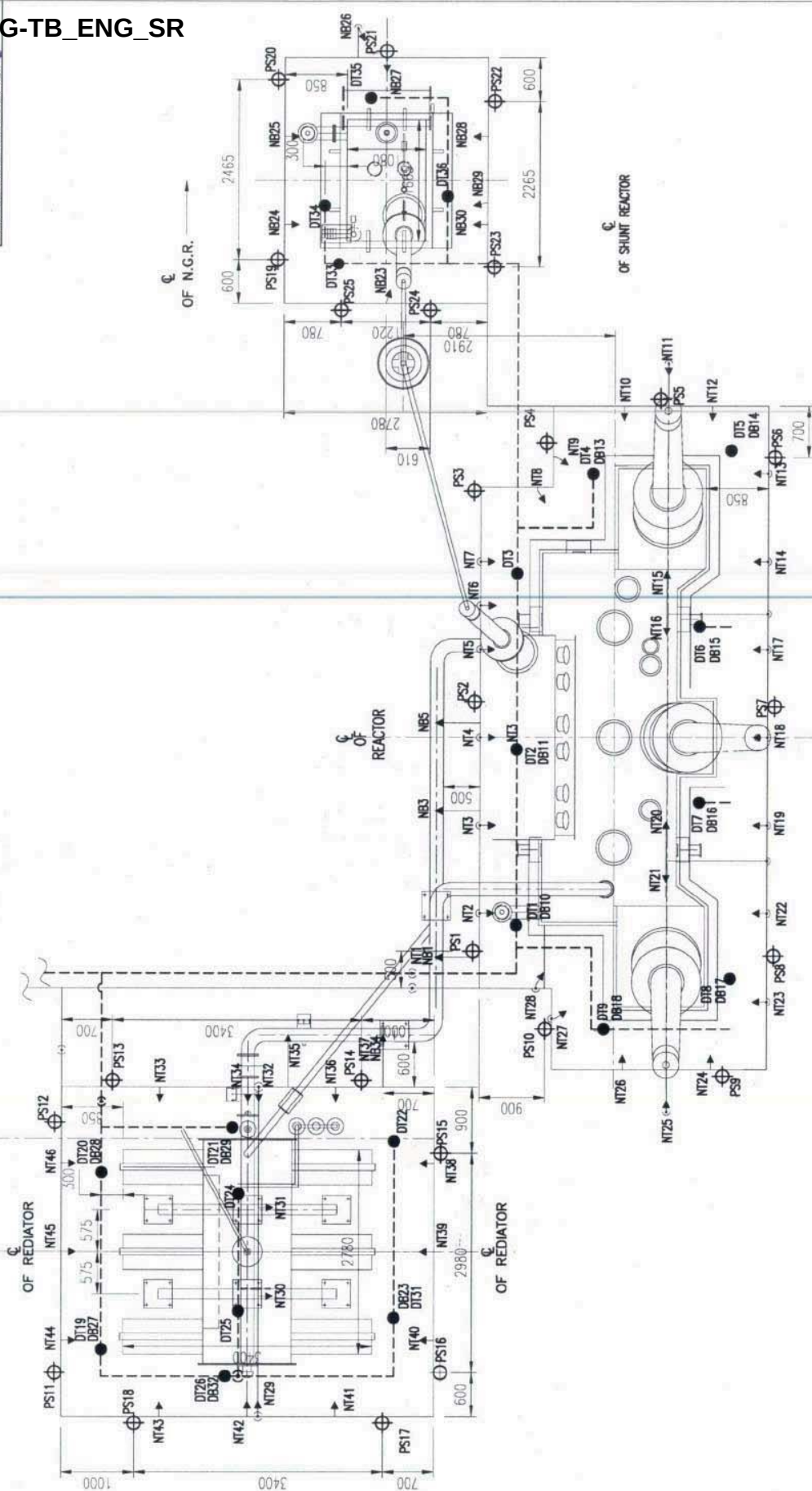
##### (B) Inspection/Testing at site :

1. IR test before and after HV test
2. HV Test
3. Functional Testing.

##### (C)

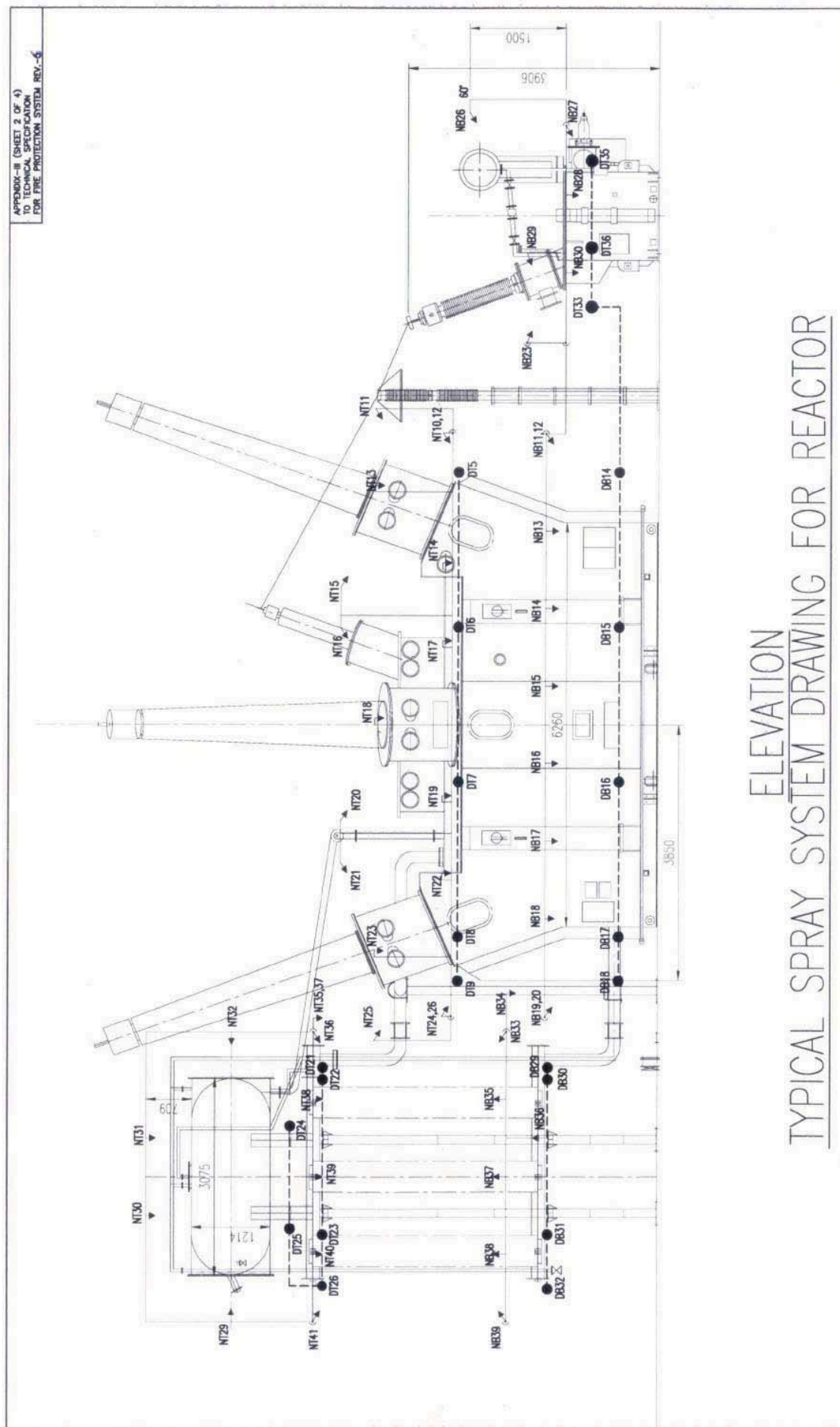
1. The Fire detection and annunciation panel shall be subjected to functional tests.
2. The Annunciation System shall be routine tested



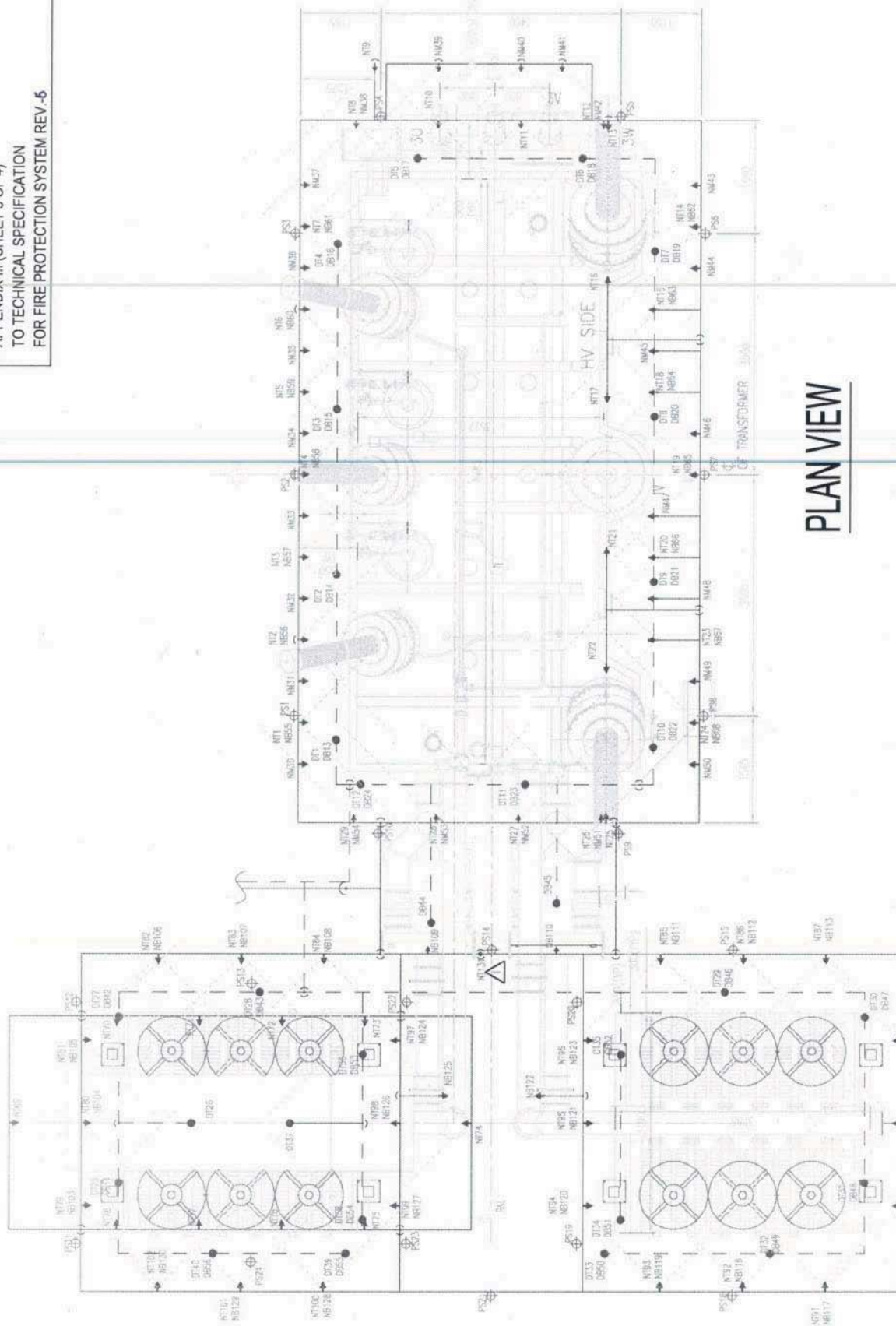


## PLAN VIEW

## TYPICAL SPRAY SYSTEM DRAWING FOR REACTOR



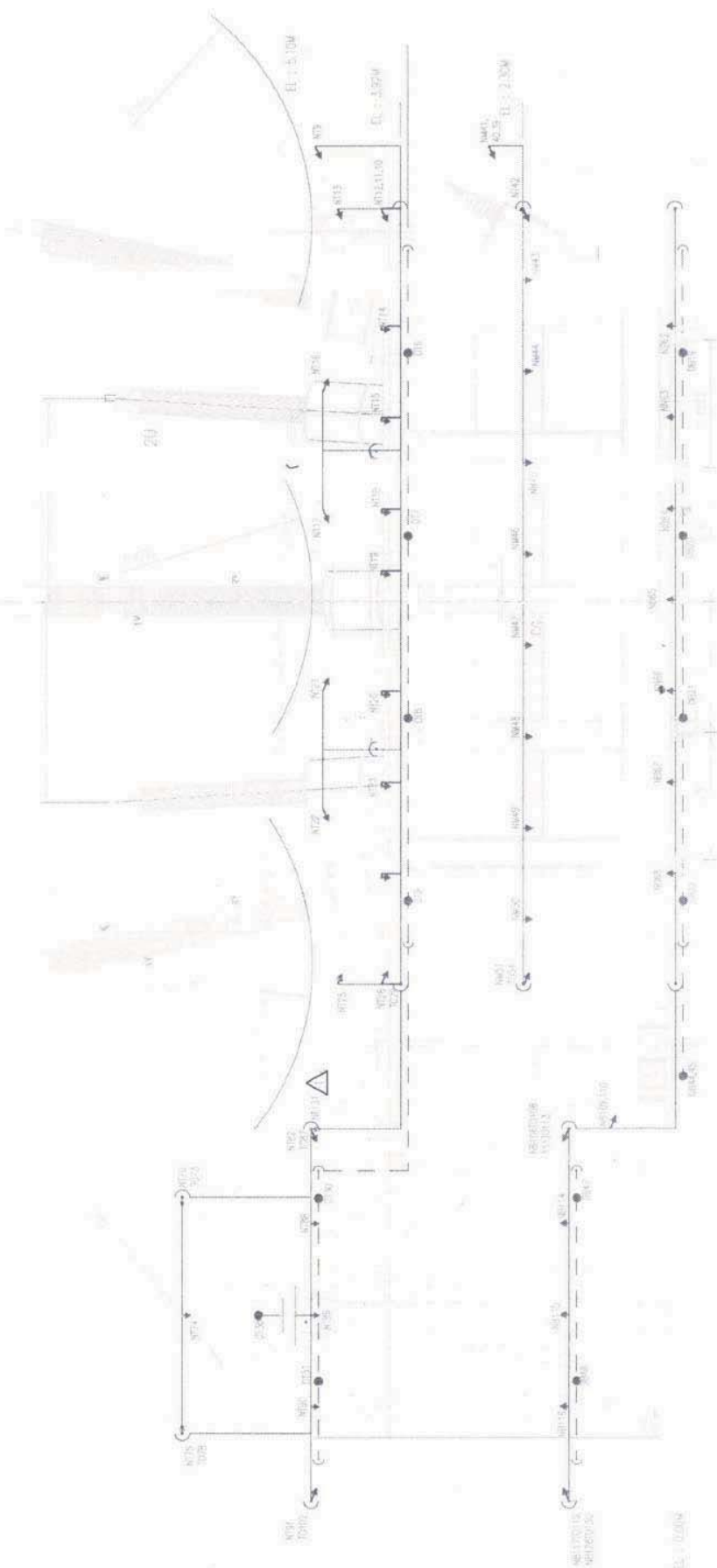
APPENDIX-III (SHEET 3 OF 4)  
TO TECHNICAL SPECIFICATION  
FOR FIRE PROTECTION SYSTEM REV.-6



## PLAN VIEW

## TYPICAL SPRAY SYSTEM DRAWING FOR ICT

APPENDIX-III (SHEET 4 OF 4)  
TO TECHNICAL SPECIFICATION  
FOR FIRE PROTECTION SYSTEM REV. 6



## ELEVATION

## TYPICAL SPRAY SYSTEM DRAWING FOR ICT

**TECHNICAL DATA SHEETS**

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

**DATASHEET FOR HVW SPRAY NOZZLE**

|     |                                       |                                                      |
|-----|---------------------------------------|------------------------------------------------------|
| 1.0 | Make                                  | POWERGRID Approved make                              |
| 2.0 | Type                                  | High velocity water spray type                       |
| 3.0 | Working pressure                      | 3.5 bar to 5 bar                                     |
| 4.0 | Material                              | Brass                                                |
| 5.0 | K factor                              | As per approved design & drawings                    |
| 6.0 | Quantity                              | As per approved design & drawings                    |
| 7.0 | Integral non-ferrous strainer provide | Yes                                                  |
| 8.0 | Approval of HVW spray Nozzle.         | FM of USA, UL of USA, LPCB of U.K. or VDS of Germany |

**DATA SHEET FOR QUARTZOID BULB DETECTORS**

|     |                          |                                                      |
|-----|--------------------------|------------------------------------------------------|
| 1.0 | Make                     | POWERGRID Approved make                              |
| 2.0 | Type                     | Quartzoid bulb type                                  |
| 3.0 | Rated pressure           | 12.3 kg/ cm <sup>2</sup> (175 PSI).                  |
| 4.0 | Hydrotest pressure       | 30kg/cm <sup>2</sup>                                 |
| 5.0 | Material of construction |                                                      |
| 5.1 | Frame                    | Bronze                                               |
| 5.2 | Bulb                     | Glass                                                |
| 5.3 | Deflector                | Copper                                               |
| 6.0 | Temperature rating       | 79°C                                                 |
| 7.0 | Quantity                 | As per approved drawings                             |
| 8.0 | Approval of Detector     | FM of USA, UL of USA, LPCB of U.K. or VDS of Germany |

**Vendor list for Equipments/ Items for Fire Protection System****अग्नि सुरक्षा प्रणाली के लिए उपकरणों / वस्तुओं के लिए विक्रेता सूची**

| Sl No | Item name                                          | Vendor Name                                                                                                                                                                                               |
|-------|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | Pumps                                              | Wilo Mather and Platt Pumps private limited , Kolhapur/KBL,Pune/Flowmore, Ghaziabad/KSB Pumps, Pune                                                                                                       |
| 2     | Diesel Engine                                      | Greaves Cotton/Kirloskar                                                                                                                                                                                  |
| 3     | Gate Valve & Check Valve                           | Kalpna Valves, Howrah/H Sarker and Company Valves Pvt Ltd, Howrah/VENUS Valves Manufacturing Co,Howrah/Levcon/Advance Valve, Una                                                                          |
| 4     | VALVES (HYDRANT) AND ACCESSORIES                   | Ghosh Engineering Industries , Hooghly/SUKAN, Ahmedabad/ United Fire Equipments Pvt Limited , Delhi / Shah Bhogilal Jethalal & Bros,Gandhi Nagar                                                          |
| 5     | Deluge Valve                                       | HD Fire, Jalgaon/FLOW-TEK VALVES AND CONTROLS INC, Ahmedabad/ Venus Valve & Engineering Works, Howrah                                                                                                     |
| 6     | MS and GI Pipes                                    | Jindal, Gahziabad/Surya/AS per COV                                                                                                                                                                        |
| 7     | Stariners (Y Type & Basket Type)                   | Jaypee Industries, Faridabad/GUJARAT OTOFILT,Ahmedabad/Grandprix/Venus Pumps, Howrah/ Venus Valve & Engineering Works, Howrah/ RAK DIN Engineers , Gurugram                                               |
| 8     | QB Detector                                        | HD Fire,Thane/ACE Turnkey,Mumbai/Spray Safe,UK/Tyco                                                                                                                                                       |
| 9     | Heat & Smoke Detector                              | APOLLO,UK/PYROTONICS SYSTEM SENSOR,USA/Nittan,UK/Tyco                                                                                                                                                     |
| 10    | HV Nozzel                                          | HD Fire, Thane/Ghosh Engineering Industries , Hooghly/ United Fire Equipments Pvt Limited , Delhi                                                                                                         |
| 11    | RESPONSE INDICATORS /<br>HOOTERS/BREAK GLASS UNITS | MATHS, Thane/MEHTA & ASSOCIATES, Ahmedabad/                                                                                                                                                               |
| 12    | Butterfly Valve                                    | Kalpna Valves, Howrah/H Sarker and Company Valves Pvt Ltd, Howrah/Leader,Jalandhar/Advance Valve, Una                                                                                                     |
| 13    | Pressure Switch                                    | FIBEG , Mumbai/SWITZER, Ghaziabad/DELAVEL<br>TURBINES,Germany/DANFOSS,Chennai/INDFOSS INDUSTRIES, Gahziabad/Trafag                                                                                        |
| 14    | MS SECTIONS:-<br>FLATES/ANGLES/CHANNELS/PLAT ES    | POWERGRID approved sources                                                                                                                                                                                |
| 15    | Air Vessel                                         | Anu Designers & fabricators, Ahmedabad/TEMASME VESELEX, Noida/Rattan Industries, Bokaro/Heat Fabs,Pune                                                                                                    |
| 16    | Electrical Panels                                  | POWERGRID approved sources as per COV                                                                                                                                                                     |
| 17    | Hose Pipes                                         | Newage, Surendernagar/Chhatariya Rubber & Chemical Industries, Gujarat/JAYASHREE/Ghosh Engineering Industries , Hooghly/ Shah Bhogilal Jethalal & Bros,Gandhi Nagar                                       |
| 18    | Fire Alaram Zonal Panels                           | Agni Instruments, Okhla/ECD/ Apollo, UK/Daksha, Uttarakhand                                                                                                                                               |
| 19    | Fire Extinguisher                                  | safex Fire, Mumbai/ KANADIA FYR FYTER PVT.LTD,<br>Bhavnagar /Minimax/ Zenith/ United Fire Equipments Pvt Limited , Delhi / Intime Fire Appliances Pvt Ltd                                                 |
| 20    | Level Switch and Indicator                         | Sigma Instruments, Mumbai/Levcon                                                                                                                                                                          |
| 21    | Hose Box                                           | Ghosh Engineering Industries , Hooghly/TECHNICO (INDIA) PVT LTD, Kolkata/ United Fire Equipments Pvt Limited , Delhi /Venus Valve & Engineering Works, Howrah/ Shah Bhogilal Jethalal & Bros,Gandhi Nagar |
| 22    | Branch Pipe                                        | Ghosh Engineering Industries , Hooghly/ United Fire Equipments Pvt Limited , Delhi / Shah Bhogilal Jethalal & Bros,Gandhi Nagar                                                                           |
| 23    | Pressure Guage                                     | Gauges Bourdon (I) Pvt. Ltd, Panvel/Fiebeg/H Guru                                                                                                                                                         |
| 24    | Motor                                              | Siemens/ABB/CGL/Bharat Bijlee/Kirloskar                                                                                                                                                                   |

|    |                                                    |                                                                                                                                 |
|----|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| 25 | Air Compressor                                     | KGK/ELGI/INGERSOL Rand                                                                                                          |
| 26 | Battery                                            | POWERGRID approved sources as per COV                                                                                           |
| 27 | Solenoid Valve                                     | Avcon/Rotex                                                                                                                     |
| 28 | RESPONSE INDICATORS /<br>HOOTERS/BREAK GLASS UNITS | M.C.ENGINEERING/MATHS /MEHTA & ASSOCIATES FIRE /TECHNICO (INDIA) PVT LTD/Agni Instruments, Okhla                                |
| 29 | Coupling                                           | United Fire Equipments Pvt Limited , Delhi / Ghosh Engineering Industries , Hooghly/ Shah Bhogilal Jethalal & Bros,Gandhi Nagar |

**NOTE : Please note that other than above list, all other vendors approved by POWERGRID are also valid.**

1. Any sub vendor already approved by POWERGRID and not appearing in this list can be informed to Corporate, QA&I Department with relevant documents/evidence as a proof of POWERGRID approval. On review of these documents and if, necessary after audit/ reassessment, their name may be considered for inclusion in this list. Further, any shifting of subvendor premises shall be intimated to POWERGRID.
2. Those Vendors who have not supplied material to POWERGRID projects for more then 2 years shall be re-assessed/audited. Contractors shall confirm the same before placing any order

Updated on/ संशोधित किया गया

27.09.2018

|                  |                                                                                                                                                                                                                                                                                                    |                                 |                                                                                     |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|-------------------------------------------------------------------------------------|
| <b>Project</b>   | <b>Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route</b> | <b>TB-409-552-01<br/>Rev 01</b> |  |
| <b>System</b>    | <b>FIRE FIGHTING SYSTEM</b>                                                                                                                                                                                                                                                                        |                                 |                                                                                     |
| <b>Owner</b>     | <b>POWERGRID CORPORATION OF INDIA LTD.</b>                                                                                                                                                                                                                                                         |                                 |                                                                                     |
| <b>Purchaser</b> | <b>BHARAT HEAVY ELECTRICALS LTD (Transmission Business Group)</b>                                                                                                                                                                                                                                  |                                 |                                                                                     |

### GENERAL TECHNICAL REQUIREMENTS-SECTION 3

#### Site Information

| S.No                   | Particular                                 | Details                                                                                                                                                                                                                                                                                     |
|------------------------|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| a)                     | Owner                                      | Fatehgarh-II Transco Limited- a 100% wholly owned subsidiary of Power Grid Corporation of India Limited                                                                                                                                                                                     |
| b)                     | Customer                                   | Fatehgarh-II Transco Limited- a 100% wholly owned subsidiary of Power Grid Corporation of India Limited                                                                                                                                                                                     |
| c)                     | Project Title                              | Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route |
| d)                     | Location                                   | Fatehgarh-2, Rajasthan<br>Bhadla-2, Rajasthan                                                                                                                                                                                                                                               |
| e)                     | Transport Facilities                       | Road/Train<br>Nearest Rail Head For Fatehgarh-2: Fatehgarh<br>Nearest Rail Head For Bhadla-2: Nokha                                                                                                                                                                                         |
| <b>SITE CONDITIONS</b> |                                            |                                                                                                                                                                                                                                                                                             |
| a)                     | Max. ambient air temp.                     | 50°C                                                                                                                                                                                                                                                                                        |
| b)                     | Min. ambient air temp.                     | 0°C                                                                                                                                                                                                                                                                                         |
| c)                     | Max. design ambient temp.                  | 50°C                                                                                                                                                                                                                                                                                        |
| d)                     | Design reference temp.                     | 50°C                                                                                                                                                                                                                                                                                        |
| e)                     | Average Humidity                           | Max. 100%                                                                                                                                                                                                                                                                                   |
| f)                     | Special corrosion conditions               | No                                                                                                                                                                                                                                                                                          |
| g)                     | Solar Radiation                            | 1.2kW/sqmtr                                                                                                                                                                                                                                                                                 |
| h)                     | Atmospheric UV radiation                   | High                                                                                                                                                                                                                                                                                        |
| i)                     | Altitude above sea level                   | Less than 1000 meter above mean sea level (MSL)                                                                                                                                                                                                                                             |
| j)                     | Pollution Severity                         | High Pollution level                                                                                                                                                                                                                                                                        |
| k)                     | Seismic Zone                               | As per IS 1893 but not less than 0.3g horizontal                                                                                                                                                                                                                                            |
| <b>WIND DATA</b>       |                                            |                                                                                                                                                                                                                                                                                             |
|                        | Wind velocity                              | As per IS-875                                                                                                                                                                                                                                                                               |
|                        | Average No. of thunderstorm days per annum | As per IS                                                                                                                                                                                                                                                                                   |

|                  |                                                                                                                                                                                                                                                                                                    |                                       |                                                                                     |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|-------------------------------------------------------------------------------------|
| <b>Project</b>   | <b>Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route</b> | <b>TB-409-552-01</b><br><b>Rev 01</b> |  |
| <b>System</b>    | <b>FIRE FIGHTING SYSTEM</b>                                                                                                                                                                                                                                                                        |                                       |                                                                                     |
| <b>Owner</b>     | <b>POWERGRID CORPORATION OF INDIA LTD.</b>                                                                                                                                                                                                                                                         |                                       |                                                                                     |
| <b>Purchaser</b> | <b>BHARAT HEAVY ELECTRICALS LTD (Transmission Business Group)</b>                                                                                                                                                                                                                                  |                                       |                                                                                     |

|  |                             |                                                                                                                      |
|--|-----------------------------|----------------------------------------------------------------------------------------------------------------------|
|  | Main Electrical Parameters: |                                                                                                                      |
|  | Fault Levels:               | 765kV: 40kA for 1 sec                                                                                                |
|  | Creepage Distance           | 25mm/kV for All Equipment i.e BPI/Bushings, CB, Isolator, CT, CVT, LA, WT, NCT etc.<br>31mm/kV for string insulators |

## GENERAL TECHNICAL REQUIREMENTS-SECTION 3

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| System    | FIRE FIGHTING SYSTEM                                                                                                                                                                                                                                                                               |                         |                                                                                     |
| Owner     | POWERGRID CORPORATION OF INDIA LTD.                                                                                                                                                                                                                                                                |                         |                                                                                     |
| Purchaser | BHARAT HEAVY ELECTRICALS LTD (Transmission Business Group)                                                                                                                                                                                                                                         |                         |                                                                                     |

## GENERAL TECHNICAL REQUIREMENTS-SECTION 3

### 1.0 FOREWORD

The provisions under this section are intended to supplement requirements for the materials, equipments and services covered under other sections of tender documents and are not exclusive.

The Supplier shall note that the standards mentioned herein are not mutually exclusive or complete in themselves, but are intended to complement each other, with minimum repetition, to define the requirements of the Specification. In the event of a conflict between requirements of any two clauses of the Specification/ documents or requirements of different codes/ standards specified, the more stringent requirement as per the interpretation of the owner shall apply, unless confirmed otherwise by the owner in writing based on a written request from the Supplier.

In case of conflicting requirements between this document (General Technical Requirement Section 3) and equipment specification (Section 1 & Section 2), equipment specification shall prevail.

When specific requirements stipulated in the Specification exceed or change those required by the applicable standards, the stipulations of the Specification shall take precedence.

Unless specifically agreed to by the Purchaser prior to Award of Contract, the Work shall be in accordance with the standards indicated and the requirements of the Specification. The Supplier shall be held responsible for any deviation.

In case of conflict between the various standards, the decision of owner shall be binding & final.

### 2.0 GENERAL REQUIREMENT

The following words and expressions shall have the meanings hereby assigned to them throughout this document

"Employer/Owner" means Power Grid Corporation of India Ltd.

"Purchaser" means Bharat Heavy Electricals Limited

"Supplier/Manufacturer/Bidder" means the person or persons, firm or company assigned to execute the works as defined by the scope of supply, described here.

"Specification" refers to this document.

|           |                                                                                                                                                                                                                                                                                             |                         |                                                                                     |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-------------------------------------------------------------------------------------|
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| System    | FIRE FIGHTING SYSTEM                                                                                                                                                                                                                                                                        |                         |                                                                                     |
| Owner     | POWERGRID CORPORATION OF INDIA LTD.                                                                                                                                                                                                                                                         |                         |                                                                                     |
| Purchaser | BHARAT HEAVY ELECTRICALS LTD (Transmission Business Group)                                                                                                                                                                                                                                  |                         |                                                                                     |

The supplier should be approved by Power Grid. If not, it is the responsibility of the vendor to be assessed and approved by Power Grid, before placement of order by BHEL. Any cost involved in vendor assessment/approval must be borne by the vendor himself.

## 2.1 Definitions

2.1 —The ~~contractor~~Supplier/Manufacturer shall furnish catalogues, engineering data, technical information, design documents, drawings etc., fully in conformity with the technical specification during detailed engineering.

2.2 It is recognised that the Bidder may have standardised on the use of certain components, materials, processes or procedures different from those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to Employer.

2.3 Wherever a material or article is specified or defined by the name of a particular brand, Manufacturer or Vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition.

2.4 Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the Technical Specifications unless included in the list of exclusions. Materials and components which are minor in nature and incidental to the requirement but not specifically stated in the specification, which are necessary for commissioning and satisfactory operation of the switchyard/ substation unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/parts of similar standard equipment provided, shall be inter-changeable with one another.

2.5 Deleted.

|           |                                                                                                                                                                                                                                                                                             |                         |                                                                                     |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-------------------------------------------------------------------------------------|
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| System    | FIRE FIGHTING SYSTEM                                                                                                                                                                                                                                                                        |                         |                                                                                     |
| Owner     | POWERGRID CORPORATION OF INDIA LTD.                                                                                                                                                                                                                                                         |                         |                                                                                     |
| Purchaser | BHARAT HEAVY ELECTRICALS LTD (Transmission Business Group)                                                                                                                                                                                                                                  |                         |                                                                                     |

2.6 Deleted.

### **3.0 STANDARDS**

- 3.1 The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.
- 3.2 The equipment to be furnished under this specification shall conform to latest issue with all amendments (as on the originally scheduled date of bid opening) of standard specified under Annexure-C of this section, unless specifically mentioned in the specification.
- 3.3 The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to compliment each other.
- 3.4 The Bidder shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC.
- 3.5 When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.
- 3.6 Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards specified under Annexure-C/individual sections for various equipments shall also, be accepted, however the salient points of difference shall be clearly brought out during detailed engineering along with English language version of such standard. The equipment conforming to standards other than specified under Annexure-C/ individual sections for various equipments shall be subject to Employer's approval.

### **4.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED**

- 4.1 The 800kV system is being designed to limit the switching surge over voltage of 1.9 p.u. and the power frequency over voltage of 1.4 p.u. The equipment furnished under this specification shall perform all its functions and operate satisfactorily without showing undue strain, restriking etc under such over voltage conditions.
- 4.2 All equipments shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation.
- 4.3 All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow, (wherever applicable) short circuit etc for the equipment.

|           |                                                                                                                                                                                                                                                                                             |                         |                                                                                     |
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| System    | FIRE FIGHTING SYSTEM                                                                                                                                                                                                                                                                        |                         |                                                                                     |
| Owner     | POWERGRID CORPORATION OF INDIA LTD.                                                                                                                                                                                                                                                         |                         |                                                                                     |
| Purchaser | BHARAT HEAVY ELECTRICALS LTD (Transmission Business Group)                                                                                                                                                                                                                                  |                         |                                                                                     |

4.4 The bidder shall design terminal connectors of the equipment taking into account various forces that are required to withstand.

4.5 The equipment shall also comply to the following:

a) To facilitate erection of equipment, all items to be assembled at site shall be “match marked”.

b) All piping, if any between equipment control cabinet/operating mechanism to marshalling box of the equipment, shall bear proper identification to facilitate the connection at site.

#### 4.6 System Parameter

##### 765kV, System

| SL No | Description of parameters                                               | 765kV System                                                              |
|-------|-------------------------------------------------------------------------|---------------------------------------------------------------------------|
| 1.    | System operating voltage                                                | 765kV                                                                     |
| 2.    | Maximum operating voltage of the system (rms)                           | 800kV                                                                     |
| 3.    | Rated frequency                                                         | 50HZ                                                                      |
| 4.    | No. of phase                                                            | 3                                                                         |
| 5.    | Rated Insulation levels                                                 |                                                                           |
| i)    | Full wave impulse withstand voltage (1.2/50 microsec.)                  | 2100kVp                                                                   |
| ii)   | Switching impulse withstand voltage (250/2500 micro sec.) dry and wet   | 1550kVp                                                                   |
| iii)  | One minute power frequency dry withstand voltage (rms)                  | 830kV                                                                     |
| SL No | Description of parameters                                               | 765kV System                                                              |
| iv)   | One minute power frequency dry and wet withstand voltage (rms)          | -                                                                         |
| 6.    | Corona extinction voltage                                               | 508 kV                                                                    |
| 7.    | Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz | 2500 $\mu$ V at 508 kV rms                                                |
| 8.    | Minimum creepage distance - for Equipment other than Insulator string   | 20000 mm                                                                  |
|       | Minimum creepage distance - for Insulator String                        | 24800 mm                                                                  |
| 9     | Min. clearances                                                         |                                                                           |
| i.    | Phase to phase                                                          | <b>7600mm</b><br>(for conductor conductor configuration)<br><b>9400mm</b> |

|           |                                                                                                                                                                                                                                                                                                    |                                       |                                                                                     |
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| System    | <b>FIRE FIGHTING SYSTEM</b>                                                                                                                                                                                                                                                                        |                                       |                                                                                     |
| Owner     | <b>POWERGRID CORPORATION OF INDIA LTD.</b>                                                                                                                                                                                                                                                         |                                       |                                                                                     |
| Purchaser | <b>BHARAT HEAVY ELECTRICALS LTD (Transmission Business Group)</b>                                                                                                                                                                                                                                  |                                       |                                                                                     |

|      |                                                 |                                                                                     |
|------|-------------------------------------------------|-------------------------------------------------------------------------------------|
|      |                                                 | (for rod-conductor configuration)                                                   |
| ii.  | Phase to earth                                  | <b>4900mm</b><br>(for conductor structure)<br><b>6400mm</b><br>(for rod- structure) |
| iii. | Sectional clearances                            | 10300 mm                                                                            |
| 10.  | Rated short circuit current for 1 sec. duration | 40kA                                                                                |
| 11.  | System neutral earthing                         | Effectively earthed                                                                 |

#### Notes:

1. The above parameters are applicable for installations up to an altitude of 1000m above mean sea level. For altitude exceeding 1000m, necessary altitude correction factor shall be applicable as per relevant IEC.

2. The insulation and RIV levels of the equipments shall be as per values given in the Technical Specification of respective equipment.

3. Corona and radio interference voltage test and seismic withstand test procedures for equipments shall be in line with the procedure given at **Annexure-A** and **Annexure-B** respectively.

## **5.0 ENGINEERING DATA AND DRAWINGS**

5.1 Deleted.

5.2 The Bidder shall submit 4 (four) sets of drawings/ design documents /data / detailed bill of quantity and 1 (one) set of test reports for the approval of the Employer. The bidder shall also submit the softcopy of the above documents in addition to hardcopy.

## **5.3 Drawings**

5.3.1 All drawings submitted by the Bidder shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, dimensions, internal & the external connections, fixing arrangement required and any other information specifically requested in the specifications.

|           |                                                                                                                                                                                                                                                                                                    |                                 |                                                                                     |
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| System    | <b>FIRE FIGHTING SYSTEM</b>                                                                                                                                                                                                                                                                        |                                 |                                                                                     |
| Owner     | <b>POWERGRID CORPORATION OF INDIA LTD.</b>                                                                                                                                                                                                                                                         |                                 |                                                                                     |
| Purchaser | <b>BHARAT HEAVY ELECTRICALS LTD (Transmission Business Group)</b>                                                                                                                                                                                                                                  |                                 |                                                                                     |

5.3.2 Drawings submitted by the Bidder shall be clearly marked with the name of the Employer, the unit designation, the specifications title, the specification number and the name of the Project. POWERGRID has standardized a large number of drawings/documents of various make including type test reports which can be used for all projects having similar requirements and in such cases no project specific approval (except for list of applicable drawings along with type test reports) is required. However, distribution copies of standard drawings/documents shall be submitted as per provision of the contract. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in SI units.

5.3.3 The review of these data by the Employer will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect substation layout. This review by the Employer may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the Employer shall not be considered by the Bidder, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

5.5 All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Bidder's risk. The Bidder may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Employer. Approval of Bidder's drawing or work by the Employer shall not relieve the bidder of any of his responsibilities and liabilities under the Contract.

5.6 All engineering data submitted by the Bidder after final process including review and approval by the Employer shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the Employer in Writing.

## **5.7 Approval Procedure**

The following schedule shall be followed generally for approval and for providing final documentation.

i) Approval/comments/ \_\_\_\_\_ As per schedule  
by Employer on initial submission

ii) Resubmission \_\_\_\_\_ As per contract  
(whenever \_\_\_\_\_  
required)

|           |                                                                                                                                                                                                                                                                                                    |                                 |                                                                                     |
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| System    | <b>FIRE FIGHTING SYSTEM</b>                                                                                                                                                                                                                                                                        |                                 |                                                                                     |
| Owner     | <b>POWERGRID CORPORATION OF INDIA LTD.</b>                                                                                                                                                                                                                                                         |                                 |                                                                                     |
| Purchaser | <b>BHARAT HEAVY ELECTRICALS LTD (Transmission Business Group)</b>                                                                                                                                                                                                                                  |                                 |                                                                                     |

- iii) Approval or comments As per contract
- iv) Furnishing of distribution 2 weeks from the date  
copies (2 hard copies to each of approval  
substation and one scanned  
copy (pdf format)
- v) Furnishing of distribution  
copies of test reports  
(a) Type test reports 2 weeks from the date  
(one scanned softcopy in of final approval  
pdf format to each substation  
plus one for corporate centre  
& one hardcopy per substation)
- (b) Routine Test Reports -do-  
(one copy for each  
substation)
- vi) Furnishing of instruction/ On completion of Engineering  
operation manuals (2 copies  
per substation and one softcopy  
(pdf format) for corporate centre  
& per substation)
- (vii) As built drawings (two sets of On completion of entire works  
hardcopy per substation & one  
softcopy (pdf format) for corporate centre & per substation)

#### **NOTE :**

(1) The bidder may please note that all resubmissions must incorporate all comments given in the earlier submission by the Employer or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.

(2) All drawings should be submitted in softcopy form, however substation design drawings like SLD, GA, all layouts etc. shall also be submitted in AutoCAD Version. SLD, GA & layout drawings shall be submitted for the entire substation in case of substation extension also.

(3) The instruction Manuals shall contain full details of drawings of all equipment being supplied under this contract, their exploded diagrams with complete instructions for storage, handling.

|           |                                                                                                                                                                                                                                                                                                    |                                 |                                                                                     |
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| System    | <b>FIRE FIGHTING SYSTEM</b>                                                                                                                                                                                                                                                                        |                                 |                                                                                     |
| Owner     | <b>POWERGRID CORPORATION OF INDIA LTD.</b>                                                                                                                                                                                                                                                         |                                 |                                                                                     |
| Purchaser | <b>BHARAT HEAVY ELECTRICALS LTD (Transmission Business Group)</b>                                                                                                                                                                                                                                  |                                 |                                                                                     |

erection, commissioning, testing, operation, trouble shooting, servicing and overhauling procedures.

(4) If after the commissioning and initial operation of the substation, the instruction manuals require any modifications/additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Bidder to the Employer.

(5) The Bidder shall furnish to the Employer catalogues of spare parts.

(6) All As-built drawings/documents shall be certified by site indicating the changes before final submission.

## **6.0 MATERIAL/ WORKMANSHIP**

### **6.1 General Requirement**

6.1.1 Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended.

6.1.2 In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard, the Employer shall decide upon the question of similarity. When required by the specification or when required by the Employer the Bidder shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it is to be understood that the cost as well as the time delay associated with the rejection shall be borne by the Bidder.

6.1.3 The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfil their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Employer.

6.1.4 Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different

|           |                                                                                                                                                                                                                                                                                             |                         |                                                                                     |
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| System    | FIRE FIGHTING SYSTEM                                                                                                                                                                                                                                                                        |                         |                                                                                     |
| Owner     | POWERGRID CORPORATION OF INDIA LTD.                                                                                                                                                                                                                                                         |                         |                                                                                     |
| Purchaser | BHARAT HEAVY ELECTRICALS LTD (Transmission Business Group)                                                                                                                                                                                                                                  |                         |                                                                                     |

pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

6.1.5 Deleted.

6.1.6 The Bidder shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Bidder shall apply all operational lubricants to the equipment installed by him.

6.1.7 All oil, grease and other consumables used in the Works/Equipment shall be purchased in India unless the Bidder has any special requirement for the specific application of a type of oil or grease not available in India. If such is the case, he shall declare in the proposal, where such oil or grease is available. He shall help Employer in establishing equivalent Indian make and Indian Bidder. The same shall be applicable to other consumables too.

## **6.2 Provisions For Exposure to Hot and Humid climate**

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favourable to the growth of fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

### **6.2.1 Space Heaters**

6.2.1.1 The heaters shall be suitable for continuous operation at 240V as supply voltage. On-off switch and fuse shall be provided.

6.2.1.2 One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the compartment and electrical connections shall be made sufficiently away from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

### **6.2.2 FUNGI STATIC VARNISH**

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on parts which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

|           |                                                                                                                                                                                                                                                                                             |                         |                                                                                     |
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| System    | FIRE FIGHTING SYSTEM                                                                                                                                                                                                                                                                        |                         |                                                                                     |
| Owner     | POWERGRID CORPORATION OF INDIA LTD.                                                                                                                                                                                                                                                         |                         |                                                                                     |
| Purchaser | BHARAT HEAVY ELECTRICALS LTD (Transmission Business Group)                                                                                                                                                                                                                                  |                         |                                                                                     |

### 6.2.3 Ventilation opening

Wherever ventilation is provided, the compartments shall have ventilation openings with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust.

### 6.2.4 Degree of Protection

The enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall comply with following degree of protection as detailed here under:

- a) Installed out door: IP- 55
- b) Installed indoor in air conditioned area: IP-31
- c) Installed in covered area: IP-52
- d) Installed indoor in non-air conditioned area where possibility of entry of water is limited: IP-41.
- e) For LT Switchgear (AC & DC distribution Boards): IP-52

The degree of protection shall be in accordance with IS:13947 (Part-I)/IEC-60947 (Part-I)/IS 12063/IEC-60529. Type test report for IP-55 or higher degree of protection test, shall be submitted for approval.

## 6.3 RATING PLATES, NAME PLATES AND LABELS

6.3.1 Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Employer. The rating plate of each equipment shall be according to IEC requirement.

6.3.2 All such nameplates, instruction plates, rating plates of transformers, reactors, CB, CT, CVT, SA, Isolators, C & R panels and PLCC equipments shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

## 6.4 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, soldering/brazing material for all copper piping of circuit breakers and essential chemicals etc. which will be required to put the equipment covered under the scope of the specifications, into

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| System    | <b>FIRE FIGHTING SYSTEM</b>                                                                                                                                                                                                                                                                        |                         |                                                                                     |
| Owner     | <b>POWERGRID CORPORATION OF INDIA LTD.</b>                                                                                                                                                                                                                                                         |                         |                                                                                     |
| Purchaser | <b>BHARAT HEAVY ELECTRICALS LTD (Transmission Business Group)</b>                                                                                                                                                                                                                                  |                         |                                                                                     |

operation, shall be furnished by the Bidder unless specifically excluded under the exclusions in these specifications and documents.

## **7.0 DESIGN IMPROVEMENTS / COORDINATION**

7.1 Deleted.

7.2 Deleted.

7.3 The Bidder shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

7.4 The Bidder has to coordinate designs and terminations with the agencies (if any) who are Consultants/Bidder for the Employer. The names of agencies shall be intimated to the successful bidders.

7.5 The Bidder will be called upon to attend design co-ordination meetings with the Engineer, other Bidder's and the Consultants of the Employer (if any) during the period of Contract. The Bidder shall attend such meetings at his own cost at POWERGRID Corporate Centre, Gurgaon (Haryana) or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions.

## **8.0 QUALITY ASSURANCE PROGRAMME**

8.1 To ensure that the equipment and services under the scope of this Contract, whether manufactured or performed within the Bidder's Works or at his Sub-Bidder's premises or at the Employer's site or at any other place of Work as applicable, are in accordance with the specifications, the Bidder shall ensure suitable quality assurance programme to control such activities at all points necessary. A quality assurance programme of the Bidder shall be in line with ISO requirements & shall generally cover the following:

a) The organisation structure for the management and implementation of the proposed quality assurance programme.

b) System for Document and Data Control.

c) Qualification and Experience data of Bidder's key personnel.

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| System    | <b>FIRE FIGHTING SYSTEM</b>                                                                                                                                                                                                                                                                        |                         |                                                                                     |
| Owner     | <b>POWERGRID CORPORATION OF INDIA LTD.</b>                                                                                                                                                                                                                                                         |                         |                                                                                     |
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d) The procedure for purchases of materials, parts, components and selection of sub- Bidder's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.

e) System for shop manufacturing and site erection controls including process controls, fabrication and assembly control.

f) System for Control of non-conforming products including deviation dispositioning, if any and system for corrective and preventive actions based on the feedback received from the Customers and also internally documented system for Customer complaints.

g) Inspection and test procedure both for manufacture and field activities.

h) System for Control of calibration of testing and measuring equipment and the indication of calibration status on the instruments.

i) System for indication and appraisal of inspection status.

j) System of Internal Quality Audits, Management review and initiation of corrective and Preventive actions based on the above.

k) System for authorising release of manufactured product to the Employer.

l) System for maintenance of records.

m) System for handling, storage and delivery.

n) A quality plan detailing out the specific quality control measures and procedure adopted for controlling the quality characteristics relevant to each item of equipment furnished and /or service rendered.

o) System for various field activities i.e. unloading, receipt at site, proper storage, erection, testing and commissioning of various equipment and maintenance of records. In this regard, the Employer has already prepared Standard Field Quality Plan for transmission line/substation equipments as applicable, Civil/erection Works which is required to be followed for associated works.

The Employer or his duly authorised representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Bidder/his vendor's quality management and control activities.

## 8.2 Quality Assurance Documents

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| <b>System</b>    | <b>FIRE FIGHTING SYSTEM</b>                                                                                                                                                                                                                                                                        |                                 |                                                                                     |
| <b>Owner</b>     | <b>POWERGRID CORPORATION OF INDIA LTD.</b>                                                                                                                                                                                                                                                         |                                 |                                                                                     |
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The Bidder shall ensure availability of the following Quality Assurance Documents:

- i) All Non-Destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication, and reports including radiography interpretation reports.
- ii) Welder and welding operator qualification certificates.
- iii) Welder's identification list, welding operator's qualification procedure and welding identification symbols.
- iv) Raw Material test reports on components as specified by the specification and in the quality plan.
- v) The Manufacturing Quality Plan (MQP) indicating Customer Inspection Points (CIPs) at various stages of manufacturing and methods used to verify that the inspection and testing points in the quality plan were performed satisfactorily.
- vi) Factory test results for testing required as per applicable quality plan/technical specifications/GTP/Drawings etc.
- vii) Stress relief time temperature charts/oil impregnation time temperature charts, wherever applicable.

### **8.3 INSPECTION, TESTING & INSPECTION CERTIFICATE**

- 8.3.1 Bidder shall procure bought out items from sub-vendors as per the list in "Compendium of Vendors" available on POWERGRID web-site [www.powergridindia.com](http://www.powergridindia.com) after ensuring compliance to the requirements/conditions mentioned therein. Bidder shall explore first the possibilities of procuring the bought out items from POWERGRID approved existing vendors. In case of their unavailability / non-response, Bidder may approach POWERGRID for additional sub-vendor approval. In that case, the assessment report of proposed sub vendor by Bidder along with the enclosures as per Annexure-F shall be submitted within 60 days of the award. The proposal shall be reviewed and approval will be accorded based on the verification of the document submitted and/or after the physical assessment of the works as the case may be. The physical assessment conducted by POWERGRID, if required, shall be on chargeable basis. Charges shall be as per the POWERGRID norms prevailing at that time, which shall be intimated by POWERGRID separately. If proposal for sub-vendor is submitted after 60 days, the Bidder's proposal normally will not be considered for current LOA. However, POWERGRID may process the case for developing more vendors for referred items, if found relevant. In all cases, It is the responsibility of the Bidder that Project activities do not suffer on account of delay in approval/non approval of a new sub-vendor.

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| <b>System</b>    | <b>FIRE FIGHTING SYSTEM</b>                                                                                                                                                                                                                                                                        |                                 |                                                                                     |
| <b>Owner</b>     | <b>POWERGRID CORPORATION OF INDIA LTD.</b>                                                                                                                                                                                                                                                         |                                 |                                                                                     |
| <b>Purchaser</b> | <b>BHARAT HEAVY ELECTRICALS LTD (Transmission Business Group)</b>                                                                                                                                                                                                                                  |                                 |                                                                                     |

The responsibility and the basis of inspection for various items & equipment is placed at Annexure-G along with the requirement of MQP (Manufacturing Quality Plan), ITP (Inspection & Test Plan), FAT (Factory Acceptance Test) which should be valid & POWERGRID approved and Level of inspection envisaged against each item.

Bidder shall ensure that order for items where MQP/ITP/FAT is required will be placed only on vendors having valid MQP/ITP/FAT and where the supplier's MQP/ITP/FAT is either not valid or has not been approved by POWERGRID, MQP shall be generally submitted as per POWERGRID format before placing order.

Items not covered under MQP/ITP/FAT shall be offered for inspection as per POWERGRID LOA/technical Specifications/POWERGRID approved data sheets/POWERGRID approved drawings and relevant Indian/International standards. Inspection Levels: For implementation of projects in a time bound manner and to avoid any delay in deputation of POWERGRID or its authorized representative, involvement of POWERGRID for inspection of various items / equipment will be based on the level below:

**Level -I:** Bidder to raise all inspection calls and review the report of tests carried out by the manufacturer, on his own, as per applicable standards/ POWERGRID specification, and submit to concerned POWERGRID inspection office/Inspection Engineer. CIP/MICC will be issued by POWERGRID based on review of test reports/certificates of manufacturers.

**Level - II:** Bidder to raise all inspection calls and carry out the inspection on behalf of POWERGRID on the proposed date of inspection as per applicable standards/specification. However, in case POWERGRID wishes to associate itself during inspection, the same would be intimated to Bidder and CIP/MICC will be issued by POWERGRID. Else, Bidder would submit their test reports/certificates to POWERGRID. CIP/MICC will be issued by POWERGRID based on review of test reports/certificates.

**Level - III:** Bidder to raise inspection calls for both, stage (as applicable) & final inspection and carry out the stage inspections (if applicable) on behalf of POWERGRID on the proposed date of inspection as per applicable standards/specification. However, in case POWERGRID wishes to associate itself during stage inspection, the same would be intimated to Bidder and CIP will be issued by POWERGRID. Else, Bidder would submit the test reports / certificates of stage inspection after their own review and CIP will be issued by POWERGRID based on review of test reports / certificates. Final inspection will be carried out by POWERGRID and CIP/MICC will be issued by POWERGRID.

**Level - IV:** Bidder to raise inspection calls for both, stage (as applicable) & final inspections. POWERGRID will carry out the inspection for both stage & final inspection as per applicable standards/specification and CIP/MICC will be issued by POWERGRID.

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| <b>System</b>    | <b>FIRE FIGHTING SYSTEM</b>                                                                                                                                                                                                                                                                        |                                 |                                                                                     |
| <b>Owner</b>     | <b>POWERGRID CORPORATION OF INDIA LTD.</b>                                                                                                                                                                                                                                                         |                                 |                                                                                     |
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- 8.3.2 Bidder shall ensure that to implement the above inspection levels, particularly for the quality control and inspection at sub-vendor's works, they would depute sufficient qualified & experienced manpower in their Quality Control and Inspection department. Further, to assure quality of construction, Bidder shall have a separate workforce having appropriate qualification & experience and deploy suitable tools and plant for maintaining quality requirement during construction in line with applicable Field Quality Plan (FQP).
- 8.3.3 The Employer, his duly authorised representative and/or outside inspection agency acting on behalf of the Employer shall have at all reasonable times access to the Bidder's premises or Works and shall have the power at all reasonable times to ensure that proper Quality Management practices / norms are adhered to, inspect and examine the materials & workmanship of the Works, to carry out Quality/Surveillance Audit during manufacture or erection and if part of the Works is being manufactured or assembled at other premises or works. The Bidder shall obtain for the Employer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Bidder's own premises or works. The item/equipment, if found unsatisfactory with respect to workmanship or material is liable to be rejected. The observations for improvements during product/ process inspection by POWERGRID shall be recorded in Quality Improvement Register (available & maintained at works) for review & timely compliance of observations.
- 8.3.4 Bidder shall submit inspection calls over internet through POWERGRID website. The required vendor code and password to enable raising inspection call will be furnished to the main Bidder within 30 days of award of contract on submission of documents by Bidder. After raising the inspection calls, Bidder shall then proceed as per the message of that particular call which is available on the message board.
- 8.3.5 The Employer reserves the right to witness any or all type, acceptance and routine tests specified for which the Bidder shall give the Employer/Inspector Twenty one (21) days written notice of any material being ready for testing for each stage of testing as identified in the approved quality plan as customer inspection point(CIP) for indigenous inspections. All inspection calls for overseas material shall be given at least forty five (45) days in advance. Such tests shall be to the Bidder's account except for the expenses of the Inspection Engineer. The Employer/inspector, unless witnessing of the tests is waived by Employer, will attend such tests within Twenty one (21) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Bidder may proceed with the test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector three copies of tests, duly certified. Bidder shall ensure, before giving notice for type test, that all drawings and quality plans have been got approved. The equipment shall be dispatched to site only after approval of Routine and Acceptance test results and Issuance of Dispatch Clearance in writing by the Employer. CIP/Material Inspection clearance certificate (MICC) shall be issued by the Employer after inspection of the equipment or review of test reports as applicable. Employer may waive off the presence of Employer's inspecting engineer. In that case test will be carried out as per approved

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| <b>System</b>    | <b>FIRE FIGHTING SYSTEM</b>                                                                                                                                                                                                                                                                        |                                 |                                                                                     |
| <b>Owner</b>     | <b>POWERGRID CORPORATION OF INDIA LTD.</b>                                                                                                                                                                                                                                                         |                                 |                                                                                     |
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QP and test certificate will be furnished by the supplier for approval. CIP/MICC will be issued only after review and approval of the test reports.

- 8.3.6 Bidder shall generally offer material for inspection as per supply bar chart approved by POWERGRID and not before 30 days from schedule indicated in the bar chart. In case Bidder offers material(s) for inspection prior to 30 days from the scheduled date with necessary approval of POWERGRID, POWERGRID shall inspect the material and issue CIP only. However, in such an exceptional case, MICC shall be issued only as per provision of original / revised approved supply schedule.
- 8.3.7 Bidder shall minimize the number of inspection calls by offering optimum quantities in each inspection call at the respective manufacturer's works.
- 8.3.8 Bidder shall inspect the material themselves and only after they are fully convinced about the Quality, they shall offer the material for POWERGRID inspection and shall also ensure that relevant portion of LOA/NOA, approved drawing and data sheets along with applicable Quality Plans are available at the works of Bidder or their Sub-vendor before the material is offered for inspection.
- 8.3.9 Bidder shall ensure that material which has been cleared for dispatch after inspection will be dispatched within 30 days in case of domestic supplies and within 60 days in case of Off-shore supplies from the date of issuance of CIP. Material which is not dispatched within stipulated time as above will be reoffered for POWERGRID inspection or specific approval of POWERGRID QA&I shall be obtained for delayed dispatch.
- 8.3.10 The Employer or IE shall give notice in writing to the Bidder, of any objection either to conformance to any drawings or to any equipment and workmanship which in his opinion is not in accordance with the Contract. The Bidder shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Employer/Inspection Engineer giving reasons therein, that no modifications are necessary to comply with the Contract.
- 8.3.11 All Test Reports and documents to be submitted in English during final inspection of equipment by POWERGRID or as and when required for submission.
- 8.3.12 When the factory tests have been completed at the Bidder's or Sub-Bidder's works, the Employer/ Inspection Engineer (IE) shall issue a certificate to this effect within fifteen (15) days after completion of tests & submission of documents by Bidder/manufacturer but if the tests are not witnessed by the Employer/IE, the certificate shall be issued within fifteen (15) days of receipt of the Bidder's Test certificate by the Employer/IE. Bidder shall, on completion of all tests, submit test reports within Ten (10) days to POWERGRID IE. Failure of the Employer/IE to issue such a certificate shall not prevent the Bidder from proceeding with the Works. The completion of these

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| <b>System</b>    | <b>FIRE FIGHTING SYSTEM</b>                                                                                                                                                                                                                                                                        |                                 |                                                                                     |
| <b>Owner</b>     | <b>POWERGRID CORPORATION OF INDIA LTD.</b>                                                                                                                                                                                                                                                         |                                 |                                                                                     |
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tests or the issue of the certificate shall not bind the Employer to accept the equipment should, it, on further tests after erection, be found not to comply with the Contract.

- 8.3.13 In all cases, where the Contract provides for tests whether at the premises or works of the Bidder or of any Sub- Bidder, the Bidder, except where otherwise specified, shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Employer/Inspector or his authorised representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Employer/Inspection Engineer or to his authorised representative to accomplish testing.
- 8.3.14 The inspection and acceptance by Employer and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Bidder in respect of the agreed quality assurance programme forming a part of the Contract, or if such equipment is found to be defective at a later stage.
- 8.3.15 The Employer will have the right of having at his own expenses any other test(s) of reasonable nature carried out at Bidder's premises or at site or in any other place in addition of aforesaid type and routine tests, to satisfy that the material comply with the specification.
- 8.3.16 The Employer reserves the right for getting any additional field tests conducted on the completely assembled equipment at site to satisfy that material complies with specifications.
- 8.3.17 Rework/ Re-engineering, if any, on any item/equipment shall be carried out only after mutual discussions and in accordance with mutually agreed procedure. Bidder shall submit Joint Inspection Report of equipments under Re-Work/Re-Engineering alongwith procedure for the same to POWERGRID for approval, before taking up the Re-Work/Re-Engineering, failing which POWERGRID reserves the right to reject the equipment.
- 8.3.18 Bidder may establish a field test Laboratory to execute Civil Construction testing requirements at site with the condition that all testing equipment shall be calibrated from POWERGRID approved accredited Testing laboratories, with calibration certificates kept available at site and all testing personnel employed in the Field Testing Laboratories to be qualified and experienced Engineers or testing to be carried out at POWERGRID approved Third Party Laboratories.
- 8.3.19 Bidder shall ensure that all possible steps are taken to avoid damages to the equipment during transport, storage and erection.
- 8.3.20 Bidder shall implement additional stringent quality checks and preparation during installation of GIS at site (if applicable) as per POWERGRID approved guidelines/Technical specifications.
- 8.3.21 Bidder shall ensure commissioning of all CSDs along with Circuit Breakers wherever applicable.

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| <b>System</b>    | <b>FIRE FIGHTING SYSTEM</b>                                                                                                                                                                                                                                                                        |                                 |                                                                                     |
| <b>Owner</b>     | <b>POWERGRID CORPORATION OF INDIA LTD.</b>                                                                                                                                                                                                                                                         |                                 |                                                                                     |
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### 8.3.22 For EHV transformers/reactors:

Insulation oil shall be as per POWERGRID Technical specifications and same grade shall be used for impregnation of the active part & testing at the works of Transformer/Reactor Manufacturer and as well as for filling the Transformer/Reactors at site. Bidder to ensure that windings for Transformer/Reactors are made in air conditioned environment. Core-coil assembly shall be performed in positive pressurized dust controlled environment. Dust measurements shall be monitored regularly at Transformer / Reactor Manufacturer works. Bidder shall ensure that respective civil foundations & Fire walls for Transformer/Reactors units to be commissioned, shall be made ready at concerned sites before receipt of Transformer/Reactors units. All the requisite material for Neutral & Delta Bus formation required for charging of complete bank of 765KV class 1-ph Transformer/Reactor units shall be made available at the concerned sites before receipt of the Transformer/Reactor units at site.

- 8.3.23 The Employer reserves the right to increase or decrease their involvement in inspections at Bidder's Works or at his Sub-Bidder's premises or at the Employer's site or at any other place of Work based on performance of Bidder/sub-Bidder.

## 9.0 TYPE TESTING & CLEARANCE CERTIFICATE

- 9.1 All equipment being supplied shall conform to type tests as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective sections.
- 9.2 The reports for all type tests as per technical specification shall be furnished by the Bidder alongwith equipment / material drawings. However, type test reports of similar equipments/ material already accepted in POWERGRID shall be applicable for all projects with similar requirement. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited based on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by POWERGRID or representative authorized by POWERGRID or Utility or representative of accredited test lab.

Unless otherwise specified elsewhere, the type test reports submitted shall be of the tests conducted on or after 05-Nov-2009. In case the test reports are of the test conducted earlier than 05-Nov-2009, the bidder shall repeat these test(s) at no extra cost to the BHEL/Employer.

Further, in the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes or due to non-compliance with the requirement stipulated in the Technical Specification or any/all type tests not carried out, same shall be carried out without any additional cost implication to the BHEL/Employer.

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| <b>System</b>    | <b>FIRE FIGHTING SYSTEM</b>                                                                                                                                                                                                                                                                        |                             |                                                                                     |
| <b>Owner</b>     | <b>POWERGRID CORPORATION OF INDIA LTD.</b>                                                                                                                                                                                                                                                         |                             |                                                                                     |
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The Bidder shall intimate the Employer the detailed program about the type tests atleast two (2) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.

- 9.3 The Employer intends to repeat those type tests which are indicated in the price schedule and the same shall be payable as per provision of contract. The price of conducting type tests shall be included in Bid price and break up of these shall be given in the relevant schedule of Bid Proposal Sheets. These Type test charges would be considered in bid evaluation. In case Bidder does not indicate charges for any of the type tests or does not mention the name of any test in the price schedules, it will be presumed that the particular test has been offered free of charge. Further, in case any Bidder indicates that he shall not carry out a particular test, his offer shall be considered incomplete and shall be liable to be rejected. The Employer reserves the right to waive the repeating of type tests partly or fully and in case of waiver, test charges for the same shall not be payable.
- 9.4 The Employer reserves the right to witness any or all the type tests. The Employer shall bear all expenses for deputation of Employer's representative(s) for witnessing the type tests.
- 9.5 The list of makes of various items, for which Type test reports are not required to be submitted are specified in Compendium of Vendors (COV).

#### **10.0 Deleted.**

#### **11.0 PACKAGING & PROTECTION**

- 11.1 All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the Employer, the Bidder shall also submit packing details/associated drawing for any equipment/material under his scope of supply, to facilitate the Employer to repack any equipment/material at a later date, in case the need arises. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken into account. The Bidder shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Bidder. Employer takes no responsibility of the availability of the wagons.
- 11.2 All coated surfaces shall be protected against abrasion, impact, discolouration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

#### **12.0 FINISHING OF METAL SURFACES**

|                  |                                                                                                                                                                                                                                                                                                    |                                 |                                                                                     |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|-------------------------------------------------------------------------------------|
| <b>Project</b>   | <b>Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route</b> | <b>TB-409-552-01<br/>Rev 01</b> |  |
| <b>System</b>    | <b>FIRE FIGHTING SYSTEM</b>                                                                                                                                                                                                                                                                        |                                 |                                                                                     |
| <b>Owner</b>     | <b>POWERGRID CORPORATION OF INDIA LTD.</b>                                                                                                                                                                                                                                                         |                                 |                                                                                     |
| <b>Purchaser</b> | <b>BHARAT HEAVY ELECTRICALS LTD (Transmission Business Group)</b>                                                                                                                                                                                                                                  |                                 |                                                                                     |

- 12.1 All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. All steel conductors including those used for earthing/grounding (above ground level) shall also be galvanized according to IS: 2629.

## 12.2 HOT DIP GALVANISING

- 12.2.1 The minimum weight of the zinc coating shall be 610 gm/sq.m and minimum average thickness of coating shall be 86 microns for all items having thickness 6mm and above. For items lower than 6mm thickness requirement of coating thickness shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq.m minimum.
- 12.2.2 The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.
- 12.2.3 After galvanizing, no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate or alternate approved treatment shall be provided to avoid formation of white rust after hot dip galvanization.
- 12.2.4 The galvanized steel shall be subjected to four numbers of one minute dips in copper sulphate solution as per IS-2633.
- 12.2.5 Sharp edges with radii less than 2.5 mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.
- Coating thickness
  - Uniformity of zinc
  - Adhesion test
  - Mass of zinc coating
- 12.2.6 Galvanised material must be transported properly to ensure that galvanised surfaces are not damaged during transit. Application of touch-up zinc rich paint at site shall be allowed with approval of Engineer Incharge.

## 12.3 PAINTING

|                  |                                                                                                                                                                                                                                                                                                    |                                 |                                                                                     |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|-------------------------------------------------------------------------------------|
| <b>Project</b>   | <b>Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route</b> | <b>TB-409-552-01<br/>Rev 01</b> |  |
| <b>System</b>    | <b>FIRE FIGHTING SYSTEM</b>                                                                                                                                                                                                                                                                        |                                 |                                                                                     |
| <b>Owner</b>     | <b>POWERGRID CORPORATION OF INDIA LTD.</b>                                                                                                                                                                                                                                                         |                                 |                                                                                     |
| <b>Purchaser</b> | <b>BHARAT HEAVY ELECTRICALS LTD (Transmission Business Group)</b>                                                                                                                                                                                                                                  |                                 |                                                                                     |

- 12.3.1 All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS- 6005 “Code of practice for phosphating iron and sheet”. All surfaces, which will not be easily accessible after shop assembly, shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swaf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.
- 12.3.2 After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, stoving type zinc chromate primer. The first coat may be “flash dried” while the second coat shall be stoved.
- 12.3.3 After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting.
- 12.3.4 The exterior and interior colour of the paint in case of new substations shall preferably be RAL 7032 for all equipment, marshalling boxes, junction boxes, control cabinets, panels etc. unless specifically mentioned under respective sections of the equipments. Glossy white colour inside the equipments /boards /panels/junction boxes is also acceptable. The exterior colour for panels shall be matching with the existing panels in case of extension of a substation. Each coat of primer and finishing paint shall be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments.
- 12.3.5 In case the bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc., the procedure shall be submitted during detailed engineering for Employer's review & approval.
- 12.3.6 The colour scheme as given below shall be followed for Fire Protection and Air Conditioning systems

| <b>S.No.</b>                  | <b>PIPE LINE</b>                         | <b>Base colour</b> | <b>Band colour</b> |
|-------------------------------|------------------------------------------|--------------------|--------------------|
| <b>Fire Protection System</b> |                                          |                    |                    |
| 1                             | Hydrant and Emulsifier system pipeline   | FIRE RED           | -                  |
| 2                             | Emulsifier system detection line – water | FIRE RED           | Sea Green          |
| 3                             | Emulsifier system detection line –Air    | FIRE RED           | Sky Blue           |
| 4                             | Pylon support pipes                      | FIRE RED           | -                  |
| <b>Air Conditioning Plant</b> |                                          |                    |                    |

|                  |                                                                                                                                                                                                                                                                                                    |                                       |                                                                                     |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|-------------------------------------------------------------------------------------|
| <b>Project</b>   | <b>Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route</b> | <b>TB-409-552-01</b><br><b>Rev 01</b> |  |
| <b>System</b>    | <b>FIRE FIGHTING SYSTEM</b>                                                                                                                                                                                                                                                                        |                                       |                                                                                     |
| <b>Owner</b>     | <b>POWERGRID CORPORATION OF INDIA LTD.</b>                                                                                                                                                                                                                                                         |                                       |                                                                                     |
| <b>Purchaser</b> | <b>BHARAT HEAVY ELECTRICALS LTD (Transmission Business Group)</b>                                                                                                                                                                                                                                  |                                       |                                                                                     |

|   |                                                    |                      |           |
|---|----------------------------------------------------|----------------------|-----------|
| 5 | Refrigerant gas pipeline – at compressor suction   | Canary Yellow        | -         |
| 6 | Refrigerant gas pipeline – at compressor discharge | Canary Yellow        | Red       |
| 7 | Refrigerant liquid pipeline                        | Dark Admiralty Green | -         |
| 8 | Chilled water pipeline                             | Sea Green            | -         |
| 9 | Condenser water pipeline                           | Sea Green            | Dark Blue |

**Project** Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route

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Rev 01



**System** FIRE FIGHTING SYSTEM

**Owner** POWERGRID CORPORATION OF INDIA LTD.

**Purchaser** BHARAT HEAVY ELECTRICALS LTD  
(Transmission Business Group)

#### SECTION 4

#### GUARANTEED TECHNICAL PARTICULARS

Bidder should refer only latest approved Powergrid's standard GTPs for applicable items of fire fighting system. However some GTP's are given in section-2 (Powergrid specification for reference and tender purpose only).

**Project** Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route

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**System** FIRE FIGHTING SYSTEM  
**Owner** POWERGRID CORPORATION OF INDIA LTD.  
**Purchaser** BHARAT HEAVY ELECTRICALS LTD  
(Transmission Business Group)

## SECTION- 5

### ENCLOSURES TO SPECIFICATION

#### SCHEDULES TO BE FILLED UP BY THE BIDDER

- Schedule 1 **Schedule of Deviations**
- Schedule 2 **Schedule of past experience and qualifying requirements**
- Schedule 3 **Schedule of performance certificates**
- Schedule 4 **Details of contact persons (technical & commercial)**
- Schedule 5 **Enclosures to Specification**
- a) **Drawings**

**Project** Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route

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**System** FIRE FIGHTING SYSTEM

**Owner** POWERGRID CORPORATION OF INDIA LTD.

**Purchaser** BHARAT HEAVY ELECTRICALS LTD  
(Transmission Business Group)

## SCHEDULE-1

### SCHEDULE OF TECHNICAL DEVIATION

The following are the deviations / variations / exceptions from the specification:

| Section | Clause No./<br>Page No. | Statement of deviation/<br>Variations/Exceptions |
|---------|-------------------------|--------------------------------------------------|
|---------|-------------------------|--------------------------------------------------|

- 1) In case, this schedule is not submitted, it will be presumed that the equipment /material to be supplied under this contract is deemed to be in compliance with the specification.
- 2) If there is NIL deviation, even then the format to be filled as **NIL DEVIATION**
- 3) Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.

Place

Signature of the authorized representative of Bidder

Name -----

Date

Designation-----

Company seal-----

**Project** Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route

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**System** FIRE FIGHTING SYSTEM

**Owner** POWERGRID CORPORATION OF INDIA LTD.

**Purchaser** BHARAT HEAVY ELECTRICALS LTD  
(Transmission Business Group)

## SCHEDULE – 2

### SCHEDULE OF PAST EXPERIENCE AND QUALIFYING REQUIREMENT

Following is the list of earlier orders executed by us for supply of equipment / material of similar nature over the last past five years:

| S.No. | Item | Brief rating | Qty | customer | Date<br>of order | Date<br>of supply | Order<br>value |
|-------|------|--------------|-----|----------|------------------|-------------------|----------------|
|-------|------|--------------|-----|----------|------------------|-------------------|----------------|

Place \_\_\_\_\_ Signature of the authorized representative of Bidder

Date \_\_\_\_\_ Name-----

Designation-----

Company seal -----

Note: Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.

**Project** Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route

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**Rev 01**



**System** FIRE FIGHTING SYSTEM

**Owner** POWERGRID CORPORATION OF INDIA LTD.

**Purchaser** BHARAT HEAVY ELECTRICALS LTD  
(Transmission Business Group)

### SCHEDULE – 3

#### SCHEDULE OF PERFORMANCE CERTIFICATE

Bidder shall furnish the performance certificate of the similar equipment having The following details:

| S.No. | Item | Brief rating | Qty | Customer | Date of supply |
|-------|------|--------------|-----|----------|----------------|
|-------|------|--------------|-----|----------|----------------|

Place \_\_\_\_\_ Signature of the authorized representative of Bidder

Date \_\_\_\_\_ Name-----

Designation-----

Company seal -----

**Note:** Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.

**Project** Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route

TB-409-552-01  
Rev 01



**System** FIRE FIGHTING SYSTEM

**Owner** POWERGRID CORPORATION OF INDIA LTD.

**Purchaser** BHARAT HEAVY ELECTRICALS LTD  
(Transmission Business Group)

#### SCHEDULE-4

#### DETAILS OF CONTACT PERSON BOTH TECHNICAL AND COMMERCIAL

Name

Address for correspondence

Phone No.

Fax No.

Email

Place

Signature of the authorized representative of Bidder

Date

Name-----

Designation-----

Company seal -----

**Note:** Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.

**Project** Substation Package - SS02 for (i) 765kV Fatehgarh-2 (PG) S/S Extension and (ii) 765kV Bhadla-2 (PG) S/s Extension under Transmission System Associated With LTA applications from Rajasthan SEZ Part-B (Rajasthan SEZ Part-B Project) through Tariff Based Competitive Bidding (TBCB) Route

TB-409-552-01

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**System** FIRE FIGHTING SYSTEM

**Owner** POWERGRID CORPORATION OF INDIA LTD.

**Purchaser** BHARAT HEAVY ELECTRICALS LTD  
(Transmission Business Group)

## SCHEDULE -5

### ENCLOSURES TO SPECIFICATION

#### DRAWINGS

1. 765 kV LAYOUT PLAN AND SECTION FOR FATEHGARH SUB-STATION EXTN.  
*DRG. NO. TB-0-409-316-031-F*
2. OGA OF 80MVAR REACTOR  
*DRG. NO. 2BB-712-319-1Y*

EXISTING/FUTURE - NOT IN BHEL SCOPE

BHEL SCOPE

## STATION: FATEHGARH II EXTENSION

### 61) BILL OF EQUIPMENTS - 765KV:-

[illegible]

| S.NO | DESCRIPTION                                                                | BRNO.<br>QTY. (NO.) | SUPPLY<br>UNIT (NO.) | REV. AM<br>REV. (NO.) | SYMBOL | MAKER |
|------|----------------------------------------------------------------------------|---------------------|----------------------|-----------------------|--------|-------|
| 1.0  | 75KV CIRCUIT BREAKER WITH & WITHOUT CSO (3150A, 40KA 1 SEC. 3PH.)          | 2                   | 4                    | 4                     |        | ##    |
| 2.0  | 75KV CIRCUIT BREAKER WITHOUT CR(3150A, 40KA 1 SEC. 3PH.)                   | 2                   | 4                    | 4                     |        | ##    |
| 3.0  | 3PHASE SWING JOCK (CSO) FOR 75KV CIRCUIT BREAKER (3150A, 40KA 1 SEC. 3PH.) | 2                   | 2                    | 0                     | *      | ##    |
| 4.0  | 3PHASE SWING JOCK (CSO) FOR 75KV CIRCUIT BREAKER (3150A, 40KA 1 SEC. 3PH.) | 2                   | 2                    | 0                     | *      | ##    |
| 5.0  | 75KV ISOLATOR WITH 1 PHASE REACTOR SWITCHING                               | 1                   | 1                    | 1                     |        | ##    |
| 6.0  | 75KV ISOLATOR WITH 2 EARTH SWITCH (3-Ph), 3150A, 40KA 1 SEC                | 0                   | 2                    | 2                     |        | ##    |
| 7.0  | 75KV ISOLATOR WITH 2 EARTH SWITCH (3-Ph), 3150A, 40KA 1 SEC                | 4                   | 8                    | 8                     |        | ##    |
| 8.0  | 75KV ISOLATOR WITH ONE EARTH SWITCH (1-Ph), 2000A, 40KA 1 SEC              | 6                   | 6                    | 7                     |        | ##    |
| 9.0  | 75KV ISOLATOR WITHOUT EARTH SWITCH (1-Ph), 2000A, 40KA 1 SEC               | 12                  | 12                   | 11                    |        | ##    |
| 10.0 | 75KV CURRENT TRANSFORMER 3000A, 40KA 1 SEC. 1-Ph.                          | 6                   | 12                   | 12                    |        | ##    |
| 11.0 | 75KV CAPACITIVE VOLTAGE TRANSFORMER 8800P, 1-Ph.                           | 6                   | 6                    | 6                     |        | BHEL  |
| 12.0 | 624KV SURGE ARRESTOR, CLASS V                                              | 12                  | 12                   | 12                    |        | ##    |
| 13.0 | 75KV, 1 PH LINE TRAP (3150A, 40KA 1 SEC. 1PH.)                             | 4                   | 4                    | 4                     |        | ##    |
| 14.0 | 800 KV, 1PH, BUS POST INSULATOR — 8KV                                      | 23                  | 23                   | 36                    |        | ##    |
| 15.0 | 800 KV, 1PH, GUY INSULATOR                                                 | 18                  | 18                   | ---                   |        | BHEL  |

BILL OF EQUIPMENTS - NGR RELATED:-

| LINE NO. | DESCRIPTION                                                  | QTY. AS QTY. AS PER S.D PER S.D | SYMBOL | MAKE |
|----------|--------------------------------------------------------------|---------------------------------|--------|------|
| 1.0      | 15KW CIRCUIT BREAKER (1-PH) FOR NGR BY-PASSING ARRANGEMENT   | 2                               | □      | ##   |
| 2.0      | 33KV NEUTRAL CURRENT TRANSFORMER FOR EACH 750VA REACTOR BANK | 2                               | ⊙      | ##   |
| 3.0      | 145 KV, 1PH. BUS POST INSULATOR — 6KN                        | 13                              | •      | ##   |

| SL NO | DESCRIPTION            | LEVEL FROM PAVEMENT | BAR CHARACTER                            | REINFORCEMENT SCHEDULE                             |
|-------|------------------------|---------------------|------------------------------------------|----------------------------------------------------|
| 1.    | ANCHORS                | UP 200 (MIN)        | Q40 AND BELL CONCRECTION WITH 10% CEMENT | DOUBLE TENDON 20 X 200<br>20% CEMENT<br>20% CEMENT |
| 2.    | GRAVELLY LAMPINGS      | -                   | Q40 AND BELL CONCRECTION WITH 10% CEMENT | 20% CEMENT<br>20% CEMENT                           |
| 3.    | CONCRETE INTERSECTIONS | UP 100 (MIN)        | Q40 AND BELL CONCRECTION WITH 10% CEMENT | 20% CEMENT<br>20% CEMENT                           |
| 4.    | EXPANSIVE              | UP 400 (MIN)        | Q40 AND BELL CONCRECTION WITH 10% CEMENT | 20% CEMENT<br>20% CEMENT                           |
| 5.    | ROAD AND SURFACE BAR   | UP 400 (MIN)        | Q40 AND BELL CONCRECTION WITH 10% CEMENT | 20% CEMENT<br>20% CEMENT                           |

| THE TECHNICAL PARAMETERS FOR WHICH THE SYSTEM IS DESIGNED ARE | 7500V           | 10000V          |
|---------------------------------------------------------------|-----------------|-----------------|
| SYSTEM OPERATING VOLTAGE                                      | 10000V          | 10000V          |
| IS MAX SYSTEM VOLTAGE 5000V                                   |                 |                 |
| LIGHTING SYSTEM VITAMINUS VOLTAGE CORT & WINDSHIELD           |                 |                 |
| SWITCHING IMPULSE VITAMINUS VOLTAGE CORT & WINDSHIELD         |                 |                 |
| SWITCHING FREQUENCY VITAMINUS VOLTAGE CORT & WINDSHIELD       |                 |                 |
| MAXIMUM CREEPAGE DISTANCE - FOR EQUIPMENT                     | 3000MM (3000MM) | 3000MM (3000MM) |
| MAXIMUM CREEPAGE DISTANCE - FOR INSULATOR SYSTEMS (3000MM)    |                 |                 |
| MAXIMUM FACTOR LEVEL                                          | 1000V/100V      | 1000V/100V      |
| MAXIMUM EXTENSION VOLTAGE                                     | 1000V           | 1000V           |
| SYSTEM NEUTRAL POINT                                          |                 |                 |
| SYSTEM FREQUENCY & NO. OF PHASE                               | 50Hz/3          | 50Hz/3          |

1. State the three essential and distinctive elements of the concept of a shell and give an example of each. (3 marks)
2. Explain the meaning of the term "waterproofing" and state the two main methods of waterproofing. (2 marks)
3. Explain the meaning of the term "waterproofing" and state the two main methods of waterproofing. (2 marks)
4. Explain the meaning of the term "waterproofing" and state the two main methods of waterproofing. (2 marks)
5. Explain the meaning of the term "waterproofing" and state the two main methods of waterproofing. (2 marks)
6. Explain the meaning of the term "waterproofing" and state the two main methods of waterproofing. (2 marks)
7. Explain the meaning of the term "waterproofing" and state the two main methods of waterproofing. (2 marks)
8. Explain the meaning of the term "waterproofing" and state the two main methods of waterproofing. (2 marks)
9. Explain the meaning of the term "waterproofing" and state the two main methods of waterproofing. (2 marks)
10. Explain the meaning of the term "waterproofing" and state the two main methods of waterproofing. (2 marks)

[illegible]



**765 HV LAYOUT PLAN AND SECTION**

DATE: 15/05/2019  
 DRAWN BY: SURESH  
 CHECKED BY: SURESH

**REVISIONS**

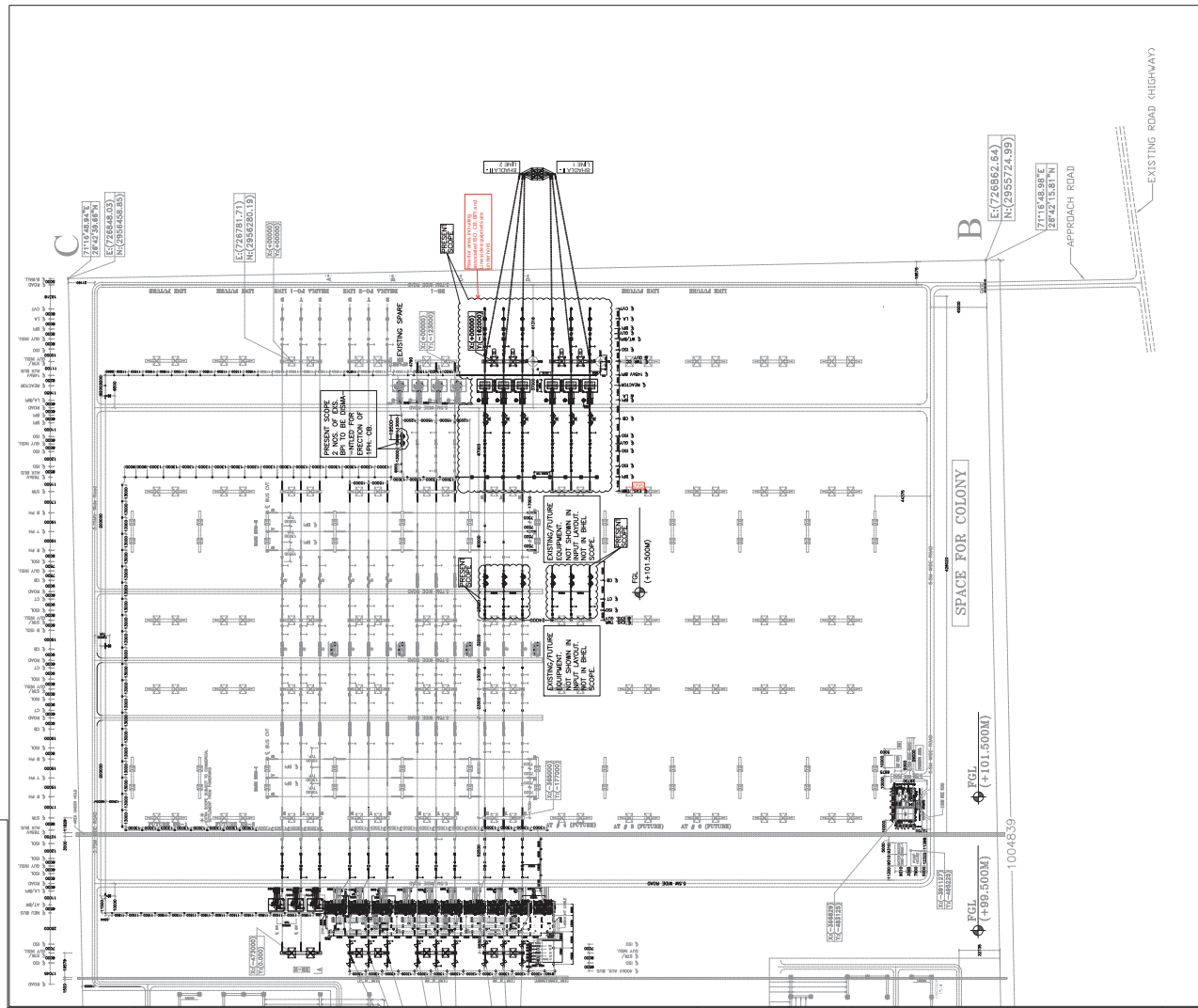
| NO. | REVISION               | DATE       |
|-----|------------------------|------------|
| 01  | ISSUED FOR MANUFACTURE | 15/05/2019 |

**COMPONENTS**

| QTY | DESCRIPTION                    | UNIT |
|-----|--------------------------------|------|
| 1   | 765 HV LAYOUT PLAN AND SECTION | NO.  |

**NOTES**

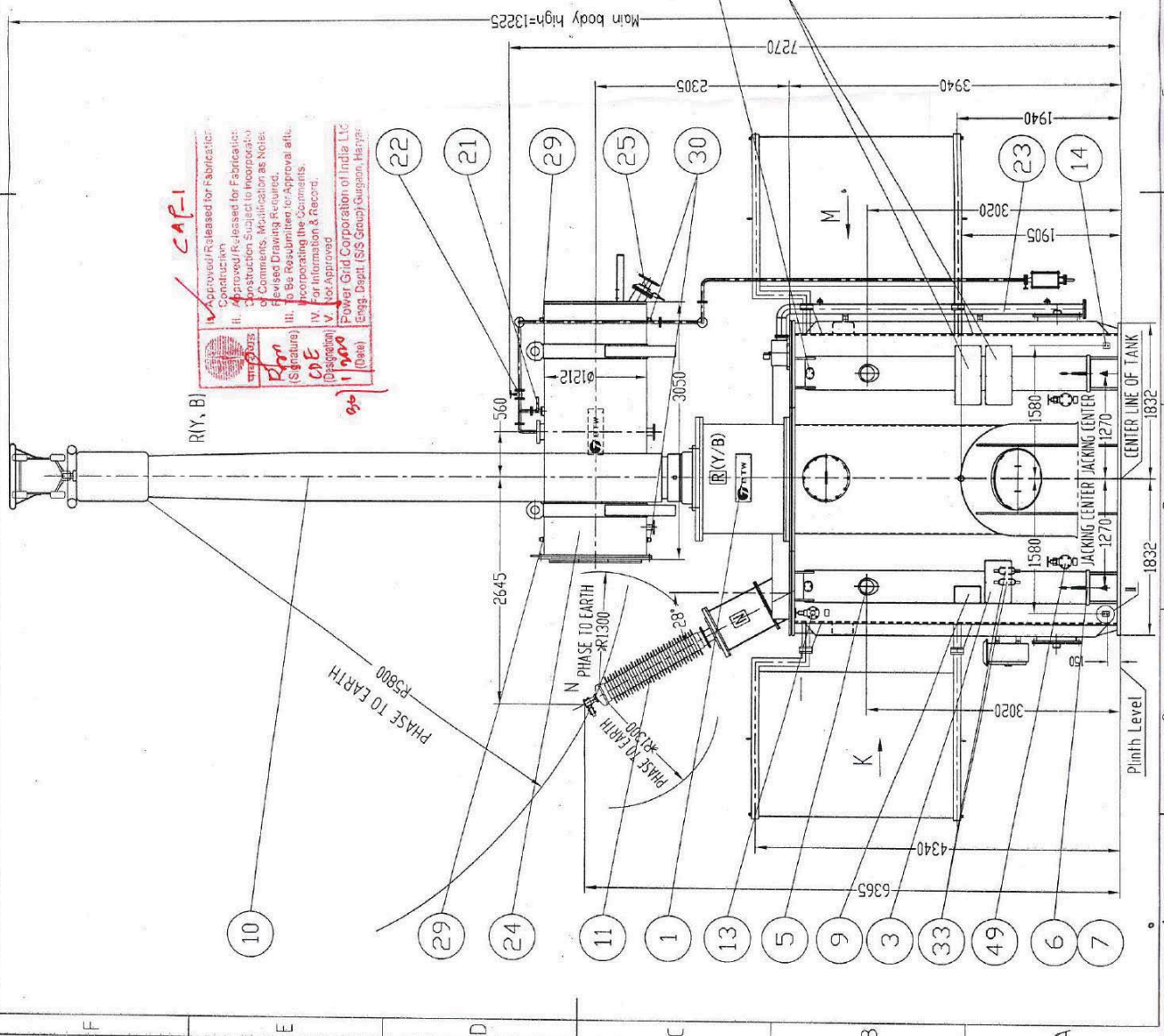
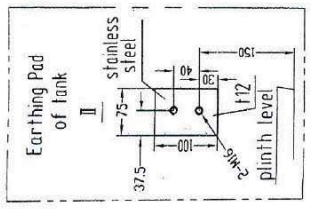
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. ALL DIMENSIONS ARE TO BE TAKEN FROM THE CENTER OF THE HOLE.
3. ALL DIMENSIONS ARE TO BE TAKEN FROM THE CENTER OF THE HOLE.
4. ALL DIMENSIONS ARE TO BE TAKEN FROM THE CENTER OF THE HOLE.



TECHINICAL SPECIFICATION

- 1. Tolerance on dimensions, weights, oil quantity is ±5%.
- 2. Reactor external Paint shade No. is RAL 7035. Colour shade of internal Paint is Glossy white and internal & external paint thickness as per specification.
- 3. All accessories will be provided in standard colour shade and as per standard painting procedure followed by accessories supplier.
- 4. Reactor tank is bolted type.
- 5. Roller are only for bringing reactor upto plinth level. After reaching at its location, roller will be removed & base plate will be welded/bolted directly on plinth.
- 6. Rail level shall be 25mm below the Plinth level.

| ITEM                                               | WEIGHT(kg) |
|----------------------------------------------------|------------|
| WEIGHT OF ACTIVE PARTS (CORE AND WINDING ASSEMBLY) | 61300      |
| TANK COVER                                         | 3100       |
| TANK AND FITTING                                   | 36800      |
| WEIGHT OF TOTAL OIL                                | 31100      |
| REACTOR WEIGHT FILLED WITH DRY AIR                 | 82400      |
| TOTAL WEIGHT                                       | 129200     |



Approved/Released for Fabrication/Construction

Approved/Released for Fabrication/Construction

Comments, Modification as per Revised Drawing Required, To Be Resubmitted for Approval after Incorporating the Comments.

For Information & Record

Power Grid Corporation of India Ltd.

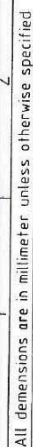
Engg. Dept. ISS Group/Gurgaon, Haryana

Signature: CAP-1

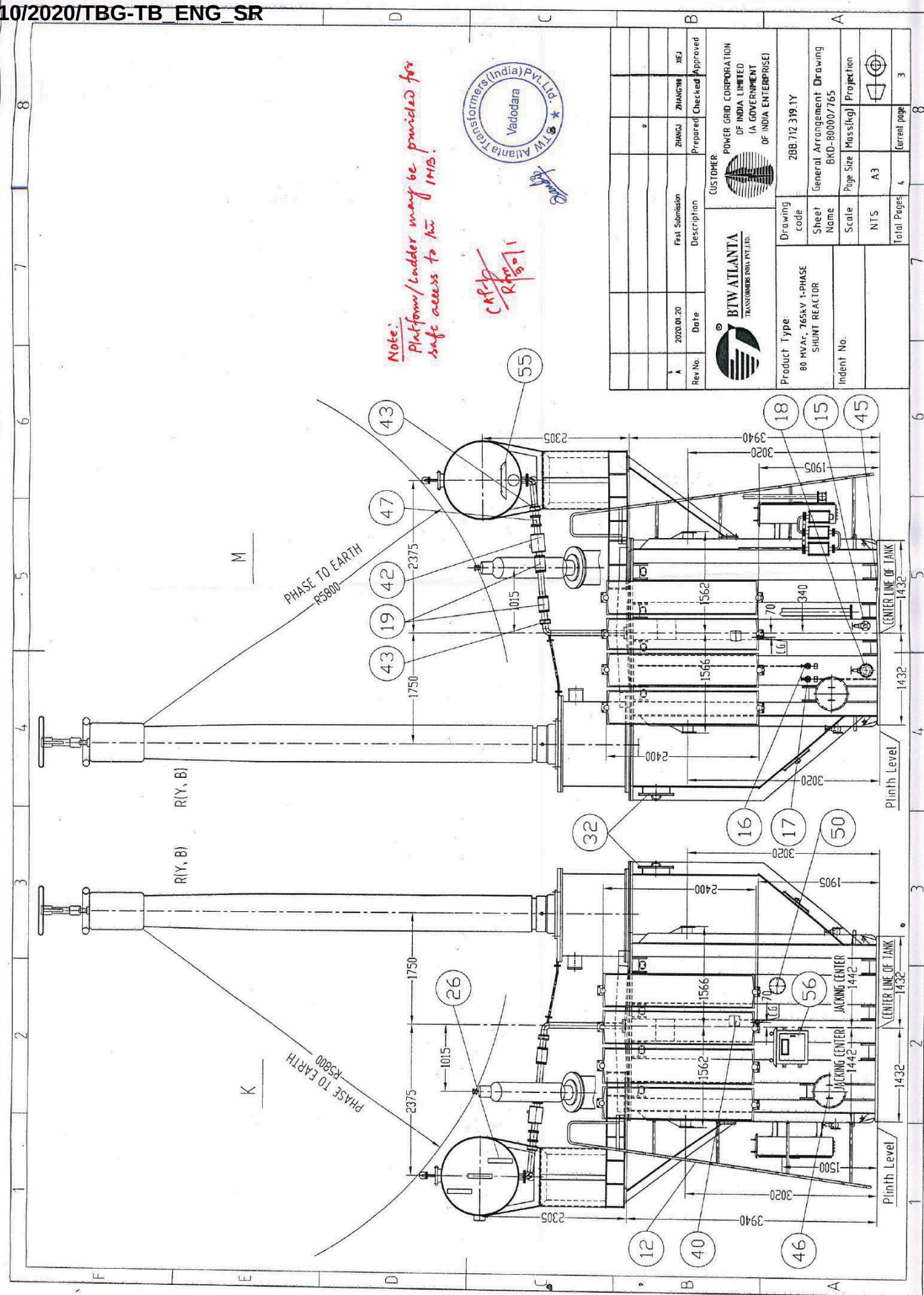
Date: 11/06/20

|              |   |            |      |                                                                            |          |         |          |
|--------------|---|------------|------|----------------------------------------------------------------------------|----------|---------|----------|
| Rev No.      | A | 2020.01.20 | Date | First Submission                                                           | Prepared | Checked | Approved |
|              |   |            |      |                                                                            | ZHANG    | ZHANG   | XUE      |
| CUSTOMER     |   |            |      | POWER GRID CORPORATION OF INDIA LIMITED (A GOVERNMENT OF INDIA ENTERPRISE) |          |         |          |
| Product Type |   |            |      | 80 MVA, 765kV 1-PHASE SHUNT REACTOR                                        |          |         |          |
| Drawing code |   |            |      | 28B.712.319.1Y                                                             |          |         |          |
| Sheet Name   |   |            |      | General Arrangement Drawing                                                |          |         |          |
| Scale        |   |            |      | BKD-80000/765                                                              |          |         |          |
| Indent No.   |   |            |      | Page Size Mass(kg) Projection                                              |          |         |          |
|              |   |            |      | NTS A3                                                                     |          |         |          |
| Total Pages  |   |            |      | 4                                                                          |          |         |          |
| Current page |   |            |      | 1                                                                          |          |         |          |

All dimensions are in millimeter unless otherwise specified



28010/2020/TBG-TB ENG SR



Note:  
Platform/ladder may be provided for  
safe access to the IMB.



CR-1  
R-10/1

| Rev No. | Date       | First Submission | Description | Prepared | Checked | Approved |
|---------|------------|------------------|-------------|----------|---------|----------|
| A       | 2020.01.20 |                  |             | ZHANG    | ZHANG   | XEJ      |

|                                                   |                                        |                                                                                                        |                     |
|---------------------------------------------------|----------------------------------------|--------------------------------------------------------------------------------------------------------|---------------------|
| <b>BTW ATLANTA</b><br>TRANSFORMER INDIA PVT. LTD. |                                        | <b>CUSTOMER</b><br>POWER GRID CORPORATION<br>OF INDIA LIMITED<br>(A GOVERNMENT<br>OF INDIA ENTERPRISE) |                     |
| Product Type                                      | 80 MVA, 765KV 1-PHASE<br>SHUNT REACTOR | Drawing code                                                                                           | 28B.712.319.1Y      |
| Sheet Name                                        | General Arrangement Drawing            | Scale                                                                                                  | BKD-80000/765       |
| Indent No.                                        |                                        | Page Size                                                                                              | Mass(kg) Projection |
|                                                   |                                        | NTS                                                                                                    | A3                  |
|                                                   |                                        | Total Pages                                                                                            | 4                   |
|                                                   |                                        | Current page                                                                                           | 3                   |

All dimensions are in millimeter unless otherwise specified

| Location |           | Item No. | Item Description                                                         | Qty.  | Make                   |
|----------|-----------|----------|--------------------------------------------------------------------------|-------|------------------------|
| F        | Fixed     | 25       | MOLG for conservator                                                     | 1     | Salini or equivalent   |
|          | Removable | 26       | Prismatic oil level gauge for conservator                                | 3     | YGYA or equivalent     |
| E        | Fixed     | 27       | Dehydrating Silicagel breather, D10-5 (3 is series)                      | 1     | YGYA or equivalent     |
|          | Removable | 28       | Oil filling & drain valve for conservator, 50NB, Gate type, G.M.         | 1     |                        |
| D        | Fixed     | 29       | Air release Plug for conservator, M16, Steel                             | 2     |                        |
|          | Removable | 30       | Drain plug for main conservator, M16, Steel                              | 2     |                        |
| C        | Fixed     | 31       | CT terminal box                                                          | 2     | Salini or equivalent   |
|          | Removable | 32       | Inspection cover for H.V. line bushing                                   | 2     |                        |
| B        | Fixed     | 33       | Gas collection device                                                    | 2     | VIAI or equivalent     |
|          | Removable | 34       | Marshalling box                                                          | 1     |                        |
| A        | Fixed     | 35       | Common marshalling box (only for 3 phase bank)                           | 1     |                        |
|          | Removable | 36       | Bath for OIL (1 for spare)                                               | 2     |                        |
| F        | Fixed     | 37       | Bath for WTI (1 for spare)                                               | 2     |                        |
|          | Removable | 38       | Bath for thermometer pocket (spare)                                      | 2     |                        |
| E        | Fixed     | 39       | Bath for RTD (2 for spare)                                               | 4     |                        |
|          | Removable | 40       | Impact recorder (returnable basis)                                       | 2     |                        |
| D        | Fixed     | 41       | Sudden pressure relay (ø25, 14PSI/s)                                     | 1     | VIAI or equivalent     |
|          | Removable | 42       | Shut-off Valve                                                           | 1     | CTR or equivalent      |
| C        | Fixed     | 43       | Buchholz isolation valve, 80NB, Butterfly type, C.I.                     | 2     | Pelson or equivalent   |
|          | Removable | 44       | Cable tray for reactor to MB, Galvanised Steel                           | 1 set |                        |
| B        | Fixed     | 45       | Plug for drain oil of tank bottom, M16, Steel                            | 1     |                        |
|          | Removable | 46       | Manhole                                                                  | 2     |                        |
| A        | Fixed     | 47       | Belows for main conservator pipe (ø80, L=200mm)                          | 1     |                        |
|          | Removable | 48       | Vacuum valve on tank cover, 50NB, Butterfly type, C.I.                   | 1     | Pelson or equivalent   |
| F        | Fixed     | 49       | Valve for UHF, 50NB, Gate type, G.M.                                     | 4     | G6 Valve or equivalent |
|          | Removable | 50       | Fiber Optical sensors feed through plate                                 | 1 set |                        |
| E        | Fixed     | 51       | Handhole on tank cover                                                   | 2     |                        |
|          | Removable | 52       | Isolation valve for insulating oil drying system, 50NB, Globe type, G.M. | 2     | G6 Valve or equivalent |
| D        | Fixed     | 53       | Isolation valve for online DGA, 25NB, Globe type, G.M.                   | 2     | G6 Valve or equivalent |
|          | Removable | 54       | Sand in tank stiffener                                                   | 1 set |                        |
| C        | Fixed     | 55       | Canopy for MOLG, PRD, SPR and Buchholz relay.                            | 1 set |                        |
|          | Removable | 56       | FIBER OPTIC BOX (EXCLUDING MEASURING UNIT)                               | 1 set |                        |

## NOTE

1. Make and model of sub-vendor items are subjected to "QA&I" POWERGRID approval.
2. Canopy shall be provided for Buchholz relay, PRD, SPR and MOLG.

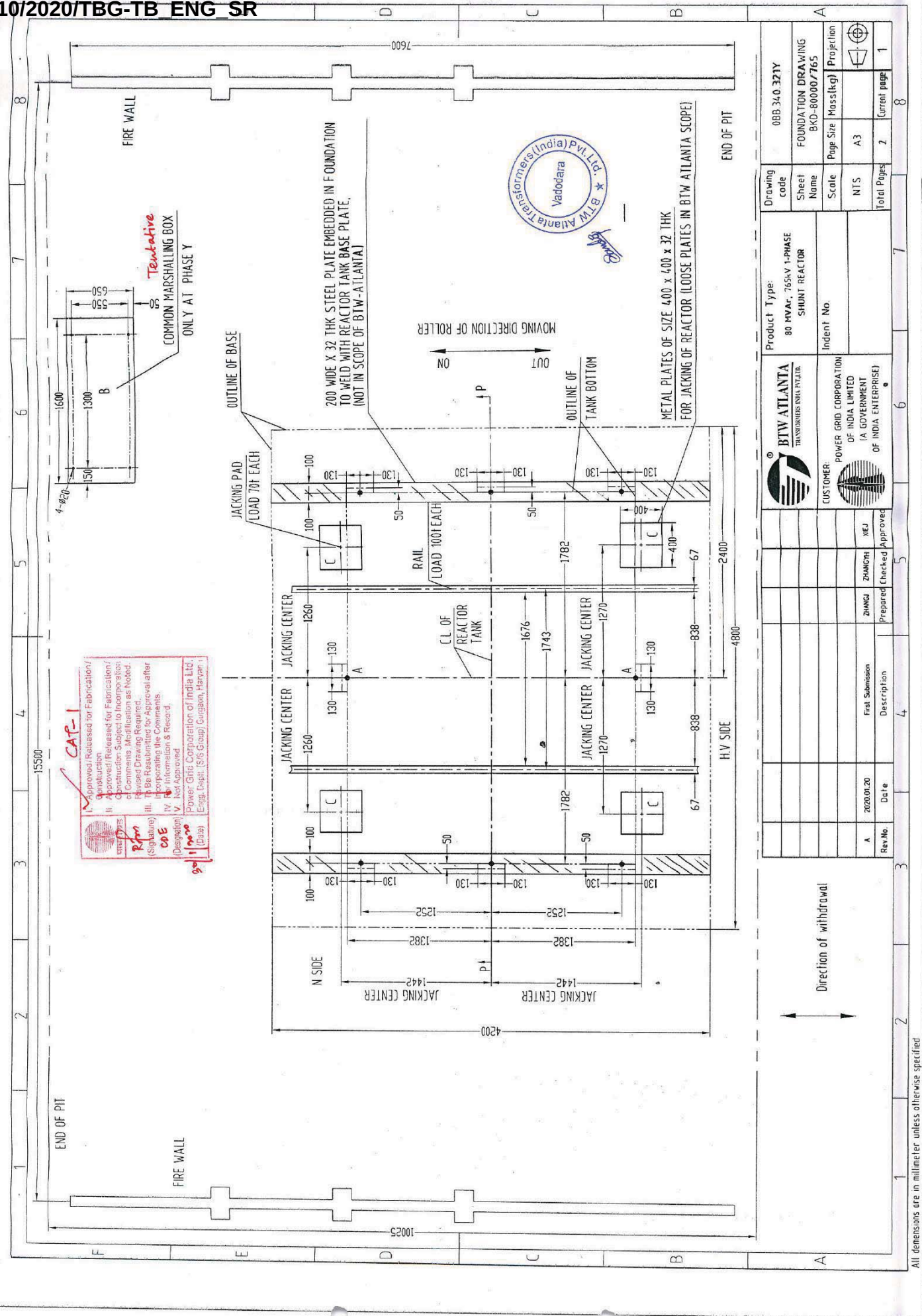
## List of Fittings

| Location | Item No.  | Item Description                                                                                 | Qty.  | Make                   |
|----------|-----------|--------------------------------------------------------------------------------------------------|-------|------------------------|
| F        | Fixed     | BTW ATALANTA monogram plate (tank + Conservator)                                                 | 2     |                        |
|          | Removable | Rafing and diagram plate (English+India)                                                         | 2     |                        |
| E        | Fixed     | Valve schedule plate                                                                             | 1     |                        |
|          | Removable | Pressure relief device with 150NB opening (shroud type, push & plug, Operating Pressure is 8PSI) | 2     | VIAI or equivalent     |
| D        | Fixed     | Lifting bollard, ø160, 50t                                                                       | 4     |                        |
|          | Removable | Jacking pad (thickness 40mm)                                                                     | 4     |                        |
| C        | Fixed     | Pulling eye (66t)                                                                                | 8     |                        |
|          | Removable | core and frame terminal box                                                                      | 1 set | Salini or equivalent   |
| B        | Fixed     | Oil level diagram plate for conservator                                                          | 1     |                        |
|          | Removable | HV bushing, 800kV/2500A                                                                          | 1     | CG POWER or equivalent |
| A        | Fixed     | H.V.N. BUSHING, 145kV 1250A                                                                      | 1     | YASHI or equivalent    |
|          | Removable | Detachable ladder with door for access to top of reactor                                         | 1     | G6 Valve or equivalent |
| F        | Fixed     | Top filter valve, 50NB, Gate type, G.M.                                                          | 1     | G6 Valve or equivalent |
|          | Removable | Earthing pad for main tank                                                                       | 2     |                        |
| E        | Fixed     | Bottom filter valve, 50NB, Gate type, G.M.                                                       | 1     | G6 Valve or equivalent |
|          | Removable | Upper sampling valve, 15NB, Globe type, G.M.                                                     | 2     | G6 Valve or equivalent |
| D        | Fixed     | Bottom sampling valve, 15NB, Globe type, G.M.                                                    | 2     | G6 Valve or equivalent |
|          | Removable | Drain valve, 100NB, Globe type, G.M.                                                             | 1     | G6 Valve or equivalent |
| C        | Fixed     | Buchholz relay for conservator (ø80)                                                             | 2     | VIAI or equivalent     |
|          | Removable | Radiator (PC2400 (1800) -36/570)                                                                 | 8     | TRIVENI or equivalent  |
| B        | Fixed     | Equalizing valve for vacuum between conservator and airtel, 25NB, Ball type                      | 1     | G6 Valve or equivalent |
|          | Removable | Isolation valve for conservator dehydrating breather, 25NB, Globe type, G.M.                     | 1     | G6 Valve or equivalent |
| A        | Fixed     | PRD drain pipe                                                                                   | 2     |                        |
|          | Removable | Aircell type conservator (ø1200X3000).                                                           | 1     |                        |

|                                                                                                                                                                                                                                                                 |            |                                |         |          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|--------------------------------|---------|----------|
| Rev No.                                                                                                                                                                                                                                                         | Date       | Prepared                       | Checked | Approved |
| A                                                                                                                                                                                                                                                               | 2020/07/20 | ZHANGJ                         | ZHANGJ  | XUEJ     |
| <div style="display: flex; justify-content: space-between;"> <div> <b>BTW ATLANTA</b><br/>TRANSFORMERS PVT. LTD.         </div> <div> <b>CUSTOMER:</b><br/>POWER GRID CORPORATION OF INDIA LIMITED<br/>(A GOVERNMENT OF INDIA ENTERPRISE)         </div> </div> |            |                                |         |          |
| Product Type:                                                                                                                                                                                                                                                   |            | 28B 712.319.1Y                 |         |          |
| 80 MVA, 765KV 1-PHASE SHUNT REACTOR                                                                                                                                                                                                                             |            | General Arrangement Drawing    |         |          |
| Indent No.                                                                                                                                                                                                                                                      |            | Page Size: BMD-80000/765       |         |          |
| Scale                                                                                                                                                                                                                                                           |            | Page Size: Mass(kg) Projection |         |          |
| NTS                                                                                                                                                                                                                                                             |            | A3                             |         |          |
| Total Pages                                                                                                                                                                                                                                                     |            | 4                              |         |          |
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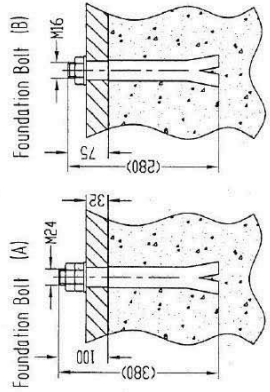
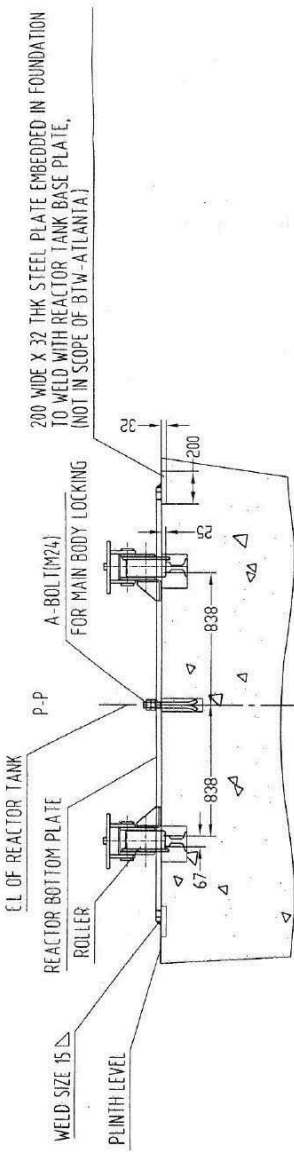
28010/2020/TBG-TB ENG\_SR



All dimensions are in millimeter unless otherwise specified

TECHNICAL REQUIREMENTS

- 1. REACTOR SHALL BE RESTED ON PLINTH DIRECTLY.
- 2. ROLLER SHALL BE USED FOR MOVEMENT ONLY.
- 3. ALL DIMENSIONS ARE IN mm;
- 4. TOTAL WEIGHT WITH OIL OF REACTOR: 129200kg
- 5. TOLERANCE OF THE FOUNDATION SURFACE IS  $\pm 15$ mm MAX.
- 6. TOP SURFACE OF BASE PLATE SHOULD BE IN THE SAME LEVEL WITH CONCRETE SURFACE.
- 7. THE ROLLER IS ONLY FOR INSTALLATION.
- 8. RAIL LEVEL SHALL BE 25mm BELOW THE PLINTH LEVEL.
- 9. FOUNDATION BOLTS ARE IN THE SCOPE OF BTW-ATLANTA



| TABLE FOR FOUNDATION PLAN |           |     |                               |
|---------------------------|-----------|-----|-------------------------------|
| IT. NO.                   | BOLT SIZE | QTY | DESCRIPTION                   |
| A                         | M24       | 2   | FIXING THE REACTOR MAIN BODY  |
| B                         | M16       | 4   | FIXING COMMON MARSHALLING BOX |
| C                         | --        | 4   | JACKING POINT                 |

| COMPO. PLATE SIZE (mmxmm) | LOAD (kg) |
|---------------------------|-----------|
| MIN 1600x650              | 600       |
| MIN 400x400               | 75000     |

Foundation Bolt Type: M24/100 JB/ZQ4763-2006

Foundation Bolt Type: M16/75 JB/ZQ4763-2006

Handwritten signature and date: 16/07/20



|              |  |                                      |  |                    |  |
|--------------|--|--------------------------------------|--|--------------------|--|
| Drawing code |  | Product Type:                        |  | Drawing            |  |
| Sheet Name   |  | 80 MVAR, 765KV 1-PHASE SHUNT REACTOR |  | code               |  |
| Scale        |  | Indent No.                           |  | FOUNDATION DRAWING |  |
| NTS          |  |                                      |  | BKD-80000/765      |  |
| Total Pages  |  |                                      |  | Page Size          |  |
| 2            |  |                                      |  | Mass(kg)           |  |
|              |  |                                      |  | Projection         |  |
|              |  |                                      |  | A3                 |  |
|              |  |                                      |  | Current page       |  |
|              |  |                                      |  | 2                  |  |

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