

CONTRACT NO.

**GUJARAT WATERSUPPLY & SEWERAGE BOARD**  
**GANDHINAGAR**  
**(A WHOLLY OWNED GOVERNMENT OF GUJARAT UNDERTAKING)**



**Bid documents for“Supply, Installation, Testing & Commissioning of VT Pump with associated Electro-Mechanical accessories at Aambaghata(Mumanvas) H/W Tal : Satalasana, Dist: Mehsana Under Augmantation Of Palanpur Rural RWSS-2026-27”**

**Estimated Cost: Rs.1,44,69,074.00**

**VOLUME – II A**  
**TECHNICAL SPECIFICATIONS**

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## **Brief Description of the Project**

The mechanical, electrical parts of the project covers design, engineering, manufacture, Supply, Installation, Testing & Commissioning of VT Pump with associated Electro-Mechanical accessories at Aambaghata(Mumanvas) H/W Tal : Danta, Dist: Banaskantha Under Augmentation Of Palanpur Rural RWSS-2026-27

## **Extent of Work**

The scope of this tender includes design, engineering, Supply, Installation, Testing & Commissioning of VT Pump with associated Electro-Mechanical accessories at Aambaghata(Mumanvas) H/W Tal :Satalasana , Dist:Mehsana Under Augmentation Of Palanpur Rural RWSS-2026-27

### **1 MECHANICAL WORKS**

- (a) Design & Supply of VT pump (Suitable stage) with minimum acceptable efficiency as specified along with squirrel cage induction motor( with minimum IE-3 efficiency class), working on three phase AC supply with 50 Hz  $\pm$  3%, 415 V (2Working) **for Ambaghata pumping section.**
- (b) **Valves**

**Butterfly Valve:** Providing and supplying ISI mark CI D/F Butterfly Valves as per IS:13095 (Latest Edition) of following class and diameter including all taxes, insurance, transportation, freight charges, octrol, inspection charges, loading, unloading, conveyance to departmental stores stacking etc complete.PN-2.5

**Sluice Valve:** Providing and supplying ISI mark CI D/F Sluice Valves as per IS:14846 (Latest Edition) of following class and diameter including all taxes,

insurance, transportation, freight charges, octrol, inspection charges, loading, unloading, conveyance to departmental stores stacking etc complete. PN-2.5

**DPCV:** Supply, installation, painting, testing & commissioning of non-slam, spring action, flanged Dual plate check valve confirming to API 594 & 598 PN 2.5 with C.I. body, spring steel spring, S.S. seating with all carbon steel hardware's and other accessories as per data sheet and specification.

- (c) **EXPANSION BELLOWS:** Supply, installation, testing and commissioning of flanged metallic S.S. expansion bellows confirming to EJMA standard with PN 2.5 rating & all necessary carbon steel hardware's as per data sheet. Single metallic Stainless-Steel corrugated Expansion Bellows and M S pipe work (individual discharge, common discharge header & by pass line) with specials.
- (d) **Electromagnetic Flow Meters (One Numbers) common discharge header line for Ambaghata pumping section**
- (e) **Pressure gauges** on individual pump discharge & common discharge header **and pressure transmitter on common discharge header line of each pumping section.**
- (g) Auxiliaries like horizontal mono submersible pump (drain pump) complete with all required accessories.
- (h) Installation, testing, pre commissioning checks & commissioning of the above equipment & accessories.
- (i) Submission of data sheets, QAP, GA drawing, cross section drawing, layout drawings of all equipment and to get final approval from Executive Engineer (Mechanical).

## 2 ELECTRICAL WORKS

- (a) ~~11 KV switchyard with two pole structure with all required accessories including gravel filling. Alternatively load break switch unit of adequate rating & capacity with all required fittings & accessories is also acceptable.~~
- (b) ~~Oil filled energy efficient power transformer 11 KV efficiency level 3 as per relevant governing standards with MS gate and chain link fencing including 01 standby of full capacity~~
- (c) H V (11 KV) VCB switchgear panel.
- (e) PMCC Panel with soft starter panel.
- (f) ~~Fixed capacitor banks for power factor improvement of 11 K V 250 K W motors.~~
- (g) LV PMCC panel with soft starter / LV Automatic power factor improvement panel and Lighting distribution board.
- (h) Grounding (earthing) system (Chemical type & funnel type) with accessories
- (i) Power (HV & LV) & control cables with jointing kits & accessories including cable carrier system.
- (j) General lighting arrangement with accessories.
- (k) Safety accessories with exhaust fans.
- (l) Installation, testing & commissioning of all above equipment & accessories.
- (m) Liaison with power utility i. e. UGVCL & other concerned department, carry out entire procedure for approval including preparation of electrical installation drawings and procuring NOC from Electrical Inspector before commissioning of equipment.



- (n) Submission of data sheets, QAPs, GA drawings, cross section drawings, layout drawings of all equipment and to get approval of same.
- (o) **All instruments like Electromagnetic Flow Meters, Pressure Gauge, Temperature Scanners, Pump Running Hour Meters (panel mounting type) etc. as specified in data sheets will have to be provided as per detailed specifications & governing standards without any additional costs.**

#### **4 CIVIL & MISCELLANEOUS WORKS**

- (a) Construction of cement concrete thrust blocks & supports for pipe work and valves.
- (b) Construction of drain chamber for drain pumps (if and as required).
- (c) Construction of pedestal (plate form) & fire wall for transformers, grouting blocks for DP structure & chain link fencing.
- (d) Construction of water tight cement concrete chambers of required depth & dimensions for installation of electromagnetic full bore flow meters. (if and as required).
- (f) Disassembling & dismantling of existing VT pumps with mechanical & electrical equipment, instruments & accessories including breaking of existing thrust blocks, transformer foundation, earthing chambers etc. including handling, stacking, temporary storage etc. as directed by the Engineer-in-charge.
- **Contractor must bid for Buy back values for items laying at various site in as it is condition before submitting the Bid. No claim regarding any damage/ missing component or depreciation of any items will be entitled to contractor. Contractors are advised to visit sites before submitting the Bid.**

**CONCEPTUAL DESIGN REPORT (Not applicable)**

The scope includes preparation of conceptual design report furnishing all details regarding design & engineering of Horizontal Split case Centrifugal pump (Single stage) set with sets with TEFC / CACA / CACW (TEAAC / TEWAC minimum acceptable efficiency as specified along with squirrel cage induction motor( with minimum IE-3 efficiency class), working on three phase AC supply with 50 Hz  $\pm$  3%, 415V for **Ambaghata** pumping station including all associated mechanical, electrical & instruments as per relevant & applicable governing standards & as per prevailing best engineering practices.

Duty parameters of VT pumps along with rating of prime mover including total quantities with working + standby configuration is specified in the table below. All associated & required electrical & mechanical equipment, accessories, instruments etc. of required capacities / ratings / sizes / quantities are deemed to have been included in the scope of the tender.

Sizes and ratings of all major equipment, components & accessories keeping in view the duty parameters i. e. Q (flow) & (H) head of pump set are given below. In case of any change in these parameters subsequently, all other dependent associated mechanical, electrical & instruments etc. will also change to suit the actual requirements. Any and all such required / desired changes / modifications / improvements shall have to be incorporated in CDR without any additional cost to the department. Claim either in the form of excess quantities or extra items on account of such changes (if any) shall not be admissible & shall not be entertained by the department under any circumstances.

All major items are specified below. All sub-assemblies, components & minor items like packing / jointing sheets - materials, fasteners, sundry items etc. are deemed to have been included in the scope of this turnkey project. Any item(s) not included or specified explicitly but is required to complete the project & give stated performance is deemed to have been included & shall fall within the scope of work without any additional cost to GWSSB.

CDR is to be designed assessing all particular requirements of raw water supply pumping system as per best prevailing practices and all relevant & applicable latest standards of all equipment & accessories (if applicable). The same shall be submitted to the department for scrutiny, acceptance & approval to the designated Executive Engineer (Mechanical). Final approval shall be accorded by the Executive Engineer (Mechanical), the overall project execution in charge. EE (Mechanical) may suggest modifications, improvements & required changes which the agency shall incorporate in the CDR before getting final approval.

### Design / Selection Criteria for Ambaghata Pumping Station (PUMPING MACHINERY)

Sr. No.	Name of Pumping Station	Type of Pump	Water Demand MLD	Discharge in M <sup>3</sup> /Hr(LPS)	Head in Meters	Pumping Hours	Minimum Acceptable Pump Efficiency	Motor in KW (Minimum)	Number of Stages	RPM	No of Pumps (Working + Standby)
1	Ambaghata	VT	14.30	650.0 (90.42)	135	22	83	315 KW	3/4/5 (Single)	1000 /1500	2 Working

### Design / Selection Criteria for Ambaghata Pumping Station (ELECTRICAL & INSTRUMENTATIONSECTION)

Sr. No.	Name of Pumping Station	11 KV Switchyard with HV VCB Panel	Transformer (11 KV / 0.433 KV)	LV 415 V PMCC, APFC Panel/ LDB	Power, Control & Instrument Cables & Carrier System + Accessories	Chemical Earthing Protection; Ventilation + Lighting Systems + Safety Accessories	Temperature Measurement, Sound Level Meter, Vibration Measurement (All Portable Systems)	Instrumentation viz. Pressure Transmitters; EM Flow Meters, Pump Running Hour Meters
1	Ambaghata	Required as per specifications & data sheets	Main:500 KVA (1 W +1 SB)	300 KVAR APFC panel Required as per specifications & data sheets	Required as per specifications & data sheets	Required as per specifications & data sheets	Required as per specifications & data sheets	Required as per specifications & data sheets

**Note- Final decision regarding Number of stages provided by pump manufacturer will be taken by Engineer in charge of work and will be bound to the contractor.**

## **MECHANICAL SECTION**

### **VT PUMPING MACHINERY WITH 0.415 VTEFC/ CACA / CACW INDUCTION MOTORS**

<b>Sr. No.</b>	<b>Name of Pumping Station</b>	<b>Pumping Section</b>	<b>Type of Pump / Discharge Q / Head (H) / Minimum Acceptable Efficiency of Pump / Minimum Acceptable kW / Minimum Acceptable Efficiency of Motor</b>	<b>Quantity &amp; Configuration (Working + Standby)</b>	<b>Remarks</b>
1	<b>Ambaghata PS</b>	Ambaghata PS	Minimum Motor rating 315 KW, Capacity:650 m <sup>3</sup> /hr, Head:135 mtrs (2W), Minimum pump efficiency 83%, & 1000 / 1500 RPM	02 Sets Working	<b>Pumps with mechanical seal</b>

**Note:** Prime mover KW shown above is minimum required KW to operate the pump with above duty parameters. However, Contractor may supply higher rating Prime mover for the same duty parameters without any extra cost to GWSSB. Contractor is not entitled for any excess/extra payment against such supply.

### **VALVES, EXPANSION BELLOWS, PIPE MANIFOLD SYSTEM & SPECIALS**

Sluice valve on suction side; butterfly and dual plate check valve on individual delivery side; and butterfly, dual plate check valve and sluice valves are to be provided on common

discharge header as per relevant governing standards of minimum pressure nomenclature of **PN 2.5**

All valves (except those for by pass line on common discharge header pipes and butterfly valves on individual delivery line) shall be Manually operated.

Velocity to be considered for sizing of valves on suction side shall be less than 2 meters /second and for individual discharge it shall be less than 2.5 meters / second. For common discharge headers the same shall be around 1.0 meter / second.

Single metallic (Stainless Steel) corrugated expansion bellows of **PN 2.5** class on suction, delivery and common discharge header are to provided matching exactly the size of valves.

All valves and expansion bellows shall be double flanged with required flange drilling as per relevant governing standards.

Sluice valve on by pass pipe on common discharge header shall be provided which shall not be less than 25% of cumulative flow of working pumps.

Size of individual delivery and common discharge header pipes shall match with that of valves. MS pipes as per relevant governing standards are to be provided of required wall thickness.

All required flanges & specials shall be made from MS. Specials include concentric & eccentric reducers / enlargers, bends, flanges of required thickness etc.

Sr. No.	Name of Pumping Station	Pumping Section	Size & Type of Valves& EB on individual Suction, delivery& common	Remarks
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			<b>discharge header</b>	
1	<b>Ambaghata PS</b>	-----	<b>Suction:</b> 250 mm SV& EB  <b>Delivery:</b> 350 mm SV &DPCV& EB  <b>Common discharge header:</b> 600 mm SV& EB	All valves of <b>PN 2.5</b> All valves shall be Manually <b>operated.</b> Sluice Valve by pass line on common discharge header and Butterfly Valve on individual delivery line shall be <b>manually operated.</b>

## ELECTROMAGNETIC FLOW METER

Full bore electromagnetic flow meters **(one Numbers)(600 mm dia. NB) at common discharge header line for Ambaghata pumping section.**

These flow meters must be installed in water tight fully enclosed cement concrete chambers to be constructed of required depth & dimensions as per actual requirement.

Constant voltage stabilizer (CVT) has to be provided with each flow meter. Length of shielded cable shall be as per actual requirement and must be in single piece only.

## ELECTRICAL SECTION

### ~~11 K V SWITCHYARD & DISTRIBUTION TRANSFORMERS~~

~~At Kothasana 11 KV power supply is existing & is given by UGVCL i. e. power utility @ their two poles structure. This load, if required shall be augmented appropriately to suit the actual requirement. Two pole structure complete with accessories are to be provided as per requirement. Alternatively load break switch unit of required rating & size complete with required accessories can be used with prior approval of the Engineer in charge.~~

~~One working with one standby (of full capacity) oil filled power transformer 11 KV / 0.415 KV ONAN Dyn 11 as specified in the data sheet are to be provided as per relevant governing standards & CBIP manual. Minimum acceptable capacity of transformer is 500 kVA transformers are to be provided with with off circuit tap changer & all required accessories as per governing standards.~~

~~Suitable pedestals (RCC foundation) & Fire wall as recommended by original equipment manufacturer of transformers' or power utility (UGVCL) are to be constructed along with chain link fencing.~~

### **11 KV HV SWITCHGEAR & LV PMCC, APFC & LDB PANELS**

~~11 K V630, Amperes (26.3 KA for 3sec) vacuum circuit breaker type switchgear panel (01 incomer + 02 outgoing feeders) as per relevant governing standards is to be provided.~~



## GENERAL TECHNICAL CONDITIONS & REQUIREMENTS

### 1 SCOPE OF CONTRACT

- 1.1 This specification covers the design, engineering, manufacturing, testing at manufacturers' factory premises, delivery at site, unloading, handling and storage at site, complete erection, final checks, painting, testing and commissioning of **Vertical Turbine pump motor set of specified duty parameters & guaranteed efficiency of following MOC with specified capacity vertical solid shaft TEFC squirrel cage induction motor (with minimum IE-3 efficiency class), working on three phase AC supply with 50 Hz  $\pm$  3%, 415 V  $\pm$  10%, rated speed 1000 / 1500 RPM at Ambaghata pumping station with electrical & mechanical equipment, various auxiliaries & accessories** to be supplied under this contract and subsequent trial operational run of minimum 28 days to achieve a guaranteed performance coordinated with commercial conditions of the contract to the entire satisfaction of GWSSB.
- 1.2 Any item of work either supply and / or erection of materials / equipment which have not been specifically mentioned in the specifications but are necessary to complete the work for trouble free and efficient operation and guaranteed performance of the entire plant / system / equipment offered shall deemed to be included within the scope of this contract and shall be provided by contractor without any extra cost to the GWSSB. Entire mechanical, electrical & instrumentation systems & accessories, components are to be carried out on a turnkey basis.
- 1.3 The project information is indicated in the enclosed specification. **It is advisable that the bidder must visit the site and familiarize / apprise himself of all site conditions including assessment of existing conditions of the plant and machinery / equipment prior to preparing the bid.**

### 2 EQUIPMENT AND SERVICES TO BE INCLUDED BY CONTRACTOR UNDER THESE SPECIFICATIONS

- 2.1 Mechanical, electrical, instrumentation & system etc. works required at Ambaghata pumping station, **Taluka:Satalasana, District:Mehsana under Palanpur Rural RWSS.**
- 2.2 Pumping machinery at pumping station with all the accessories as per detailed specifications and data sheets, discharge MS pipe work including fittings is in to the vendor's scope as indicated by the GWSSB with necessary pipe support etc. shall be included in the offer.
- 2.3 Sluice Valves, butterfly valves, DPC Valves, expansion bellows etc. as per specifications. The individual delivery of each pump shall be provided with butterfly and DPC valves while discharge header pipes shall be provided with sluice, butterfly & DPCV valves, with velocity in delivery piping and valves not exceeding 2.5 m / sec, while velocity for suction shall be  $< 2.0$  m / sec and for common discharge header around 1.0 m / sec.
- 2.4 Pressure gauges of suitable range of Glycerine filled as per specifications with installation.

- 2.5 11 KV / 0.415 KV Distribution Transformers (including standby), 11 KV HV switchgear panel, 0.415 KV LV PMCC, LV APFC panels as per specifications & requirement.
- 2.6 Power (HV & LV), control & instrumentation cables Switch cable tray & accessories etc. as per specifications and requirement for the pumping stations.
- 2.7 Earthing and lightening protection system, lighting systems for all electric equipment within pumping station & buildings & plant area as per specifications and requirement.
- 2.8 L V electrical wiring with required cable & accessories etc.
- 2.9 All wiring (power & control) shall have to be done with new motor feeder panels along with required wiring with new equipment & accessories as defined in the scope of this tender.
- 2.10 The contractor shall take the responsibility for all the testing and inspections at manufacturers' works / premises to be conducted in manner as specified in this specification in the presence of designated third party inspection agency (TPI) & GWSSB's EIC or his representative. The inspection will be at the cost of contractor. Third party inspection shall also be carried out in the presence of the GWSSB's representative i.e. jointly. **Inspection charges shall be paid to designated third party inspection agency by the contractor & contractor shall bid accordingly.**
- 2.11 Transportation of all equipment packed in the specified way from the manufacturer's works to the project site inclusive of all intermediate handling.
- 2.12 Unloading of equipment from railway wagons / trucks at site handling and proper storing at site in the approved way under security.
- 2.13 Opening of package, checking, tallying, sorting out and inspection of equipment received at the site and lodging of insurance claims if any.
- 2.14 Taking delivery of equipment / materials from contractor's site stores, transportation to erection site. If erection is delayed arrange for proper storage of the equipment / material in approved ways.
- 2.15 Erection, inspection, testing, pre commissioning checks, commissioning, trial run of the equipment and complete plant at guaranteed performance.
- 2.16 Erection of pipe and valves including all necessary hot deep GI / SS bolts, nuts, sleeves, insert plate etc. to complete the pipe manifold system.
- 2.17 Furnishing all erection and commissioning supervision service. The contractor shall also arrange for maintenance & repairs (as required) of equipment during guarantee and commissioning period.
- 2.18 The contractor shall also arrange technical expert of equipment from proprietary suppliers' to site as and when felt necessary until the commissioning & trial run of the plant is completed.

- 2.19 The contractor must ascertain duty parameters of each pump set, especially required head of pump before submitting CDR and QAPs of pump for approval. Independent study of the pumping system @ pumping station is within the scope of this tender & the same shall invariably be carried out by the contractor to finalise the duty head in consultation with the Executive Engineer, Palanpur .In case of change in the motor rating (specified above & in price bid) on account of change in head etc. rating of the associated electrical equipment (s) viz. Transformer, PMCC, APFC& LDB panels & cables shall be upgraded / modified accordingly.
- 2.20 Initial filling of oil lubricants, grease etc. for the equipment.
- 2.21 Complete list of commissioning and maintenance spares parts for first 12 months trouble free operation and maintenance of the mechanical & electrical equipment with instrumentation systems.
- 2.22 Complete list of recommended spare parts for operation and special tools and tackles for erection and regular operation and maintenance of the mechanical and electrical equipment shall be furnished as per schedule of spare parts and accessories tools.
- 2.23 Required numbers of all relevant drawings, data and instruction manuals.
- 2.24 All ancillary work as per actual site requirement & price bid.
- 2.25 Regular routine maintenance, break down maintenance inclusive of cost of replacement spares & materials of pumping station by qualified technicians & electricians during 28 days of trial operation run from the date of commissioning.
- 2.26 Any item of work either supply and/or erection of material equipment which have not been specifically mentioned in the specification but is necessary to complete the work for trouble free and efficient operation and performance of the entire plant/system/equipment offered, shall deemed to be included within the scope of his contract and shall be provided by contract or without any extra cost to the GWSSB.

### **RESPONSIBILITY**

It is the intention of the GWSSB to achieve coordinate effect. The installation & erection of machinery is to be carried out in existing operational pump house/panel room at Ambaghata pumping station. However, note that pumping station testing and subsequent commissioning work is linked up with continuous water supply to the covered villages under the scheme. GWSSB no doubt will be doing its best to give shut down for required days appropriate to the requirement of proposed works. However, contractor is not entitled for any claim, escalation of whatsoever commissioning at a date later than the stipulated time. Necessary extension of time will be granted in case if it is established that the erection / testing / commissioning could not be achieved in

stipulated time on account of reasons beyond control of the contractor. This factor should be carefully noted as no claim what so ever nature will be entertained on an account of such situations.

### **GUARANTEE**

The contractor has to furnish guarantee for all the equipment supplied by him and complete pumping station for a period of at least 12 months from the date of handing over the head works to GWSSB.

### **DELIVERY**

The contractor has to furnish the BAR – Chart & PERT Chart for the pumping station and the same followed strictly so as to commence the pumping station as per the schedule.

### **COORDINATION BETWEEN DIFFERENT AGENCIES**

It is the responsibility of the contractor to co-ordinate with different agencies i.e. sub suppliers and vendors, civil contractor so as to commissioning the pumping station in scheduled time.

## **3.0 EQUIPMENT & SERVICE TO BE EXCLUDED FROM THIS SECTION**

3.1 Rising main beyond the battery point.

3.2 Construction of HV & LV Panel Rooms.

## **4.0 THIRD PARTY INSPECTION**

Inspection and testing of major Electrical, Mechanical & instrumentation control equipment such as HSCF/VT/SCF/MONO/Polder Pumps, LV Induction Motors, Electromagnetic Flow Meters, All Types of Valves, Transformer, HV switchgear panels, LV PMCC, LV APFC& LDB Panels, Expansion Bellows, EOT/HOT etc. shall be carried out by the designated third party inspection agency in the presence of GWSSB's EIC or his representative (i.e. jointly) at manufacturers' works / factory premises. QAPs along with manufacturers' cross-sectional drawings, characteristic curves (as applicable), material(s) of construction, bill of materials etc. for all items shall have to be submitted by the bidder & get them approved prior to their procurement invariably to the **Executive Engineer, P. H. Mechanical Division, Palanpur** for approval who will approve them as per technical specifications & requirements of the project in conformance with the governing standards. Only in case of any deviation from the approved technical specifications QAPs etc. shall be submitted to the Superintending Engineer, P. H. Mechanical Circle, Ahmadabad for acceptance & approval if required & if found acceptable. For all other items like MS pipes with specials, pressure gauge, drain pumps, power & control cables, cable tray, PC, portable measuring instruments etc. internal test / quality / calibration / guarantee - warranty certificates shall have to be furnished for review / acceptance.

**Contractors shall have to offer pump & motor for third party inspection @ pump manufacturers' premises jointly. However, all motors shall be subjected to routine tests and one each of different rating of motor for type test as per relevant standards @ motor manufacturer's works / premises jointly by the designated TPI & Engineer-in-charge. Such inspected & accepted motors shall be subsequently transported to pump manufacturer's works / premises for performance testing by the contractor. All pumps must be performance tested with Job (Original) motors. All pumps along with job motors shall be tested irrespective of quantities offered i. e. inspection of 100% quantity is mandatory.**

- 4.1 That the equipment installed complies with specification in all particulars and is of the correct rating for the duty and site conditions.
- 4.2 That all items operate efficiently and quietly to meet the specified requirements.
- 4.3 That all non-current carrying metal work is properly and safely grounded in accordance with the specifications.

The contractor shall provide all necessary instruments and labor for testing and shall make adequate records of test procedures and readings, shall repeat any tests requested by the GWSSB and shall provide test certificates signed by a properly authorized person such test certificates shall cover all works.

- 4.4 If tests fail to demonstrate the satisfactory nature of the installation or any part thereof then no claims for the extra cost of modifications, replacements, or retesting will be considered. GWSSB's decision as to what constitutes a satisfactory test shall be final. The above general requirements as to testing shall be read in conjunction with any particular requirements specified elsewhere.
- 5 GWSSB reserves right to ask for the corporate guarantee from any or all the bidder for the performance and overall completeness in accordance to GWSSB's requirements. Specifically, for in time completion of contractual works in accordance to the technical requirements in best workmanship manner.
- 5.1 GWSSB reserves the right to split the work / distribute the works among bidders.
- 5.2 GWSSB reserves the right to accept or reject the tenders with technical deviation, at the discretion of competent authority.

## **GENERAL SPECIFICATIONS FOR SUPPLY OF EQUIPMENTS**

### **1.0 GENERAL**

This part covers conditions pursuant to the contractor and will form an integral part of the contract. The following provisions shall supplement general conditions, detailed specification and requirements.

### **2.0 LIMIT OF CONTRACT**

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 specification, unless included in the list of exclusions. All similar standard components / parts of similar standard equipment provided shall be interchangeable with one another.

### **3.0 ENGINEERING DATA**

- 3.1 The contractor shall furnish complete engineering data of each sets of equipment such as name of manufacturer, the type of model of each principal item of equipment proposed to be furnished and erected in the annexure, standard catalogues design, the specification number and the name of the project. If the standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, noting, markings, and writing on the drawing shall be in English. All dimensions should be in metric units.
- 3.2 All manufactured fabrication works in connection with equipment prior to the approval of the drawing shall be at the contractor's risk. The contractor may make any changes in the design which are necessary to make any equipment conform to the provisions and intent of the contract and such changes will again be subject to the approval by the GWSSB. Approval given to the contractor's drawing or works by the GWSSB shall not relieve the contractor from any of the responsibility and liabilities under the contract.
- 3.3 Drawings shall include all installation and detailed piping drawings wherever applicable. All piping 100 milli metre and larger shall be routed in details and smaller pipe shall be shown schematically or by isometric drawings. All drawings shall be fully corrected to agree with actual "As Built" construction.

### **4.0 DESIGN IMPROVEMENTS**

- 4.1 GWSSB may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly.
- 4.2 If any such agreed upon change is such that it affects the price and schedule of completion, the party shall agree in writing as to the extent of any change in the price and / or schedule of completion before the contractor proceeds with the change. The following such agreement provision there of shall be deemed to have be enamended accordingly.
- 5.0 The following documents shall be sent by registered post to the GWSSB by contractor within 3days from the date of dispatch, to enable the GWSSB to make progressive payments to the contractor.

INVOICE (3copies)

PACKING LIST (3copies)

TEST CERTIFICATE (3copies)

- 5.1 The contractor shall prepare detailed packing list of all packages and containers, bundles & loose material forming each and every consignment dispatched to site. The contractor shall further be responsible for making all necessary arrangements or loading, unloading and other handling right from his work till the site and also till the equipment is erected, tested and commissioned. He shall be solely responsibility for proper storage and safe custody of all equipment.
- 5.2 All fine, rental, demurrages, warfare and other expenses incurred due to delayed clearance of the material or any other reason shall be to the account of the contractor.

## **6.0 PROTECTION TO PLANT**

- 6.1 All coated surface shall be protected against abrasions impact, dis colorations and any other damages. All exposed threaded portion shall be suitably protected with either a metallic or non-metallic protecting device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable device to protect them from damage. The parts which are likely to get rusted due to exposure to weather shall also be properly treated and protected in a suitable manner.

## **7.0 MATERIALS HANDLING AND STORAGE**

- 7.1 All the equipment furnished under the contract and arriving at the site shall be properly receive, unloaded transported and stored in the storage spaces by the contractor at his cost.
- 7.2 Contractor shall be responsible for examining all the dispatches and notify the GWSSB immediately of any damage, shortage discrepancy etc. for the purpose of the GWSSB in formation only. The contractor shall submit to the GWSSB every week are port detailing all the receipts

during the work. However, the contractor shall be solely responsible for any shortages or damage in transit, handling and / or in storage and erection of the equipment at the site.

- 7.3 The contractor shall maintain an accurate and exhaustive record detailing out the list of all equipment received by him for the purpose of erection and keep such record open for the inspection of the GWSSB at any time.
- 7.4 All equipment shall be handled very carefully to prevent any damage or loss. No bare wire ropes, string etc. shall be used for unloading and / or handling of the equipment. Stored equipment shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the store shall be moved to the actual location of the appropriate time so as to avoid damage of such equipment at site.
- 7.5 All electrical panels, control gears, motors and such other devices shall be properly dried by heating before they are installed and energized. Motor bearings, slip rings, commutator and other exposed parts shall be protected against moisture ingress and corrosion during storage and shall be periodically inspected. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion due to prolonged storage.
- All the electrical equipment, such as motors etc. shall be tested for insulation resistance at least once in three months from the date of receipt till the date of commissioning and record of such measured insulation values maintained by the contractor. Such records shall be kept open for inspection by the GWSSB.
- 7.6 The consumable and other supplies likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or deterioration in quality by storage.
- 7.7 All the materials stored in the open or dusty location must be covered with suitable water proof and flame proof covering material wherever applicable.
- 7.8 The contractor shall be responsible for making suitable indoor storage facilities to store all equipment which require indoor storage. Normally all the electrical equipment, such as motors, control gears, generators, exciters and consumable like electrodes, lubricants, etc shall be stored in the closed storage space. The GWSSB in addition may direct the contractor to move certain other materials which in GWSSB opinion will require indoor storage, to indoor storage areas which the contractor shall strictly comply with.

## **8.0 CONTRACTOR'S MATERIALS AT GWSSB SITE**

- 8.1 The contractor shall bring to site all equipment, component, parts, materials, including construction equipment, tools and tackles for the purpose of the work under intimation to the GWSSB. All such goods from the time of their being brought shall not on any account be removed



or taken away by the contractor or his sub-contractor without the written permission of the GWSSB. The contractor shall never the less be solely liable and responsible for any loss or destruction thereof and damage there to.

- 8.2 The GWSSB shall have the lien on such goods for any sum or sums which may at any time be due to owing to him by the contractor, under in respect of or by reasons of the contract. After giving a fifteen (15) days' notice in writing of his intention to do so, the owner shall be at liberty to sell and dispose of any such goods in such as he shall think fit including public auction or private treaty and to apply the proceeds in or towards the satisfactions of such or sums due as aforesaid.

After the completion of the works, the contractor shall remove from the site under the direction of the purchaser the materials such as construction equipment, erection tools, and tackle scaffolding etc. With the written permission of the GWSSB if the contractor fails to store or move such materials GWSSB to do so then the GWSSB shall have the liberty to dispose of such materials and credit the proceeds thereof to the account of the contractor.

## **9.0 FACILITIES TO BE PROVIDED BY THE GWSSB**

### **9.1 SPACE:**

The contractor shall advise GWSSB within fifteen (15) days from the date of acceptance of the letter of intent, about his exact requirements of space for carrying out electro-mechanical erection activities viz. storage area, pre-assembly and fabrication areas etc. The above requirement shall be reviewed by the GWSSB and as available will be given to the contractor. It will not be binding to owner GWSSB to spare the space if not available. In that case contractor shall have to make his own arrangements. The material once supplied shall have to be stored and preserved by agency up till the commissioning Agency may deploy the person to protect the materials supplied by agency at their own cost.

## **10.0 CONSTRUCTION MANAGERMENTS**

- 10.1 Time is the essence of the contract and the contractor shall be responsible for performance of his works in accordance with the specified construction schedule. If at any time the contractor is falling behind schedule, he shall make necessary action to make good for such delays by increasing his work force or by working over time or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such action in writing to the GWSSB satisfying that his action will compensate for the delay. The contractor shall not be allowed any extra compensation for such action.

**11.0 CONTRACTOR'S COOPERATION WITH THE GWSSB**

In case where the performance of the rection work by the contractor the operation of the system facilities of the GWSSB such erection work of the contract or shall be scheduled to be performed only in the manner stipulated by GWSSB and the same shall be acceptable at all times to the contractor. The GWSSB may important such restrictions on the facilities if provided to the contractor such as electricity, water etc. As the GWSSB may think fit in the interest of the itself and the contractor shall strictly adhere to such restrictions and cooper at e with the GWSSB it will be the responsibilities of the contractor to be provided all necessary temporary instrumentation and other measuring devices required during the start-up and operation of equipment systems which are erected by him. Before commissioning of any machine all old lubricants, greases etc. Shall be thoroughly removed, the part cleaned of all deleterious material and shall be freshly lubricated by sealed lubricants, of exact specifications.

**12.0 COOPERATION WITH OTHER CONTRACTORS (If Any) & FOR GWSSB**

The contractor shall agree to cooperate with the GWSSB other contractor and consultants of GWSSB and freely exchange with them such technical information and economical design features to avoid unnecessary duplication of efforts. The contractor shall attend design coordination meetings at his own cost whenever required.

**13.0 FIELD OFFICE RECORDS**

The contractor shall maintain at his site office up to date copies of all drawings, specifications and other contract documents and any other supplementary data complete with all the late s t revisions there to. The contractor shall also maintain in addition, the continuous records of all changes to the above contract documents, drawings, specifications, supplementary data etc. Affected at the field and on completion of his total assignment under the contract shall incorporate all such changes on the drawings and other engineering data to indicate as installed conditions of the equipment furnished and erected under the contract. Such drawing sand engineering data shall be submitted to the GWSSB in required number of the copies.

**14.0 DESIGN COORDINATION**

14.1 The contractor shall be responsible for the selection and design of appropriate equipment to provide the basic coordinated performance of the entire system. The design requirements are detailed out in technical specifications. The design of various components, sub-assemblies and assemblies shall be done in such a way that it facilitates easy field assembly and maintenance. All the relating components shall be so selected that the natural frequency of the compact unit is not critical at or close to the operating range of the unit.

**15.0 QUALITY ASSURANCE PROGRAMME**

To ensure that the equipment and services under scope of this contract whether manufactured or performed, within the contractor's work or at his sub contractor's premises or at the owner's site or at any other place of work are in strict accordance with the specifications. The contractor shall adopt suitable quality assurance programme for such activities at all points & such programme shall be outlined by the contractor and shall be finally accepted by the purchaser after discussions before the start of contract, and such agreed programmed shall form part of the contract.

**16.0 DEFECTS IN WORK OF OTHER CONTRACTOR (Not Applicable)**

- 16.1 The GWSSB shall be notified promptly by the contractor of any defects in the other contractor works (if any), the GWSSB shall determine the corrective measures if any required to rectify this situation after joint inspection work and such decision by the GWSSB shall be binding on the contractor.

**17.0 UNFORSEEN WORKING CONDITIONS**

- 17.1 The contractor shall confirm all his field operations to those works which can be performed without subjecting the equipment and materials to adverse effects, during inclement weather conditions, monsoon, storms etc. And during other unfavourable construction condition. No field activities shall be performed by the contractor under conditions which might adversely affect the quality and efficiency thereof, unless special precaution or measures are taken by the contractor in a proper and satisfactory manner in the performance of such works and with the concurrence of the purchaser. Such unfavourable construction conditions will in no way relieve the contractor of his responsibility to perform the works as per schedule.

**18.0 PROTECTIVE GUARDS**

- 18.1 Suitable guards shall be provided for protection of personnel on all exposed rotating and / or moving machine parts. All such guards with necessary spaces and accessories shall be designed for easy installation and removal for maintenance purposes.

**19.0 WELDING**

- 19.1 If the manufacture has special requirement relating to the welding procedures for welds at the terminals of the equipment to procedure procured by the owner separate specifications. The requirement shall be submitted to the GWSSB in advance of commencement of erection work.

**20.0 NOISE AND VIBRATIONS**

- 20.1 The equipment supplied and erection by the bidder will comply with best design and erection and its working shall be within permissible noise and vibration levels.

**21.0 EQUIPMENT BASES**

- 21.1 A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base unless otherwise agree by the GWSSB each base plate shall support the unit and its drive assembly shall be of an eat design with anchoring the units.

## **22.0 SHAFT ALIGNMENTS**

All the shafts of rotating equipment shall be properly aligned to these of the machine equipment to as perfect and accuracy as practicable. The equipment shall be free from excessive vibration so as to avoid overheating of bearing or other conditions which may tend to shorten the life of the equipment. All bearings shafts and other rotating parts shall be thoroughly cleaned and suitable lubricated before starting.

## **23.0 DOWELLING**

All the drive motors and other equipment shall suitable dowelled after alignment of shaft with tapered machine dowels as per direction of the GWSSB.

## **24.0 PAINTING**

All exposed metal parts of the equipment including piping, structures railings etc. Wherever applicable after installation unless otherwise specified shall be surface protected and shall be first painted with at least primer paint used, after thoroughly cleaning all such parts of all dirt, rust Axles greases, oil sand other foreign materials by wire brushing, scraping or sand blasting and the same being inspected and approved or sand blasting and the same being inspected approved by the board for painting. After wards the above parts shall be finished with two coats of alloyed resin machinery enamel paints. Quality of the finished paints shall be as per standards of IS or equivalent and shall be of the color as approved by the GWSSB.

## **25.0 COLOUR CODE FOR PIPE SERVICES**

- 25.1 All pipe services wherever applicable are to be painted accordance with the owner's standard color scheme by the contractor.

## **26.0 LUBRICATION**

Equipment shall be lubricated by system suitable for duty of the equipment Lubricant level indicators wherever provided shall be furnished and parked to indicate proper levels under both stand steel and operating conditions.

## **27.0 FIRST FILLING OF CONSUMABLES OIL AND LUBRICANTS**

All the first fill of consumables such as oils, lubricants and essential chemicals etc. which will be required to put the equipment covered under the scope of the specifications into successful trial operation. They shall be furnished by the contract or unless specifically excluded under the in these specification and documents.

**CHECKOUT CONTROL SYSTEMS**

After completion of wiring and cable furnished under separate specifications and laid as per the terms noted by the board the contractor shall check out the operation of all control system for the equipment furnished and installed under these specification and documents.

**28.0 EQUIPMENT PERFORMANCE GUARANTEE**

The performance guarantees of the equipment under the scope of the contract are detailed separately in the technical specifications. These guarantees shall supplement the general performance guarantee provisions covered under general terms and conditions.

**29.0 GUARANTEE**

In the event of any emergency where in the judgment of the Board delay would cause serious loss or damage, repairs or adjustments may be made by the GWSSB or a third party chosen by the GWSSB without notice to the contractor or by surety. In the event such action is taken by the purchaser the contractors will be notified promptly and he shall assist whenever possible in making the necessary corrections. This shall not extinguish the contractor's liability under the terms and conditions of the contractor.

The cost of any special or general overhaul rendered necessary during the maintenance period due to the defect in the plant or defective work carried out the contractor the same shall be borne by the contractor.

In case of these effective parts which are not repairable at site but are essential for the commercial operation of the equipment, the contractor and the GWSSB shall naturally agree to a programme of replacement or renewal which will minimize interruption to the maximum extent, in to operation of the equipment. At the end of guarantee period the contractor's liability except for the latest defects in respect of goods supplied by sub-contractor to the contractor where a longer guarantee (More than 12 months) is provided by sub - contractors, the owner shall be entitled to the benefit of such longer guarantee. Then provisions contained in this clause will not be applicable.

If the owner has not operated the equipment according to generally approved industrial practices and in accordance with the conditions of operation specified and in accordance the operating manuals, if any.

**30.0 PRE-COMMISSIONING TRIALS - TESTS START-UP**

On completion of erection of the equipment and before start up each item of the equipment shall be thoroughly cleaned and then inspected jointly by the GWSSB and the contractor for correctness

and completion of installation and acceptability for start-up, loading to initial pre-commissioning tests at site(s).

The list of pre-commissioning tests to be performed shall be as mutually agreed and include in the contractor's quality assurance programme. The contractors commissioning / start up board specifically identified as far as possible and the contractor shall be responsible for carrying out all pre-commissioning tests. On completion of inspection checking after pre-commissioning tests are satisfactorily over, the complete shall be placed on initial operation during which period the complete equipment shall be operated integral with sub systems and supporting equipment as complete plant.

### **32.0 TRIAL RUN & OPERATION**

The plant shall then be on trial operation during which period all necessary adjustments shall made while operating over the full load range enabling the plant to be made ready for performance and guarantee tests.

The duration of trial operation of the complete equipment should be **30 days or 660 Hrs.** (whichever occurs earlier) of initial operation or any other duration as may be agreed to between the contractors. The trial operation shall be considered successful provided that each item of equipment can operate continuously at the specified operating characteristics, for the period of trial operation.

For the period of trial operation, the time of operation with any load shall be counted. Minor interruptions not exceeding four (4) hours at a time caused during the continuous operation shall not affect the total during of trial operation.

However, if in the opinion of the, purchaser, the interruption is long, the operation shall be prolonged for the period if interruption. A trial report comprising of observations and recordings of various parameters to be measured in respect of the above trial operation shall be prepared by contractor. This report, besides recording the details of the observation during trial run shall also including the dates of starts and finish of the trial operation and shall be signed by there presentative of both the parties.

The report shall have sheets, recording all the details of interruptions occurred adjustment made and any minor repairs done during the trial operation, based on the observation necessary modification/repairs to the plant shall be carried out by the contractor to the full satisfaction of the GWSSB, to enable the latter on to accorded permission to carry out performance and guarantee tests on the plant.

### **33.0 PERFORMANCE AND GUARANTEE TEST**

- 32.1 The final test as to the performance and guarantees shall be conducted at site by the GWSSB. The contractor shall make the equipment ready for such tests and assist the GWSSB in conducting such tests free of cost, such test shall be commenced after the successful completion of trial operation.
- 32.2 These trends shall be binding on both the parties of the contract to determine compliance of the equipment with the performance guarantee.
- 32.3 The available instrumentation and control equipment will be used during such tests and the GWSSB will be calibrate, all such measuring equipment and devices as far as practicable. However, immeasurable parameters shall be taken into account in a reasonable manner by the GWSSB, for the requirement of these tests. The tests will be conducted for the specified duty and as near to the specified conditions as practicable. The GWSSB will apply proper correction in calculation to take into account condition, which should not correspond to the specified condition.
- 32.4 Any special equipment, tools tackles required for the successful completion of the performance and guarantee tests shall be provided by the contractor, free of cost.
- 32.5 The guaranteed performance figure of the equipment shall be provided by the contractor during these performance and guarantee cost should the results of these tests show any depressed from the guaranteed values, the contractor shall modify the equipment as required to enable them to meet the guarantees. In such case performance and guarantee tests shall be repeated one month, from the date of equipment is ready for re-tests and all cost for modification including labour material sand the cost of additional testing prove that the equipment meets the guarantees shall be borne by the contractor.
- 32.6 The specific tests to be conducted on equipment have been brought out in the technical specifications.
- 32.7 Performance and guarantee tests shall make allowance for instrumentation error as may be decided by the GWSSB.

### **33.0 REGISTRATION AND STATUTORY INSPECTION**

- 33.1 All registration and statutory inspection fees if any in respect of this work pursuant to this contract shall be to the account of the contractor. However, any registration statutory inspection fees lawfully payable under the provision of statutory laws and its amendments from time to time during erection in respect of the plant equipment ultimately to be owned by the owner shall be to account of the owner. Should any such inspection or registration need to be rearranged due to the fault of the contractor or his sub-contractor the additional fees for such inspection and /or registration shall be borne by the contractor.

**34.0 WORKS AND SAFETY REGULATION**

- 34.1 The contract or will notify the GWSSB of his intention to bring on the site any equipment or any container with liquid or gaseous fuel or other substance which may create hazard. The GWSSB shall have the right to prescribe the conditions for up keep of such hazardous equipment. Before the contract or connects any electrical appliances to any plug or socket belonging to the other contractor or owner he shall:

Satisfy the Engineer-in-charge of GWSSB that he appliance is in good working condition.

- (b) Inform the GWSSB of the maximum current rating voltage and phases power fact or the appliances.
  - (c) Obtain permission of the Board detailing the sockets to which the appliances may be connected.
- 34.2 The GWSSB shall not grant permission to connect until it is satisfied that
- (a)The appliance is in good condition and is fitted with suitable plug
  - (b)The appliance is fitted with a suitable cable having two earth conductors, one of which shall be an earthed metal sheet surrounding the cores.
- 34.3 No electrical cable in use by the contractor / GWSSB shall be disturbed without prior permission. No weight of any description will be placed on any such cable and no ladder or similar equipment will rest against or be attached to it, under which such equipment or container may be handled and used during the performance of the work and the contractor shall strictly adhere to such instruction. The GWSSB shall have the right to inspect any construction plant and to forbid its use if in its opinion it is unsafe. No claims due to such prohibition shall be entertained by the GWSSB.
- 34.4 Where it is necessary to provide and / or store petroleum products petroleum mixtures and explosives, the contractor shall be responsible for carrying out such provision and/ or storage in petroleum Act explosives Act1948 and petroleum inspector of Explosives of India.All such storage shall have prior approvals of the GWSSB in case any statutory authority the contractor shall be responsible for obtaining the same.

**35.0 ELECTRICAL SAFETY REGULATIONS**

- 35.1 In no circumstances shall the contractor interfere with fuse and electrical equipment belonging to the GWSSB or other contractors.
- 35.2 No work shall be carried out on any live equipment. The equipment shall be made safe by the GWSSB and a permit to work be issued before work is carried out.
- 35.3 The contractor shall employ the necessary number of qualified full-time electricians to maintain temporary electrical installation.



## **GENERAL REQUIREMENTS (ADDITIONAL)**

### **1. DRAWINGS**

- 1.1. The drawings as per tender specifications & requirements of the project are to be provided by the bidder as illustrative of the specifications.
- 1.2. All data and information furnished in the drawings by the bidder is to be given in completeness and accuracy thereof. The same shall be verified by the Engineer-In-Charge (EIC) for any errors or discrepancies thereof.

### **2. Drawings Furnished by the GWSSB**

- 2.1. **No drawings shall be furnished by the department.** Contractor shall visit the existing pump house to verify layout of all existing equipment & follow all instructions given by the EIC before commencing any work. Contractor shall inform the EIC in writing, within a day from the visit of existing facility, of the difficulty to execute any works or part thereof in compliance with existing layout and / or the written instructions received from the EIC. Failing to do this, he shall be liable to execute at his own cost the necessary alterations to any works resulting from these errors or omissions.
- 2.2. ~~The contractor will be furnished with 2 copies of any such drawings prepared by the EIC. The contractor will also be furnished with two copies of all instructions as may be issued by the EIC. One copy of all such drawings and instructions issued to the contractor shall be kept in his office at the site. No drawing or instruction shall be considered valid unless it has been signed by the EIC.~~

### **3. Drawing Sheet Format**

- 3.1. All drawings provided by the contractor shall be on standard size sheets, prepared on computer with Auto Cad 14 and shall show the following particulars in a title block located in the lower right hand corner, in addition to the name of contractor and equipment manufacturer, date, scale, drawing number, revision number (R0 for drawings submitted initially, R1, R2, etc. for drawings submitted subsequently) and title:

**Gujarat Water Supply & Sewerage Board / Name of Project: Ambaghata Pumping Station, Taluka: Satalasama, District: Mahesana under Palanpur Rural RWSS.**

A blank space of 90 mm x 100 mm shall be provided for the EIC's approval stamp and provision shall be made for details of revisions to be recorded.

- 3.2. All drawings submitted by the bidder / contractor shall use the English language and preferably SI units. All drawings shall be clearly and fully cross referenced to the other drawings as relevant.

**4. Tender / Contract Drawings**

4.1. Drawings submitted by the bidder shall show all the essential items of the plant offered together with sufficient details to enable the general arrangement of the Plant to be determined.

4.2. The outline dimensional drawings submitted by the contractor shall include the following in addition to overall dimensions:

Parameters of equipment

Load details

Support details

Foundation pocket details

4.3. The drawings to be provided by the Bidder / Contractor shall include the following, but shall not be limited to those listed

(\* Indicates the drawings/documents to be submitted)

<b>Sr. No.</b>	<b>Description</b>	<b>To be submitted with the Tender</b>	<b>To be submitted after the award of the Contract</b>
<b>Outline Dimensional Drawing</b>			
<b>1</b>	<b>Pumping Machinery (VT)</b>		*
<b>2</b>	<b>Induction motor with separate terminal box for</b>		*
<b>(a)</b>	<b>Line / Neutral side terminals with phase segregation</b>		*
<b>(b)</b>	<b>Resistance temperature detectors</b>		*
<b>Cross Sectional Drawing with Materials of Construction</b>			
<b>1</b>	<b>Pump</b>		*
<b>2</b>	<b>Motor for above</b>		*
<b>3</b>	<b>Pump Performance curves at rated RPMQ Vs. H, P &amp; NPSH</b>		*
<b>4</b>	<b>Q Vs. H curves super-imposed on system resistance curves</b>		*

5	Performance Test Records of 2 pumps (same as the offered model)		*
6	Pump ISO efficiency Curve		*
<b>Motor Curves</b>			
7	Starting Current Vs. time		*
8	Characteristics under cold and hot conditions		*

## 5. Submission and Approval of Drawings

- 5.1. The following shall be the procedure for submission and approval of drawings:
  - 5.1.1. The contractor shall submit 3 copies of the drawings to the GWSSB. All the drawings are to be signed by the contractor or his authorized representatives
  - 5.1.2. The EIC' representative will review the drawings and, if found fit for approval, the Employer will return 2 copies to the contractor duly approved.
  - 5.1.3. In case the drawings / documents are not fit for approval but worth for review, the EIC's representative will mark the comments on the drawings and return 2 copies to the contractor. In such case, the contractor shall resubmit the revised drawings within two weeks as per sub clause 5.1.1 above and the same shall be repeated till the drawings are finally approved as per sub clause 5.1.2 above.
  - 5.1.4. If the submitted drawings / documents are not worth for review, the contractor will be informed accordingly.
  - 5.1.5. On receipt of the approved drawings as per sub clause 5.1.2 above, the contractor shall submit floppy and documents to the employer.
  - 5.1.6. After tests on completion, the contractor shall submit, within 15 days of the conclusion of the tests, CDs of the "As Built Drawings" to the GWSSB.
- 5.2. When the drawings are received by the EIC's representative after revision by the contractor, he will only review the revision made and hence the contractor shall carefully identify all the revised details / dimensions and also describe the revisions in the revision block.
- 5.3. No drawings, with corrections made after taking the prints, will be accepted.
- 5.4. Approval of drawings by the Engineer shall not relieve the contractor of his responsibility in terms of the contract.

**6. Operation and Maintenance Manuals**

- 6.1. The operation and maintenance manuals shall be arranged to provide separate volumes for each principal section of the Works and they shall relate to as built conditions and shall include all necessary drawings and diagrams for a proper understanding of the works.
- 6.2. The operation and maintenance manual shall be approved in draft form initially prior to commencement of erection by the EIC's representative and shall cover all items of the Works. For this purpose, three draft copies shall be submitted to the EIC's representative. A mere collection of manufacturers' descriptive leaflets will not be acceptable in satisfaction of this clause. The operation and maintenance manual shall comprise both operating instructions and maintenance instructions.
- 6.3. The manuals shall include, but not be limited to the following information:
  - 6.3.1. Descriptive overview of the whole of the works.
  - 6.3.2. Descriptions of all systems installed, including mechanical, electrical, instrumentation, control systems with relevant design and operating parameters.
  - 6.3.3. Descriptions of all equipment supplied including manufacturer's leaflets, which shall be scheduled for easy reference.
  - 6.3.4. Schedules and manufacturer's catalogues for all equipment supplied, giving duties, electrical load, etc.
  - 6.3.5. Schedules of all equipment suppliers (and their local agents) including names, addresses, telephone & facsimile numbers and e-mail ID.
  - 6.3.6. Start up, operation and shut down instructions for all parts of the works. These shall include step by step directions on setting the plant to work listing all adjustments and settings necessary for the current functioning of the plant.
  - 6.3.7. Instructions on monitoring of plant performance and sample log sheets for each plant item, to be filled by operators on a routine basis.
  - 6.3.8. "Dos" and "Don'ts" in plant operation: Operator's attention shall be drawn to all operations considered to be dangerous to operators or likely to cause damage to the plant.
  - 6.3.9. Procedures to deal with breakdown and emergencies
  - 6.3.10. Safety requirements
  - 6.3.11. Checking, testing and replacement procedures to be carried out on all plant items on a daily weekly and monthly basis or at longer intervals to ensure trouble free operation. Full maintenance instructions for all equipment including planned maintenance schedules or charts giving daily, weekly, monthly, quarterly, half yearly, annual overhaul instructions together with

recommended lubricants and spares. These shall also include details of routine maintenance work that will be within the competence of the normal maintenance staff and notification of maintenance work that will have to be done by the manufacturer, his agent or other specialist operator.

- 6.3.12. Fault locations and remedy charts to facilitate tracing the cause of malfunctions or break down and correcting faults.
- 6.3.13. Complete list of recommended lubricants and lubrications charts.
- 6.3.14. A 'spares schedule' which shall consist of a complete list of item wise spares for all plant items with ordering references and part numbers.
- 6.3.15. A complete list of manufacturer's instructions for operation and maintenance of all bought out equipment. The list shall be tabulated in alphabetical order giving the name of supplier / manufacture, identification of the Plant item giving the model number and the literature provided including instruction leaflets and drawing numbers.
- 6.3.16. Step by step procedure for the dismantling, repair and re assembly of all items of equipment.
- 6.3.17. Part list and drawings or exploded diagrams for each item of plant with construction particulars, materials of construction, mating components, clearances and tolerances, maximum wear permitted before replacements are to be done etc.
- 6.3.18. Record drawings of all systems installed, including general arrangements, conduit and wiring trucking systems, wiring diagrams, control schematics and valve charts, etc., to a reduced scale.
- 6.4. The contractor shall furnish 3 copies of the Operation and Maintenance Manual for each station. Each volume shall be durable and permanently bound within a stiff binder of a design to be approved by the GWSSB. They shall permit the subsequent incorporation of revisions to be necessary during the defect liability period.

## **7. Protection and Packing for Transportation**

- 7.1. Before any plant is dispatched from manufacturer's works it shall be properly prepared and packed and the contractor shall give the GWSSB at least 14 days' notice that these preparations are to commence.
- 7.2. Prior to dispatch the plant shall be adequately protected by painting or by other approved means for the whole period of transit, storage and erection, against corrosion and incidental damage, including the effects of vermin, sunlight rain, high temperatures and humid atmospheres. The contractor shall be responsible for the plant being so packed and / or protected as to ensure that it reaches the Site intact and undamaged. The plant shall be packed

to withstand rough handling in transit and all packages shall be suitable for storage including possible delays in transit.

- 7.3. The contractor shall be deemed to have included in the schedule of prices for all materials and packing cases necessary for the safe package, conveyance and delivery and storage of the plant with all protective and preservation measures.
- 7.4. Cases containing rubber rings, bolts and other small items shall not normally weigh more than 50 kg gross per case. No one package or bundle shall contain items of plant intended for incorporation in more than one section of the works. All items of plant shall be clearly marked for identification against the packing list.
- 7.5. Eye bolts, lifting hooks and brackets shall be provided for lifting the boxes, crates and packages. Every crate or package shall contain a packing list in a waterproof envelope. A duplicate copy of the packing list shall be sent by post to the EIC's representative at site.
- 7.6. All crates, packages, etc. shall be clearly marked with a waterproof material to show the weight and where the slings should be attached, and shall also have an indelible identification mark relating them to the packing lists. Packing cases shall be nonreturnable. Contractor shall have to clear the site including packing material.
- 7.7. Electrical equipment shall be enclosed in sealed air tight package with hygroscopic material, before being placed in packing cases on shock absorbent materials and secured by means of battens.

## **8. Delivery, Unloading and Storing at Site**

- 8.1. The Contractor shall be responsible for checking all materials delivered to site and shall keep the EIC or his representative fully informed of the state of deliveries. The contractor shall carry out, at his cost, all instructions of EIC or his representative for proper unloading, preservation, maintenance, storage and security of materials delivered to site until he fulfils all his obligations under the contract.
- 8.2. The contractor shall erect and maintain on the Site any temporary storage facility as required and approved by the EIC. If built up shed or area is provided by the Employer depending upon availability, the contractor shall have to pay rent as finalised by the EIC.
- 8.3. Multiple handling and movement of materials during storage and retrieval shall be avoided.

**MATERIALS AND WORKMANSHIP****1. Introduction**

- 1.1. This part of the specification sets out the general standards of materials to be supplied and the workmanship required to be ensured by the contractor. All component parts of the Works shall, unless otherwise specified, comply with the provisions of this part or be subject to the approval of the Employer. Particular attention shall be paid to a neat, orderly and well-arranged installation carried out in a methodical competent manner.

**2. Reference Specifications and Standards**

- 2.1. Where reference is made in the Specification to a British Standard Specification (hereinafter abbreviated to 'BS') issued by the British Standards Institution of 2, Park street, London W.I., or to an Indian Standard Specification (I.S.) issued by the Bureau of Indian Standards, (earlier known as Indian Standard Institution), Mana Bhavan, 9 Bahadur shah Zafar Marg, New Delhi 110 002, or American Society for Testing and materials (ASTM) issued by ASTM 1916 Race Street, Philadelphia, P.A., 19103, U.S.A. or American National Standards Institute (ANSI) issued by ANSI 1430, Broadway, New York, N.Y., 10018, U.S.A. or Japanese Industrial Standards (JIS) issued by Japanese Standards Association, 4-1-24, Akasaka, Minato-Ku, Tokyo 107, Japan or to any other equivalent Standard it shall be to the latest revision of that Standard at the tender opening date.
- 2.2. The contractor may propose at no extra cost to the Employer, the use of any relevant authoritative internationally recognized Reference Standard.
- 2.3. All details, materials and equipment supplied and workmanship performed shall comply with the specified Standards. If bidder offers equipment to other Standards, the equipment / material should be equal or superior to those specified and full details of the difference shall be supplied.
- 2.4. In the event of conflict between this specification and the codes for equipment, provisions of this specification shall govern. Certain specifications issued by national or other widely recognised bodies are referred to in this specification. In referring to the Standard Specifications the following abbreviations are used:

IS	:	Indian Standard
ANSI	:	American National Standards Institute
API	:	American Petroleum Institute
ASME	:	American Society of Mechanical Engineers
ASTM	:	American Society of Testing and Materials

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AWS	:	American Welding Society
AWWA	:	American Water Works Association
ISO	:	International Organisation for Standardisation
DIN	:	Deutsche Institute fur Normungs
BS	:	British Standard
IEC	:	International Electro technical Commission
IEE	:	Institution of Electrical Engineers
IEEE	:	Institute of Electrical and Electronic Engineers
NEMA	:	National Electrical Manufacturers Association
AGMA	:	American Gear Manufacturer's Association

### **3. Materials General**

- 3.1. All materials incorporated in the works shall be the most suitable for the duty concerned and shall be new and of reputed make / approved quality, free from imperfections and selected for long life and minimum maintenance. Non-destructive tests, if called for in the Specification, shall be carried out. All submerged moving parts of the plant, or shafts and spindles or faces etc. in contact with them shall be of corrosion resistant materials. All parts in direct contact with various chemicals, shall be completely resistant to corrosion, or abrasion by these chemicals, and shall maintain their properties without aging due to the passages of time, exposure to light or any other cause.

### **4. Workmanship General**

- 4.1. Workmanship and general finish shall be firstclass quality and in accordance with best workshop practice.
- 4.2. All similar items of the plant and their component parts shall be completely interchangeable. Spare parts shall be manufactured from the same materials as the originals and shall fit all similar items. Machining fits on renewable parts shall be accurate and to specified tolerances so that replacements can be readily installed. All equipment shall operate without excessive vibration and with minimum noise. All revolving parts shall be truly balanced both statically and dynamically so that when running at normal speeds at any load up to the maximum there shall be no vibration due to lack of balance.
- 4.3. All parts which can be worn or damaged by dust shall be totally enclosed in dust proof housings. All materials incorporated in the works shall be the most suitable for the duty concerned, free from imperfections and selected for long life and minimum maintenance. All necessary accessories required for satisfactory and safe operation of the plant shall be supplied



by the contractor unless it is specifically excluded from his scope. Suitable provision by means of eyebolts or other means are to be provided to facilitate handling of all items that are too heavy or bulky for lifting and carrying by two men.

- 4.4. If, after installation, the operation or use of the materials or equipment furnished by the contractor proves to be unsatisfactory. The Employer shall have the right to operate or use such materials or equipment until correction of defects, errors or omissions, by repair or by partial or complete replacement, can be made without interfering with the plant operations. Except for any warranty provided for elsewhere in this contract or unless otherwise agreed upon in advance, the period of such operation or use, pending correction of defects, will not exceed 1 year.

## **5. Welding**

- 5.1. Welding shall comply with the latest revision of the BS 5135 Code.
- 5.2. Welders shall be qualified in accordance with the requirement of the appropriate section of BS 4871. The Engineer shall have the right to call for further qualification from time to time from any welder who in the opinion of the EIC does not produce weld in accordance with the qualification. Each welder shall be assigned a number and letter. Each welded end shall clearly be identified as to its welder marking the welder's code adjacent to the welds. A record chart shall be maintained for each welder showing the procedures, for which he has qualified, the date of such qualification, the type of defects produced and their frequency. The EIC shall disqualify the welder whose work require disproportionate quantum of repairs. All procedures where required shall be qualified as per BS EN 283-3.
- 5.3. Inspection and quality of surveillance shall not be limited to the examination of finished welds. The techniques employed shall be based on methods which are known to produce good results and which have been verified at Site by actual demonstration.
- 5.4. Haphazard striking of the electrodes for establishing an arc shall not be permitted. The arc shall be struck either on the joint or on a starting tag. The starting tag shall be of the same material or a material compatible with the base metal being welded. In case of any inadvertent strike on place other than the welding, the area affected shall be ground flushed and examined by liquid penetration method.
- 5.5. Generally, a stringer bead technique shall be used with a slight oscillation of necessary to avoid slag and to minimise the number of beads needed to fill exceed 3 times the wire diameter. Vertical welds shall be made in upward direction. For all pipes above 300 mm dia., welding

shall be done whenever possible, by 2 welders working simultaneously along both sides of the pipe.

- 5.6. The root pass shall have less than 1.5 mm internal reinforcement. Defects like icicles, burn through and excessive “such back” etc. shall be cause for rejection of welds.
- 5.7. Final welds shall be suitable for appropriate fabrication of the non-destructive examination of the weld. If grinding is necessary, the weld shall be blended into the parent metal without gouging or thinning of the parent metal in any way. Uneven and excessive grinding may be a cause for rejection. Fillet weld shall preferably be convex and free from undercutting and overlap at the toe of weld. Convexity and concavity shall not exceed 1.5 mm. The leg lengths shall not exceed the specified size by more than 1.5 mm.
- 5.8. All attachments such as lugs, brackets and other non-pressure parts shall also be done by qualified welders in accordance with the design details and materials specifications. Temporary attachments shall be removed in a manner that will not damage the parent metal. Areas of temporary attachments shall be dressed smooth and examined by ultrasonic or liquid penetration methods.
- 5.9. All tack welds shall be made using qualified procedure and welders, the number of size of tack welds shall be kept as small as to consist of adequate strength and joint alignments. All tack welds shall be examined visually for defects and if found defective shall be completely removed. As welding proceeds, tack welds shall be either removed completely or shall be properly prepared by grinding or filling their starting ends so that they may be satisfactorily incorporated in the welds. Unacceptable defects shall be removed by grinding machine or chipping or gouging. Flame gouging may be permitted provided gouged surfaces are ground at least by 1.0 mm below the deepest indentation.
- 5.10. All weld repairs shall be carried out using the approved welding procedures and welders. Re welded areas shall be re-examined by the methods specified for the original welds and repair procedures shall be duly qualified by the EIC’s representative.

## **6. Pre heating and Post heating Treatment**

- 6.1. Pre heating and post heating treatment shall conform to the relevant application codes. Preheating not exceeding 121<sup>0</sup> C for all carbon steel construction above 25 mm thickness would be mandatory. Such pre heating would be maintained during flame cutting, flame or arc gouging, welding and repairs and may be done by gas heating by gas torches / gas rings with neutral flame. The temperature shall be checked by temperature indicating crayons. However, such pre heating will not be necessary for welds less than 6 mm size. In large diameter pipe

fabricated out of plate materials, production control test plates in accordance with the BS 4870 Part 1 Table 6 to represent 30 % of the long seams and each welder's performance would be mandatory.

## **7. Electrodes**

- 7.1. All electrodes shall be stored in their original sealed containers under dry conditions. Electrodes shall remain identified until consumed. All electrodes shall be dried before use. Drying ovens shall be provided in work areas for drying purposes. Electrodes withdrawn from oven shall be promptly used and excess unused electrodes shall be promptly returned to oven.

## **8. Examination / NDT / Radiography**

- 8.1. The various stages of examination and types shall be as stipulated in the respective fabrication Codes. Radiographic examination shall be carried out as per provisions of BS 2600 or BS 2910. Ultrasonic tests where called for shall be carried out as per provisions of BS 3926, magnetic particle tests shall be carried out as per BS 6072. Liquid penetration tests shall be carried out as per BS 6443.

## **9. Stainless Steel Welding**

- 9.1. All welding consumables such as electrodes, filler weirs, argon gas for shielding and purging shall be of high quality and the proposed brand shall be furnished for approval of the EIC. Weld deposits shall have similar or higher physical properties and similar chemical composition to the members joined.
- 9.2. All electrodes shall be purchased in sealed containers only and stored in their packing intact. The packets opened shall be consumed as early as possible. The electrodes removed from the containers shall be kept in holding ovens at temperatures recommended by electrode manufacturer. Special care shall be taken in avoiding mixing of electrodes in the oven. The electrodes and filling wires shall be free from rust, oil, grease, earth and other foreign matter.
- 9.3. Argon gas with purity 99.5 % shall be used for shielding and purging. The purity of gas shall be certified by the gas manufacturers.
- 9.4. Non-destructive examination of the welds shall be carried out to ensure quality of weld.
- 9.5. The electric current for welding shall be direct current, straight polarity (electrode negative). The welding current shall be kept minimum possible to ensure minimum heat affected zone in the parent material. Other side of the weld joint shall be periodically flushed with argon gas.

**10. Castings**

- 10.1. Cast iron shall be of standard grey close-grained quality. The structure of the castings shall be homogeneous and free from non-metallic inclusions and other injurious defects. All surfaces of castings which are not machined shall be smooth and shall be carefully fettled to remove all foundry irregularities.
- 10.2. Minor defects in depth not exceeding 12.5 percent of total metal thickness and which will not ultimately affect the strength and serviceability of the casting may be repaired by approved welding techniques. The EIC shall be notified of large defects and no repair welding of such defects shall be carried out without prior approval of the EIC. If the removal of metal for repair should reduce the stress resisting cross section of the casting by more than 25 percent, or to such an extent that the computed stress in the remaining metal exceeds the allowable stress by more than 25 percent, then casting shall be rejected. Test coupons cast simultaneously with the main castings shall be identified to check physical, chemical analysis of casting. Major defects on casting are not acceptable. Castings repaired by welding for minor defects shall be stress relieved after such welding. Non-destructive tests as directed by the EIC will be required for any casting containing defects whose extent cannot otherwise be judged, or to determine where repair welds have been properly made.

**11. Forging**

- 11.1. All major stress bearing forging shall be made to standard specifications. Forging shall be subjected to magnetic particle testing or dye penetration test at the areas of fillets and change in section. The testing shall be conducted after rough machining (10 microns). Any defect which will not machine out during the final machining, will be gouged out fully, inspected by dye penetration or magnetic particle inspection to ensure that the defect is fully removed and repaired using an approved repair procedure. Any indication, which proves to penetrate deeper than 2.5 % of the finished thickness of the component, shall be reported to the EIC giving the details like location, length, width and depth. For the magnetic particle's inspection, the choice of wet or dry particles shall be at the Contractor's discretion.
- 11.2. All forging shall be demagnetised after test and shall be heat treated for the relief of residual stresses.

**12. Design Life**

- 12.1. The works as a whole shall be new, of sound workmanship, robustly designed for a long reliable operating life and shall be capable of 24 hours per day continuous operation for prolonged period in the climatic and working conditions prevailing at the Site, and with the

minimum of maintenance. Particular attention shall be given to temperature changes, the stability of paint finish for high temperatures, the rating of engines, electrical machinery, thermal overload services, cooling systems and the choice of lubricants for possible high and prolonged operating temperatures. The contractor shall be called upon to demonstrate this for any component part either by service records, or evidence of similar equipment already installed elsewhere or relevant type tests. Routine maintenance and repair shall as far as possible not requires the services of highly skilled personnel.

- 12.2. The plant shall be designed to provide easy access to and replacement of component parts which are subject to wear, without the need to replace whole units. No parts in contact with water shall have a life from new to replacement or repair of less than five years.
- 12.3. Design features shall include the protection of plant against damage caused by vermin, dirt, dust and dampness and to reduce risk of fire. Plant shall operate without undue vibration, and parts shall be designed to withstand the maximum stresses under the most severe condition of normal service. Materials shall have a high resistance to change in their properties due to the passage of time, exposure to light, temperature and any other cause which may have a detrimental effect upon the performance or life of the Works.
- 12.4. Plant located outside lockable areas / building shall have additional features to prevent unauthorized operation.

### **13. Lubrication**

- 13.1. A complete schedule of recommended oils and other lubricants shall be furnished by the contractor. The number of different types of lubricants shall be kept to a minimum. The schedule and the name of the supplier of the lubricants shall be submitted to the EIC.
- 13.2. Contractor shall indicate indigenously available equivalent lubricants with complete specification, to enable the GWSSB to arrange for regular supply.
- 13.3. Where lubrication is affected by means of grease, preference shall be given to a pressure system which does not require frequent adjustment or recharging. Frequent, for this purpose, means more than once in a month and grease systems having shorter periods between greasing should be avoided. Where necessary for accessibility grease nipples shall be placed at the end of the extension piping, and, when a number of such points can be grouped conveniently, the nipples shall be brought to a battery plate mounted in a convenient position. All grease nipples shall be of the same size and type for every part of the plant. Arrangements shall be provided to prevent bearings being overfilled with either grease or oil.

- 13.4. Where more than one type of special grease is required a grease gun for each special type shall be supplied and permanently labelled.
- 13.5. Oil containers shall be supplied complete with oil level indicators of the sight glass type, or where this is not practicable, with dipsticks. The indicators shall show the level at all temperatures likely to be experienced in service. The levels shall be clearly visible in the sight glass type from the normal access floor to the particular item of Plant and they shall be easily dismantled for cleaning. All sight glasses shall be firmly held and enclosed in metal protection in such manner that they cannot be accidentally dislodged.
- 13.6. All lubrication systems shall be designed so as not to cause a fire or pollution hazard and particular care shall be taken to prevent leakage of lubricants and to avoid leaking lubricants coming into contact with any electrical equipment, heated surfaces or any other potential source of fire.

#### **14. Name Plate**

- 14.1. Each item of the plant shall have permanently attached to it in a conspicuous position, a nameplate and rating plate. Upon these shall be engraved or stamped, the manufacturer's name, type and serial number of plants, details of the loading and duty at which the item of plant has been designed to operate, and such diagrams as may be required by the EIC. All indicating and operating devices shall have securely attached to them or marked upon them designations as to their function and proper manner of use.
- 14.2. Name plates, rating plates and labels shall be of a non-flame propagating material, either non hygroscopic or transparent plastic with engraved lettering of a contrasting colour. Fixing shall be by means of non-corrosive screws, drive rivets or adhesives shall not be used.
- 14.3. Warning labels shall be provided where necessary to warn of dangerous circumstances or substances. Inscriptions or graphic symbols shall be black on a yellow background.
- 14.4. Instruction labels shall be provided where safety procedures such as wearing of protective clothing are essential to protect personnel from hazardous or potentially hazardous conditions. These labels shall have inscriptions or graphic symbols in white on a blue background.

#### **15. Hardware, Nuts, Bolts, Studs and Washers**

- 15.1. Nuts, bolts, studs and washers for incorporation in the plant shall conform to the requirements of the appropriate standard. Nuts and bolts shall be of the best quality of specified grade, machined on the shank and under the head and nut

- 15.2. Fitted bolts shall be a light driving fit in the reamed holes they occupy, shall have the screwed portion of such a diameter that it will not be damaged in driving and shall be marked in a conspicuous position to ensure correct assembly at site.
- 15.3. Washers, locking devices and anti-vibration arrangements shall be provided where necessary. Jointing hardware for the entire Plant shall be provided with sufficient spares to cater for site losses.
- 15.4. Where bolts pass through structural members taper washers shall be fitted, where necessary, to ensure that no bending stress is caused in the bolt. Where there is a risk of corrosion, bolts, nuts and studs shall be designed so that the maximum stress does not exceed half the yield stress of the material under any conditions. All bolts, nuts and washers which are subject to frequent adjustment or removal in the course of maintenance and repair shall be made of nickel bearing stainless steel.
- 15.5. The contractor shall supply all holding down, alignment and levelling bolts complete with anchorages, nuts, washers and packing required to attach the plant to its foundations, and all bed plates, frames and other structural parts necessary to spread the loads transmitted by the plant to concrete foundations without exceeding the design stresses.

## **16. Allowance for Wastage**

- 16.1. The contractor shall supply reasonable excess quantities to cover wastage of those consumable which will be normally subject to waste during erection, commissioning and setting to Work.

## **17. Painting – General**

- 17.1. The contractor shall be responsible for the cleaning, preparation for painting, and priming or otherwise protecting, as specified, all parts of the plant at the place of manufacture prior to packing.
- 17.2. Parts may be cleaned but surface defects may not be filled in before testing at the manufacturer's works. Parts subject to hydraulic test shall be tested before any surface treatment. After test, all surfaces shall be thoroughly cleaned and dried out if necessary, by washing with an approved de watering fluid prior to surface treatment. Except where the specification provides to the contrary all painting materials shall be applied in strict accordance with the paint manufacturer's instructions.
- 17.3. All protective coatings shall be suitable for use in warm humid climates. All primers, under coats and finishes shall be applied by brush or airless spray, except where otherwise specified.

Consecutive coats shall be in distinct but appropriate shades. All paints shall be supplied from the store to the painters, ready for application, and addition of thinners or any other material shall be prohibited.

**18. Painting at Place of Manufacture**

- 18.1. Steel and cast-iron parts shall be sand blasted to near white cleaning before painting. Edges, sharp covers etc. shall be ground to a curve before sandblasting. A primer coat of a zinc rich epoxy resin-based coating with at least 75 microns dry film thickness is to be provided. In addition to the parts are to be provided with adequate number of coats of coal tar epoxy polyamine coating to a dry film thickness of 175 microns including primer coating.

**19. Painting at Sites**

- 19.1. Immediately on arrival at the site, all items of plant shall be examined for damage to the paint coat applied at the manufacturer's works, and any damaged portions shall be cleaned down to the bare metal, all rust removed, and the paint coat made good with similar paint.
- 19.2. After erection, such items which are not finish painted shall be done so and, items that have been finish painted at the manufacturer's works shall be touched up for any damaged paint work. For finish painting, two coats of synthetic enamel conforming to IS: 2932 shall be applied. Dry film thickness of each coat shall be at least 25 microns.
- 19.3. The dry paint film thickness shall be measured by Electrometer or other instruments approved by the GWSSB. In order to obtain the dry film thickness specified, the contractor shall ensure that the coverage rate given by the paint manufacturer will enable this thickness to be obtained. Strength of adhesion shall be measured with an adhesion tester and this value shall not be less than 10 kg/cm<sup>2</sup>. Painted fabricated steel work which is to be stored prior to erection shall be kept clear of the ground and shall be laid out or stacked in an orderly manner that will ensure that no water or dirt can accumulate on the surface. Suitable packing shall be laid between the stacked materials. Where cover is provided, it shall be ventilated.

**20. Noise and Vibration**

- 20.1. The Contractor shall provide a quiet installation. All items of plant and equipment shall be carefully chosen with a view to minimizing sound levels.
- 20.2. The Contractor shall provide and fix all material for the prevention of transmission of noise and vibration through the structure. Where appropriate all fans, A/C package unit, compressors and other motif plant shall be mounted on resilient mountings. All rotating plant shall be statically and dynamically balanced.



**21. Galvanising**

- 21.1. Wherever galvanising has been specified the hot dip process shall be used. The galvanised coating shall be of uniform thickness. Weight of zinc coatings for various applications shall not be less than those indicated below:

**1. Fabricated steel**

- |    |   |                      |
|----|---|----------------------|
| I  | Thickness less than 2 mm but not less than 1.2 mm | 340 Grams /Square mm |
| ii | Thickness 2 mm and above                          | 460 Grams /Square mm |

**Fasteners**

- |    |                        |                      |
|----|------------------------|----------------------|
| i  | Up to nominal size M10 | 270 Grams /Square mm |
| ii | Over M10               | 300 Grams /Square mm |

- 21.2. Galvanising shall be carried out after all drilling, punching, cutting, bending and welding operations have been carried out. Burrs shall be removed before galvanising. Any Site modification of galvanised parts should be covered well by zinc rich primer and aluminium paint.

**22. Support for Pipe work & Valves**

All necessary supports, saddles, slings, fixing bolts & foundation bolts shall be supplied to support the pipe work. Valve and other equipment mounted in the pipe work shall be supported independent of the pipes to which they connect.

**23. Dismantling Existing Pumping Machinery with Associated Accessories & Structures**

The existing pumping machinery & allied / associated mechanical – electrical equipment, accessories & auxiliaries are in proper working condition & functioning. Proposed works are being carried out to augment the pumping capacity by replacing existing machinery etc. However, the scheme has to remain fully functional (only exception will be, time taken during pre-decided shutdowns) during the execution of tendered items. The contractor has to take utmost care so as not to damage existing system so as to result in unwarranted interruption of water supply. Further timing for shutdown shall also be pre-decided in consultation with EIC & concerned civil wing of GWSSB. The contractor has to meticulously plan the execution of items during shutdown so as to adhere strictly to the time schedule, failing which stiff penalty shall be imposed as narrated in preamble to the price schedule of this tender in volume IV.

**24. Dismantling of Existing Pumping Machinery with Associated Accessories & Their Compulsory Buy-Back**

~~The existing pumping machinery & allied / associated mechanical — electrical equipment, accessories & auxiliaries etc. shall have to be removed from site of work & to be stored at departmental store as per instruction of engineer in charge.~~

**DETAILED & PARTICULAR TECHNICAL SPECIFICATIONS****PART I: MECHANICAL****Vertical Turbine Pump****1.0 Scope:**

This specification covers the design, performance, manufacturing, construction features, testing, delivery, installation and commissioning of vertical turbine pumps at designated pumping station.

**2.0 Codes & Standards**

The design, manufacturing, performance of vertical turbine pumps shall comply to all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall conform to IS: 1710 and IS: 11346 or its latest edition.

**3.0 Design Features**

3.1 The turbine pump shall be capable of developing the required total head at rated capacity for continuous operation.

3.2 Pumps of a particular category shall be identical and shall be suitable for parallel operation. Components of the identical pumps shall be interchangeable.

3.3 The head capacity curve shall be continuously rising towards shut off with the highest at shut off head which shall be minimum 115 % of the duty point head.

3.4 The impeller adjustment shall be such that, the impeller runs free in any installed condition despite extension of line shaft (caused by hydraulic down thrust), the weight of shafting and weight of impellers.

3.5 The rating of the motor for the pump shall be larger of the following:

a) The power input to the pump at duty point at a speed corresponding to the frequency of

48.5 Hz.MOTOR BKW	% OF PUMPING DESIGN POINT BKW
15 to 75 BKW	115 %
Above 75 BKW	110 %

b) Maximum power input while operating solo or in parallel within maximum and minimum system resistances corresponding to the speed at 50 Hz.

c) Rating of motor shall be suitable to cover load for entire operating range of pump model offered.

d) Minimum rating of motor shall not be less than that specified in the data sheet.

3.6 The pump shall be designed to handle river surface raw water having turbidity and suspended solids maximum up to 3000 PPM during flood time and in monsoon.

3.7 The velocity of vibration shall be limited to 4.5 mm / second at the thrust bearing. The noise level shall be limited to 85 DBA at a distance of 1.86 meters.

3.8 The pump shall be so selected that the bowl efficiency at the duty point without coating shall not be less than minimum bowl efficiency indicated in data sheet.

3.9 Pump shall give the guaranteed performance within the head range of +15 % to - 25 % of duty point head.

#### 4.0 Features of Construction

##### 4.1 General

4.1.1 Pumps shall be of vertical type complete with bowl, column assemblies, discharge elbow, suction strainer, bell mouth, base plate, motor stool, bearing housing etc.

4.1.2 The bowl assembly shall consist of rotating impellers which are housed in stationery bowls having guide vanes. The bowl shall also include the housing of the bottom pump shaft bearing.

4.1.3 The column assembly shall consist of the column pipe to convey the liquid handled from bowl assembly to shaft assemblies and discharge elbow.

4.1.4 The discharge elbow shall be above floor level.

##### 4.2 Bowls

4.2.1 The bowls shall be of 2% Ni Ci and free from blow holes and other detrimental defects. The surface shall be smooth.

4.2.2 The bowls shall be equipped with replaceable wearing rings. Liquid passage shall be smooth finished and the bowl shall contain bushes to serve as bearings for the impeller shaft.

### 4.3 Impeller

4.3.1 The impeller shall be of the mixed enclosed type and shall be properly balanced dynamically. The impeller shall be properly machined, with liquid passage hand finished with seal rings on their hubs. They shall be adjustable vertically by means of an adjusting nut in the head assembly.

4.3.2 Impeller shall be securely fastened to the impeller shaft with keys, taper bushings or locking nuts.

4.3.3 To avoid internal resonance the number of vanes on diffuser should not be equal to or be a multiple or number of vanes on impeller

### 4.4 Impeller shaft

4.4.1 The impeller shaft shall be made of stainless steel AISI 410 and having brinell hardness number not less than 230. Shaft sleeves shall have a surface finish between 0.75 microns or less. It shall be guided by bearings above and below each impeller. The butting faces of the shaft shall be machined square to the axis and the shaft ends shall be chamfered on the edges.

4.4.2 The shaft shall be straight within 0.125 mm for 3 meter lengths total dial indicator reading.

### 4.5 Line shaft

4.5.1 The size of the shaft shall be calculated on the basis of maximum combined shear stress. This shall not exceed 30 % of the elastic limit, in tension or 18 % of the ultimate tensile strength.

4.5.2 The design of the shaft shall also take into consideration the critical speed of the shaft which shall be at least 20 % lower or above the operating speed.

4.5.3 The shaft shall be furnished with interchangeable sections having a nominal length of 1.5 meter. The maximum permissible error in the axial alignment of the thread axis with the axis of the shaft shall be 0.05 mm in 150 mm.

### 4.6 Line shaft coupling

Couplings shall be designed with a safety factor of 1.5 times the shaft factor and shall have threads to tighten during pump operation. The outside diameter of the couplings shall be concentric with the bore and with a small transverse hole in the middle.

### 4.7 Line shaft bearings

Bearings shall be Thordon type with suitable material. Lubrication shall be by self / external water.

### 4.8 Column pipe

4.8.1 The standard lengths of column pipe shall be 1.5 meters. No part in the column pipe such as the flange outside diameter shall exceed the bowl outside diameter. The column pipe shall be welded flanged design.

4.8.2 The size of the column pipe shall be such that the friction loss will be limited to 0.5 M/10 M length at rated capacity.

4.8.3 Thickness of the column pipe shall be minimum as described in relevant sections of IS: 1239 Part I 1991 & IS: 3589 / 1991 without negative tolerance.

#### 4.9 Driver

Driver shall be coupled through flexible pin bush type coupling to the head shaft.

#### 5.0 Tests and Inspection

##### 5.1 Hydrostatic test

5.1.1 A standard hydrostatic test shall be conducted on all pump casing, discharge elbow and bowl assemblies at 1.5 time the maximum discharge pressure of the pump or twice the rated pressure, whichever is higher.

5.1.2 The hydrostatic test on the casing shall be conducted for a minimum duration of 30 minutes.

##### 5.2 Performance test

Performance test at rated speed corresponding to 50 Hz frequency shall be conducted at manufacturer's work in presence of consultant and / or purchaser's representatives or third party inspecting agency for all pumps. The test shall perform guaranteed efficiencies at duty point specified. No negative tolerance shall be accepted. All the performance tests shall be conducted according to relevant IS.

##### 5.2.1 Standard running test

A Bowl assembly shall be given running test over the full operating range, covering from free discharge with delivery valve fully open to the shut off head. The duration of tests shall be minimum one hour. A minimum of five readings shall be taken for plotting the performance Curves

B Tests shall be conducted with the actual liquid handle if feasible. If not the performance can be determined based on running test with cold water

5.3 Impeller shall be dynamically balanced at the operating speed.

5.4 Necessary test certificates of the above tests shall be furnished for the purchaser's approval

5.5 Welding

All welding and related operation shall be done as per code. Welders shall be qualified as per codes. All welding procedures shall be submitted for approval

#### 6.0 Drawings

6.1 The following drawings shall be submitted by the manufacturer.

6.1.1 Preliminary out line dimensional drawings showing details of pump, motor, civil foundation, clearances, minimum submergence etc.

6.1.2 Performance curves for capacity V/s head, efficiency, and kW requirement shall be furnished. The capacity range shall be zero flow to maximum flow.

6.1.3 Typical cross sectional drawings showing constructional details with the complete bill of material & relevant standards.

#### 7.0 Cost Loading

There shall not be any cost loading on grounds of efficiency. However pumps with efficiency lower than the minimum acceptable efficiency shall not be accepted. The manufacturer shall provide bowl efficiency & efficiency at delivery spout.

#### 7.0 Details & Requirements (DATA SHEET)

##### 1.0 PUMPING STATION DETAILS:

1.1	Pump Type	Vertical turbine pump
1.2	Number of pumps	As per price bid
1.3	Number of normally working pumps	As per price bid
1.4	Design capacity	As per price bid
1.5	Total head at design capacity	As per price bid
1.6	Total duration of operation	20 Hrs. Continuous
1.7	Speed Synchronous	1000 / 1500 nominal RPM
1.8	Submergence available	Minimum 1 meter from the impeller eye
1.9	Location	Sump Ambaghat Head work

##### 2.0 FEATURES OF CONSTRUCTION:

2.1	Type	Vertical turbine pump
2.2	Internal element	Mixed flow impeller for turbid water
2.3	Type of lubrication	self water lubricated
2.4	Type of coupling	Direct
2.5	Number of stages	as per mfg. design
2.6	Installation	Vertically directly on Sump
2.7	Application	Clear water Pumping

2.8	Column pipe diameter	350 mm / 1.5 meter each 5 nos.+1 Mtr total 6 Nos
2.9	Type of impeller	Closed design
2.10	Discharge level with respect to floor	surface discharge head
2.11	Prime mover	415 V, 50 Hz, A.C. solid shaft, squirrel cage TEFC as per data sheet of motor
3.0	LIQUID DATA:	
3.1	Liquid handled	Clear water
3.2	Specific gravity	1.0
3.3	Temperature	Ambient temp.
4.4	MATERIALS OF CONSTRUCTION:	
4.1	Base plate	MS IS: 2062
4.2	Discharge elbow	MS IS: 2062
4.3	Column pipe	ERW MS min. mm wall thickness
4.4	Suction bell	CI FG 260 IS:210 with 2% Ni
4.5	Impeller bowl	CI FG 260 IS:210 with 2% Ni
4.6	Impeller	CF8M
4.7	Impeller seal ring	CF8M
4.8	Line shaft	S.S. AISI 410
4.9	Impeller shaft	S.S. AISI 410
4.10	Head shaft	S.S. AISI 410
4.11	Shaft coupling	S.S. AISI 316
4.12	Line bearing	Thordon type
4.13	Suction strainer	S.S. AISI 304
4.14	Shaft sleeves	S.S. AISI 410
4.15	Stuffing box	CI IS 210 Grade FG 260
4.16	Gland	CI IS 210 Grade FG 260
4.17	Gland packing	Mechanical seal
4.18	Hardware in contact with water	Hot dip galvanised
4.19	companion flanges	MS
5.0	ACCESSORIES & SERVICES REQUIRED:	
5.1	Base plate	Yes
5.2	Foundation bolts	Yes
5.3	Suction strainer	Yes



5.4	companion flanges	Yes
5.5	Spares parts recommended	Yes
5.6	Maintenance tools	Yes
5.7	Startup / essential spares	Yes
6.0	TESTING:	
6.1	Hydrostatic test	
6.1.1	Bowl Assembly	Mfg. Test Certificate required
6.1.2	Pump casing	Mfg. Test Certificate required
6.1.3	Performance test	Yes, to be witnessed.
6.1.4	Standard running test	Yes, to be witnessed.
6.1.5	Static balancing test	Mfg. Test certificate required
6.1.6	Dynamic balancing test	Mfg. Test certificate required
6.1.7	Visual inspection check	Required

Note: Material testing certificates of all components shall be furnished at the time of inspection.

Documents: Following data & drawings are to be furnished after award of the contract.

- 1 Final overall dimensional drawings for the pump set. These shall show all the major parameters of the pump set.
- 2 Civil drawings, with the details of fixing, grouting, sealing, net weights, clearance and any other relevant data required for the design of civil structure.
- 3 Cross sectional drawings for pump with the complete bill of material and relevant standards.
- 4 Test certificates for materials and welding if specified.
- 5 Operation and maintenance manual in duplicate for each pump etc.
- 6 List of set of erection and commissioning tools such as pair of clamps for column pipes, spanner for tube tension plate, spanners for coupling bolts, line shafts, wrenches etc. per each pump set.

## 2.0 Induction Motor

### 2.1 Design Requirements

The motors shall generally conform to following IS and / or relevant equivalent internationally approved standards. Additionally the specific requirements mentioned in the following clauses shall also be met.

IS 325 (1996) Three phase induction motors

IS 900 (1992)	Code of practice for installation & maintenance of induction motors
IS 1231 (1974)	Dimensions of three phase foot mounted AC induction motors
IS 2223 (1983)	Dimensions of flange mounted AC induction motors
IS 4029 (1967)	Guide for testing three phase induction motors
IS 4691 (1985)	Degree of protection provided by enclosures for rotating electrical machinery
IS 4889 (1968)	Methods of determination of efficiency of rotating electrical machines
IS 6362 (1971)	Designation of methods of cooling for rotating electrical machines
IS 7538 (1975)	Three phase squirrel cage induction motors for centrifugal pumps for agricultural applications
IS 7816 (1975)	Guide for testing insulation resistance of rotating machines
IS 8789 (1978)	Value of performance characteristics for three phase induction motors.
IS 12065 (1987)	Permissible limits of noise levels for rotating electrical machines
IS 12075 (1986)	Mechanical vibration of rotating electrical machines, measurement, evaluation & limits of vibration severity

## 2.2 Performance and Characteristics

2.2.1 Motors shall be capable of giving rated output without reduction in the expected life span when operated continuously under the following supply conditions:

- a) Variation in supply voltage  $\pm 10\%$
- b) Variation in supply frequency  $+ 5\%$
- c) Combined voltage and frequency variation  $\pm 10\%$

2.2.2 Motors shall be suitable to pump in terms of dressing & the capacity with suitable starting method as specified.

2.2.3 The Power rating of the motor shall be the larger of the following:

- a) Reserve power margin as tabulated in table I (clause 3.5) of the power input to the pump at duty point at a speed corresponding to the frequency of 50 Hz.
- b) Maximum power input while operating solo or in parallel within maximum and minimum system resistances corresponding to the speed at 50 Hz.
- c) Rating of motor shall be suitable to cover load for entire operating range (preferred / recommended area of operation i. e.  $- 30\%$  to  $+ 20\%$  of design flow rate) of pump model offered with minimum rating of kW.

d) Rating of motor shall be suitable to cover load for entire operating range) of pump model offered with minimum rating of kW in case of pumps in parallel operation. In this case operating zone shall mean from shut off to run out position.

e) Minimum rating of motor shall not be less than prescribed rating in data sheet and minimum acceptable efficiency at full working load shall not be what is prescribed in the data sheet..

2.2.4 The type test of required rating (s) of motor (s) carried out by NABL approved lab / CPRI / ERDA are to be produced with QAP and / or at the time of inspection without fail.

### 2.3 Insulation

2.3.1 Any joints in the motor insulation such as at coil connections or between slot and winding sections, shall have strength equivalent to that of slot sections of the coil. The insulation shall be given tropical and fungicidal treatment for successful operation of the motor in hot, humid and tropical climate. The motors shall be provided with class F insulation with temperature rise limited to that of class B insulation.

2.3.2 Motors shall be given power house treatment. This comprises an additional treatment to the winding over and above the normal specified treatment. After the coils are placed in slots and all connections have been made, the entire motor assembly shall be impregnated by completely submerging in suitable insulating compound or varnish followed by proper baking. At least three such submersions and baking shall be applied to the assembly.

### 2.4 Constructional Features

2.4.1 The motor construction shall be suitable for easy disassembly and reassembly. The enclosure shall be sturdy and shall permit easy removal of any part of the motor for inspection and repair.

2.4.2 Motors weighing more than 25 kg shall be provided with eyebolts, lugs or other means to facilitate safe lifting.

2.4.3 The rotor bars shall not be insulated in the slot portion between the iron core laminations for squirrel cage motors.

2.4.4 In case of prime mover of VT pump vertically solid / hollow shaft oriented flange mounted design shall be required.

### 2.5 Terminal Box

2.5.1 Terminal boxes shall be of weather proof construction designed for outdoor service. To eliminate entry to dust and water, gaskets of neoprene or approved equivalent shall be provided at cover joints and between box and motor frame. It shall be suitable for bottom entry of cables. It shall be capable of being turned through 360 degrees in steps of 90 degrees.

The terminals shall be of the stud type with necessary plain washers, spring washers and check nuts. They shall be designed for the current carrying capacity and shall ensure ample phase to phase and phase to ground clearances. Suitable cable glands and cable lugs shall be supplied to match specified cables.

## 2.6 Accessories

2.6.1 Two independent earthing points shall be provided on opposite sides of the motor, for bolted connections. These earthing points shall be in addition to earthing stud provided in the terminal box.

## 2.7 Winding Design Criteria

2.7.1. Motors shall be suitable of starting and accelerating the load with the applicable method of starting, without exceeding acceptable winding temperatures, when the supply voltage is 85 % of the rated motor voltage.

2.7.2. The locked rotor current of the motor shall not exceed 600 % of full load current (subject to tolerance as per the applicable standard).

2.7.3. Motors shall be designed to withstand 120 % of rated speed for two minutes without any mechanical damage, in either direction of rotation.

2.7.4 Stator leads shall be brought to the terminal box as insulated cable through a suitable barrier and terminated in clamp type terminals.

## 2.8 Data sheet of Induction Motors

r. No.	Description	Unit	Particulars
a)	Application		Pump Motor
b)	Number of Units	Nos.	
c)	Type of motors		Squirrel Cage
d)	Supply System fault level	MVA	20
e)	Supply Neutral		Resistance earthed
	Rated Voltage	V	415

f)			
g)	No. of Phases and frequency		3 Phase, 50 Hz
h)	Type of duty / designation		Continuous / S1
i)	Method of Starting		Microprocessor Based Soft Starter
j)	Class of insulation		F
k)	Ambient reference temperature	deg. C	450
l)	Temperature rise by (i) Thermometer (ii) Winding resistance	deg. C deg. C	700 800
m)	Type of Cooling (IS:6362)		TEFC
n)	Degree of Protection		IP 54
o)	Terminations (i) Separate terminal box for line & neutral side		Phase segregated terminal box for Line side and neutral side
p)	Nominal speed	rpm	1500
q)	Minimum rating & full working efficiency	kW	<ul style="list-style-type: none"> <li>• Minimum 170 kW</li> <li>• Minimum acceptable efficiency as per manufacturer's standard</li> </ul>

## VALVES

### 1.1 GENERAL

- 1.1.1 Valves shall be as per internationally recognized standards. Flanges shall be machined on faces and edges to ISO 7005, IS 1538 / 6392 or BS 4504.
- 1.1.2 Valves shall be double flanged type and the face shall be parallel to each other and flange face should be at right angles to the valve centre line. Back side of valve flanges shall be machined or spot faced for proper seating of the head and nut.
- 1.1.3 Valve buried or installed in underground chamber, where access to a hand wheel would be impractical, shall be operated by means of extension spindle and / or keys.
- 1.1.4 All valves irrespective of size are to be operated by appropriate electric actuators only. Valves shall be suitable for frequent operation as well as operation after long periods of idleness in either open or closed position.
- 1.1.5 The valve stem, thrust washers, screws, nuts and all other components exposed to the water shall be of a corrosion resistant grade of stainless steel.
- 1.1.6 Valves shall be free from sharp projections.
- 1.1.7 Butterfly, non-return valves and non-rising spindle sluice valves size shall be provided with bypass arrangement. Butterfly shall have a gear mechanism operating arrangement with indicator to see the open close status.
- 1.1.8 Governing standards for butterfly, sluice, dual-plate check (non-return), reflux valves are tabulated below.

Sr. No.	Description	Standards
1	Sluice valves for water works purposes Class - I	IS: 14846 - 2000
2	Butterfly valve for water works purposes	IS:13095 - 1991 / BS 5155
3	Dual Plate Check Valve	API 594 / API 598

- 1.1.9 The tolerance on the valve dimensions shall be as per relevant standard / code but not exceeding the following;
- 1) Face to face  $\pm 3$  mm
  - 2) CD of flange  $\pm 3$  mm
  - 3) Bolt circle diameter  $\pm 2$  mm
  - 4) Thickness of flange  $\pm 2$  mm

Dimensional tolerance on casting shall be as indicated in IS:5519

1.1.10 for sluice valves located below floor, suitable floor stands for extension bonnets as required shall be provided. These shall be complete with proper extension stamps, valve stem coupling hand wheel above offer shall be minimum 600 mm.

**1.1.11 TESTING of all types of Valves**

1.11.1 All valves shall be tested, hydraulically as per relevant standards. Body test and test shall be carried out and check for water tightness.

1.11.2 Materials certificate physical & chemical analysis certificates of all components of all types of valves shall be furnished to GWSSB.

1.11.3 Certified hydraulic test report for all body casting shall be furnished to GWSSB.

**~~1.2 BUTTERFLY VALVE~~**

~~1.2.1 Resilient seated butterfly valve shall be as per IS-13095: 1991 / BS: 5155. Valve shall be suitable for mounting in any position.~~

~~1.2.2 The valve seat shall be of integrally cast or replaceable design. When the valve is fully closed, the seal shall seat firmly so as to prevent leakage. The seat surfaces shall be machined smooth to provide a long life for the seal.~~

~~1.2.3 All fasteners shall be set flush so as to offer the least resistance possible to the flow through the valve.~~

~~1.2.4 Valve shall be suitable for throttling purpose.~~

~~1.2.5 All valve, spindles and hand wheels shall be positioned to give good access for operational personnel.~~

~~1.2.6 Valve of diameter 400 mm and above shall be provided with enclosed gear arrangement for ease of operation. The operation gear shall be such that they can be opened and closed by one man against an unbalanced head 15% in excess of the maximum specified rating. Valve and any gearing shall be such as to permit manual operation in a reasonable time and not exceed a required rim pull of 400 N.~~

~~1.2.7 All hand wheels shall be arranged to turn in a clockwise direction to close the valve, the direction of rotation for opening and closing being indicated on the hand wheels.~~

~~1.2.8 Materials of construction for valve & various parts are specified in the data sheet.~~

### **1.3 SLUICE VALVES**

- 1.3.1 Sluice valve shall conform to IS: 14846 - 2000 relevant internationally recognised standards. Ends shall be flanged & drilled as per IS: 1538.
- 1.3.2 They shall be of non-rising spindle type. The valve shall be furnished with a bushing arrangement for replacement of packing without leakage. They shall also have renewable channel and shoe linings. The gap between the shoe and channel shall be limited to 1.5 mm.
- 1.3.3 The gate face rings shall be securely pegged over the full circumference.
- 1.3.4 Valve of 400 mm and above shall be provided with thrust bearing arrangement for ease of operation. Valve of diameter 400 mm and above shall be provided with enclosed spur gear arrangement for ease of operation. The operation gear of all valves shall be such that they can be opened and closed by one man against an unbalanced head 15 % in excess of the maximum specified rating. Valve and any gearing shall be such as to permit manual operation in a reasonable time and not exceed a required rim pull of 400 N.
- 1.3.5 All valves, spindles and hand wheels shall be positioned to give good access for operational personnel.
- 1.3.6 All hand wheels shall be arranged to turn in a clockwise direction to close the valve, the direction of rotation for opening and closing being indicated on the hand wheels.
- 1.3.7 Materials of construction for valve & various parts are specified in the data sheet.

### **1.4 DUAL PLATE CHECK VALVE**

- 1.4.1 The valve shall be suitable for mounting on a horizontal pipeline and flow direction shall be clearly embossed on the valve body.
- 1.4.2 Valves shall possess high speed closing characteristics and be designed for minimum slam condition when closing.
- 1.4.3 Dual plate check valves shall conform to API 594 and API 598. They shall have metal to metal sealing. The spring action shall optimize the equal closing rates of each plate especially when the friction coefficients are uneven due to one plate resting upon one another. The plates shall not drag on the seat while opening. The plates shall not vibrate under full or partial flow condition.
- 1.4.4 In case of the nozzle check valve, the disc shall be correctly positioned at all times to achieve fully non slam closure. The spring shall be fully shielded from the flow stream by the central flow diffuser.



- 1.4.5 Tilting disc non return valve shall incorporate a double offset shaft with a variable angle tilt disc configuration. Sealing shall be metal to metal. The disc shall be stable and shall not vibrate under full or partial load conditions.
- 1.4.6 Valve of diameter greater than 400 mm shall be provided, in addition to others, feet and jacking screws. Hinge pins / shaft shall preferably be square in section to ensure positive location of flaps and provide for secure fixing.
- 1.4.7 Materials of construction for valve & various parts are specified in the data sheet.

#### **DETAILS & REQUIREMENTS FOR ALL VALVES (DATA SHEETS)**

**Data sheet with all details & requirements as well as materials of construction for various parts, mandatory accessories, spares & services required are given in the data sheet section.**

**Contractor must go through it in depth so as to satisfy the basis, general & overall requirements of the equipment.**

### **EXPANSION BELLOWS**

The metallic single corrugated expansion bellows with all parts shall be manufactured as per EJMA standards. The rating of metallic expansion bellows is **PN 2.5** as specified in data sheet. The bellow shall have both flanged ends of suitable thickness. Materials of construction for bellow elements and all other parts are given in data sheet.

Bellow shall have minimum axial extension of 5 mm & minimum axial compression shall be 15 mm. It shall have adequate capacity to compress and expand within the limit mentioned in its entire life cycle of minimum 7000 cycles which shall be retained for the entire design period. The period shall have to be specifically mentioned by the bidders.

Bellows shall have to be subjected to hydrostatic test at required pressure depending on pressure nomenclature for hold time of minimum 30 minutes.

Expansion bellows with tie rods shall be included in the suction and delivery pipe work of all individual pumps as well as common discharge header for easy dismantling.

**DETAILS & REQUIREMENTS OF (DATA SHEET):**

**Data sheet with all details & requirements as well as materials of construction for various parts, mandatory accessories, spares & services required are given in the data sheet section.**

**Contractor must go through it in depth so as to satisfy the basis, general & overall requirements of the equipment.**

**M S PIPES & M S SPECIALS****Scope**

Supply, fabrication, testing, painting and erection of MS pipes of specified ID / OD and specified wall thickness conforming to IS: 3589 (1981). This section covers pipe and specials up to battery limit for pumping station.

Pipes shall be erected on rollers / saddles as per the requirement. Thrust blocks shall be provided at bend and dead end.

**Specifications**

<b>Sr. No.</b>	<b>Description</b>	<b>Particulars</b>
1	Plates / HR coil	Plates / HR coil IS:2062, Gr. B 250 BR / IS:10748 Gr.III Fe410, Minimum Thickness 6.0mm
2	Welding & Electrodes	ASME – SECT – IX, IS: 7310, IS: 7307, IS: 9595
3	Inside Food Grade Epoxy Coating	NACE RP 0402
4	Fabrication & Manufacturing of Pipe	IS: 3589 and / or IS: 5504

**Specification for Inside and Outside Coating**

If specified in the price bid the inside lining shall be Solvent free lining as per AWWA C210 of minimum 406 microns shall be provided. Outside coating shall be done with best quality bituminous paint.

**Laying of Pipeline**

The laying, jointing and testing of welded steel pipes conform to latest and relevant IS: 5822. Pedestals shall be constructed before commencing the pipe laying work in any section. The welded joints shall be tested as per IS: 3600 of 1966.

### **M. S. Specials**

Supply, testing and installing M S Specials suitable to M S pipes, valves and other fittings from steel plates at site of works tested to specified test pressure and including providing required flanges, painting inside zinc epoxy coating and outside anti corrosive red primer, coated with three coats of anti-corrosive water proof enamel including freight, loading, unloading, carting, stacking as directed. The sizes and types of specials shall be as per actual requirements taking into consideration in tender items like pumps, sluice valves, non-return valves, scour valves, expansion joints, dismantling joints etc.

### **Flanges**

The flanges and their dimensions of drillings shall be in accordance with part IV and VI of IS: 1538 (Part I to XXII) 1976 (specification for cast iron fittings for pressure pipes for water, gas and sewage) or its latest revision. Fabricated M S flanges shall be as per IS: 6392 (1971) (specifications for steel pipe flanges) wherever applicable. The flanges shall be flat faced with off centre bolt holes. Prior to manufacturing process, the contractor shall have to obtain approval of EIC for all sizes and types of flange drawings.

### **Jointing Materials**

Each valve shall be supplied with all necessary jointing rings, nuts, bolts and washers for completing the joints on all the flanges of valve supplied under this contract including those flanges which will be jointed to pipe system. The lengths of bolts shall be suitable for jointing MS pipes. Joint rings shall be of flat section at least 3 mm thick. They shall be of rubber in accordance with IS: 638 (1965).

The jointing material shall include:

All types of flanges fabricated from MS plates/ flats of required thickness and confirming to IS 2062. Pipe supports/ valve supports from structural steel angles/channels of required size and confirming to IS standards shall be provided using required jointing materials, hardware like nuts, bolts, washers, gaskets etc. in required quantities & of reputed makes.

Providing following specials and installing on the pipeline including welding as required for Flanged Eccentric expander at HSFC pump discharge

Flanges with hardware and gaskets for installing various valves and expansion bellows on the pipeline. Blind flanges at the end of header and tap off for future pumps.

Fabricating and connecting specials and bends on pump discharge pipelines and common header to suite site conditions.

Providing Suitable fabricated supports with clamps & hardware for pump discharge pipelines to suit site conditions.

All pipes, fittings, bolts, nuts, jointing materials and appurtenances for piping to be required for execution of the works shall be manufactured and erected in accordance with the erection plans, specifications and directives of the department. All pipe work and fittings shall be to a class in excess of the maximum pressure attained in service including any surge pressure.

The pipe work installation shall be so arranged to offer ease of dismantling and removal of pumps or other major items of equipment. All loose flanges shall be secured to fixed flanges by suitable tie bolts. All pipe work shall be adequately supported with purpose made fittings. When passing through walls, pipe work shall incorporate a puddle flange. Flange adapters and unions shall be fitted in pipe work runs wherever necessary to permit the simple disconnection of flanges, valves and equipment. The final outlet connection of the pipe work shall match the connecting point of the transmission main.

Flanged joints shall be full face, fabric reinforced rubber gaskets, pierced to take the bolts, and the face of all flanges shall be machined to give a true angle of 90° to the centre line of the pipe or fittings. All necessary supports, saddles, slings, fixing bolts and foundation bolts shall be supplied to support the pipe work and its associated equipment in an approved manner. Valves, meters and other devices mounted in the pipe work shall be supported independently of the pipes to which they are connected.

The whole of the jointing work and materials necessary to fix and connect the pipes, including adequate and efficient pipe support shall be included in the contract. The bidder shall be responsible for ensuring that the internal surface of all pipe work is thoroughly cleaned before and during erection and before commissioning. Cleaning shall include removal of all dirt, rust, scale and welding slag due to site welding. Before dispatch from the manufacturers' works, the ends of

the pipes, branch pipes etc. shall be suitably capped and covered to prevent any accumulation of dirt or damage. This protection shall not be removed until immediately prior to connecting adjacent pipes, valves or pumps. All small-bore pipes shall be blown through with compressed air before connection is made to instruments and other equipment. No point of passage of pipes through floors or walls shall be used as a point of support, except with the approval of the department.

Material of steel pipes and fittings shall conform to IS: 2062. Fabrication and testing shall be in accordance with IS: 1239 / IS: 3589 for pipes and IS: 6392, ISO: 7005 or BS: 4504 for flanges. Carbon content & other chemical properties shall be within specified limits of governing IS. Minimum corrosion allowance shall be 2 mm for pipes and fittings which are not mortar lined.

The coating shall consist of one coal tar primer coat, one coal tar enamel coat, wrapping of fibre glass and one more coat of enamel and then final wrap of enamel impregnated fibre glass.

Thickness of pipe for pump house pipe system i. e. delivery, common discharge headers & header by pass and shall not be less than what is prescribed in relevant IS standards without negative tolerance.

## **PART II: ELECTRICAL & INSTRUMENTATION (GENERAL)**

### **1.0 SCOPE**

The scope of services covers the design, detailed engineering, preparation of construction drawings, manufacture, acceptance testing at manufacturers' works, supply, packing, forwarding and delivery from manufacturers' works/ place of storage to erection site including transit insurance, unloading, storage at site, moving from place of storage to place of installation, assembly, erection, testing, commissioning & performance demonstration and handing over along with all necessary spares of original ratings & specifications on design, build & operate basis. Contractor has to ensure that design & equipment are as per detailed specifications & as per requirement of the project.

The Contractor shall prepare design calculations based on parameters/ design criteria indicated in the specifications. The Contractor shall prepare detailed engineering and construction purpose drawings to make his/ her own estimate of ratings & quantities (minimum requirements as per schedule, technical data sheets, governing standards & other relevant details) for entire electrical & instrumentation systems including all items, systems such as equipment, cables/ cable carrier system, lighting, ventilation, earthing, lightning protection, main & auxiliary power distribution, instruments, associated civil works required for the satisfactory completion of works.

Contractor shall take due care of the site seismic conditions while design of all equipment/ components used in entire electrical & instrumentation systems covered in this specification. Contractor shall furnish list of additional design parameters considered in design to fulfil above requirement.

Design and detailed engineering of the materials procured by Contractor is included in scope. Contractor shall submit design drawings/ calculations of each system which is included in scope to GWSSB for final review/ approval. All design documents/ calculations prepared by Contractor shall be as per ISO documentation procedure duly signed by qualified authorities and stamped. Design documents/ calculations prepared by sub vendors shall be approved by the contractor and stamped copy of approval along with no-deviation sheet from sub vendor shall be

submitted by the Contractor to GWSSB for final review/ approval.

Expert or manufacturers' supervision for sub vendor supplied material(s) shall be provided by Contractor and included in offer.

Contractor shall be solely responsible for any shortages or damages in transit for his supply scope, handling and/ or in storage of any materials and erection of the equipment, supply of erection tools at site. Contractor shall ensure that it will not affect any activity or project schedule. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.

Contractor shall identify activities and mile stones of the work forecasted for next month with optimistic and pessimistic dates of work completion. Contractor shall prepare program evaluation and review techniques to identify critical path of project and activity sequences. The project schedule shall be prepared and updated fortnightly in MS Project.

Nothing in this specification shall be constructed to relieve the Contractor of his/ her responsibilities towards following best engineering practices established in the country.

Obtaining approval including submission of all required drawings / documents etc. for getting sanction in increase of existing load / release from Gujarat Energy Transmission Corporation (GETCO)/ UGVCL, No Objection Certificates from UGVCL, Electrical Inspector (CEIG), relevant government agencies, and statutory authority, as applicable is included in Contractor's scope.

All necessary legal fees required for various applications to GETCO/ UGVCL / Electrical Inspector (CEIG), relevant government agencies, statutory authorities shall be paid initially by the contractor which shall be subsequently reimbursed by GWSSB on production of original payment receipt etc. The GETCO/ UGVCL deposit required to be paid for enhancement of existing load i. e. registration charges as well as FQ etc. shall be borne by the GWSSB.

The Contractor's scope shall include measurement of soil resistivity at site by Wenner's four electrode method as per IS: 3043-1987 (reaffirmed in 2006) at minimum four locations at site. The earthing shall be designed for the actual mean soil resistivity value obtained.

Even if all components of a system included in this specification are not explicitly identified and/

or listed herein, these shall be supplied under this contract to ensure that system is complete and facilitates proper operation and easy maintenance of the plant. Any and all other works not indicated above but necessary/ required to complete the system in all aspects, are deemed to have been included in the Contractor's scope.

The Contractor shall include start up spares, essential spares, recommended spares and a set of special tools necessary for operation, routine maintenance of equipment supplied for a period as specified in this contract.

Whether specifically called for or not, all accessories required for normal and satisfactory operation (as deemed by the GWSSB) of the equipment shall be considered to be a part of the Contractor's basic scope of supply and/ or work and no claims whatsoever, for extra payment on these grounds, will be accepted.

Contractor must visit site(s) and familiarise himself / herself regarding evaluating the existing site conditions, assessment of existing equipment / apparatus which are to be used with or without modification / retrofitting etc. & to completely study the scope of work for complete Electrical & Instrumentation works before submission of bid offer.

Contractor's scope shall include design, engineering, manufacture, supply, testing, commissioning and handover of following electrical equipment/ systems as per tender specifications, BOQ and other relevant details.

Tariff metering equipment as applicable (as per GETCO/ UGVCL requirement) & electric supply connection including necessary liaison works. Tariff metering equipment & electric supply connection shall be provided by GETCO/ UGVCL for which necessary liaison shall be done by the Contractor.

### **Switchyard Equipment**

Two pole structure (required to receive incoming 11K V power supply from overhead line/ cable and to extend out required feeders, bus bars, isolators (GOD) with operating mechanism, earth switches, lightning arrestors, incoming point of supply VCB HV breaker or as per statutory requirement & drop out fuses (wherever applicable for transformer(s) being fed directly from incoming power supply) etc. including necessary civil works, chain link fencing & gate etc.



Oil type, ONAN, Dyn11, Distribution Transformers with on load circuit tap changer (+ 10 % to – 10%) with RTCC panels, AVR and accessories one working and one standby both of identical capacity & to be kept in load condition.

11K V metal enclosed switchgears indoor type with vacuum circuit breakers, load break switches fully electrical draw out including necessary control, metering & relaying devices.

415V metal enclosed switchgears including automatic power factor correction panels (APFC), power distribution board (PDB) & lighting distribution board (LDB), Sub DB, Lighting DB, Receptacles for utilities. Local start/ stop push button stations shall be provided near those motors which are not controlled from a local console/ panel.

Cabling system shall consist of various voltage grade, XLPE/ PVC insulated, multi-stranded Al/Cu, GI round wire/ flat strip armoured power, control & instrumentation cables, GI / FRP ladder / perforated type cable trays & associated accessories including support structures. In case where cable carrier system i. e. trays are exposed to sun, it shall be adequately covered at the top by fabrication of appropriate canopy structure to meet the stated objective in consultation & with prior approval of the Engineer-in-charge.

Provision for continuous monitoring of electrical power & energy parameters like voltage, current, power factor, frequency, kilowatts, kilowatt-Hours etc.

Earthing for **HV/ LV** equipment and lightning protection system for all buildings in the plant premises. The general design shall be on the basis of following codes and standards (their latest amendments) in line with design criteria & specification requirements.

- a) IS 3043: 1987(Reaffirmed in 2006) : Code of practice for Safety Earthing
- b) IS/ IEC 62305: 2013 : Code of Practice for the protection of buildings and allied structures against lightning.
- c) CEA guidelines 2010 : Measures related to safety & electric supply.

Lighting system for all indoor & outdoor areas of plant & plant premises including switchyard & transformers area, intake well along with bridge, panel rooms (front & back side). The lighting system will be controlled by lighting panels installed in respective plant/ station areas, which will

be fed from the main lighting DB.

**Submission of drawings & documentations** as specified under general technical & particular requirements section for electrical, instrumentation & control equipment/ systems.

Contractor's scope shall also include all civil works required for electrical & instrumentation equipment/ structure such as equipment foundations/ support structure, indoor & outdoor trenches, switchyard structures, flow meter chambers, all excavation works including those for earthing, cabling etc. de-tanking area, soak pits, burnt oil pits, chamber etc.

Intent is not to specify all details of design and construction herein completely, nevertheless, the Electrical, Instrumentation & Control system shall conform to high standards of engineering, design and workmanship in all respects and shall be capable of performing satisfactorily in continuous commercial operation under the specified environmental conditions.

GWSSB reserves the right to issue addendum to the technical specifications to indicate modification/ changes in the requirements, if & as required subsequently.

**2.0 ENVIRONMENT & SYSTEM INFORMATION****Site / Environmental Conditions**

Ambient temperature	50°C
Relative Humidity	5% – 95 %

Area Classification	Non-Hazardous
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Seismic Data	As per IS: 1893 (latest Issue)
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Nominal System Voltage (Derived on Load Demand as per GERC norms)

**Contract Demand****Supply Voltage**

Not exceeding 100 KVA	415V
Exceeding 100 KVA & up to 4000 KVA	11 KV, 22 KV and 33KV
Plant Power/ Control Supply Distribution	11 KV, 3 Phase, 3 Wire, 50 Hz, AC
Voltage	415V, 3 Phase, 4 Wire, 50 Hz, AC
General Lighting & Space Heating:	240V, 1 Phase, 2 Wire, 50Hz, AC
Control, Protection & Emergency Lighting:	24/ 30 or 110V, 2 Wire DC (as applicable)
Voltage Transformer Secondary:	110 V, 3 Phase, 50 Hz, AC
Voltage Variation / Frequency Variation /	± 10% / ± 5% / ± 10%
Combined Voltage & Frequency Variation	
System Earthing	11 K V, 3 Phase AC system: Neutral Solidly Earthed
	415 V, 3 Phase, AC system: Neutral Solidly Earthed
	240 V, 1 Phase, AC system: Neutral Solidly Earthed

**1. Design Criteria for Electrical, Instrumentation and Control Equipment / Systems General**

The design criteria, specified herein has to be followed by the Contractor for designing/ sizing of electrical, instrumentation & control equipment covered under Contractor's battery limits, However it is to be noted by the Contractor that, following this design criteria does not relieve the Contractor from adherence to the standards, regulatory requirements & prevailing best engineering practices.

### Estimation of Load and Maximum Demand

The following considerations are to be followed to arrive at the maximum electrical demand.

#### Load Factor

- |    |   |   |     |
|----|---|---|-----|
| 1. | Main motors   | : | 0.9 |
| 2. | Auxiliary load (valve actuators, Crane/ Hoist etc.) | : | 0.4 |
| 3. | Lighting load                                       | : | 1.0 |

#### Diversity Factor

- |    |  |   |     |
|----|--|---|-----|
| 1. | Main motors                                    | : | 1.0 |
| 2. | Auxiliary load (Valve Actuators, Crane/ Hoist) | : | 1.1 |
| 3. | Lighting load                                  | : | 1.1 |

#### Power Factor of Motors

As per the Manufacturer's Data sheets

#### Efficiency of Motors

Energy efficient motors as per the Manufacturer's Data sheets & minimum acceptable as specified in the data sheet.

#### Power Supply Scheme

The source of power supply for pumping stations will be through one no. 11 K V, overhead line from UGVCL. **Two Distribution transformers** of 11 KV are required to meet the pumping load requirement of one pumping section. The capacity of power transformer shall be designed to sufficiently take the full working load of only working motors of the pumping station.

The short circuit apparent power of the system at the proposed main switchyard shall be as follows as per IS: 2026 (Part I).

- |               |   |         |
|---------------|---|---------|
| 11 KV Systems | : | 350 MVA |
| 415 V System  | : | 20 MVA  |

#### Bus-Bar Sizing

1. The Contractor shall furnish calculations after award of contract, establishing the adequacy of the bus bar sizes to meet the continuous and short time current ratings as calculated.
2. The bus-bars shall be sized considering the following criteria:
  1. Sleeves made of insulating material on all bus bars.
  2. Design ambient temperature 50°C.

3. Final temperature of the bus-bar complying with requirements of IS 8623 & IEC 60947.  
Reduced temperature rise limit by 5K (for indoor panels) & 10K (for outdoor panels) to that of mentioned in IS 8623 & IEC 60947 shall be considered to satisfy the final temperature.
4. Bus bars being inside the panel, de-rating for enclosure and ventilation.
5. Bus bar suitability for carrying rated current continuously.
6. Configuration of bus bars and proximity effect
7. Bus bars shall withstand the short time rating of the panel for 1 sec duration.

### Power Factor Improvement

**Automatic power factor improvement (APFC) panel** with APP type capacitor banks for 415 V LV motors to be suitably designed to suit the requirement of L V motors. Power factor is to be improved up to the level of 0.99 on lagging side in case of L V.

While APFC Panel shall be sized considering following design criteria:

Minimum 10 to 12 steps in an APFC relay shall be considered.

**Capacitor shall be All Poly Propylene (APP) of double layer type.**

Fixed type capacitor bank, with manual & auto switching and components as per detailed specifications and as indicated in the data sheet shall be provided in each mains incomer (LV) PCC - MCC panel for transformer no load compensation.

For each bus section of the Main LV PCC/ MCC panel, separate APFC panel based on above design criteria are to be provided. Other requirements of APFC panel & its components shall be as per requirement provided in this specification.

Total capacity & capacitor bank sizes shall be as given in table below:

Capacity in KVAR	1	2	5	10
* kVAr	# Nos.	# Nos.	# Nos.	# Nos.

(\*) = Contractor has to calculate the capacitor rating based on the system power factor (0.85 or actual, whichever is lesser - to be corrected for 0.99. Rating of APFC panel shall be based on 50% of running load on each bus section & not on the connected load basis. Number of stages/

steps in a particular APFC panel shall be decided by the vendor such that minimum 12 steps & maximum 16 steps shall be provided in a particular panel. CT changeover scheme when only one transformer is running is also to be considered.

### **Cable Sizing**

The Contractor shall ensure that cable and wires associated with the power distribution and control systems, plant wiring and all other installations throughout the Works are adequately rated for their use.

The following main aspects shall also be considered while deciding the final size of the cables viz. Supply voltage and frequency;

1. All cables shall be selected to carry the corresponding full load current under site conditions.
2. Route length and disposition of cables
3. Maximum allowable temperature-rise under normal full load condition based on the materials' of cable insulation (XLPE/ PVC).
4. Maximum short circuit current duration (fault clearing time) and final temperature of cable during short circuit current flowing through the cable.
5. For cables emerging from ACB outgoing, fault clearing time shall be considered as for cables emerging from MCCB outgoing, fault clearing time shall be considered as 0.01 second
6. For the HV incomer cables (metering kiosk to HV switchgear/transformer) minimum fault clearing time shall be considered as 1 sec. for cable from HV panel outgoing to transformer, fault clearing time shall be considered as 0.16 second.
7. Cable from transformer secondary to PCC incomer, fault clearing time shall be 1sec
8. Contractor to note that, the above fault clearing times are minimum to be considered & fault clearing time shall be considered as per actual relay co-ordination study.
9. Appropriate de-rating factors as per cable manufacturer's catalogue and enlisted below shall be considered for sizing the cable:
  1. Ambient Air Temperature (minimum 50°C).
  2. Ambient ground temperature (minimum 40°C to be considered)
  3. Laid in air/ ducts/ directly buried in ground etc.

4. Depth of cable burial (minimum 750 mm for LV and 900 mm 11KV HV)
5. Thermal resistivity of soil (minimum 150°C Cm/ W to be considered)
6. No. of cables in a group-touching each other or separated by a distance
7. No. of cable trays in tier
8. Any other de-rating factors as applicable & as per Manufacturer's catalogue.
9. Permissible voltage dips at the time of starting the corresponding motor load. Vendor to ensure adherence to the Criteria-2 mentioned above.
10. In running condition, cumulative voltage drop (at 100 % rated load) shall not exceed 5 % (measured at load end) for the L V loads.
11. HV cables shall be E/ UE grade (as per system requirement), multi-stranded Al conductor, XLPE insulated, inner/ outer extruded PVC sheath ST2, galvanized steel flat strip armoured cables.
12. LV cables shall be 1.1 KV grade, multi-stranded Copper/ Al conductor, XLPE insulated, colour coded, inner and outer extruded PVC sheathed, galvanized steel round wire/ flat strip armoured cables.
13. Cables up to & including 4.0 sq.mm shall be Copper multi-stranded conductor with galvanized steel round wire armoured& balance cables shall be Al multi-stranded conductor with galvanized steel round wire/ flat strip armoured.
14. Single core cable shall have nonmagnetic material armouring.
15. Control cables shall be Copper multi-stranded conductor with galvanized steel round wire/ flat strip armoured. For cables above 7 cores, minimum two spare cores shall be considered.

### **Illumination System**

Illumination for various indoor & outdoor areas shall be conforming to the requirements mentioned below:

The illumination levels to be considered for the design of lighting system for various areas shall be as following. These are the illumination levels achieved at work plane. Work plane height shall be considered as 0.76 m from FGL.

Area	Illumination Level (Lux) - Average values
------	---

Pump House	250
Office rooms	300
Switchgear rooms	250
Control rooms	300
Chemical and general stores	150
All other indoor areas	150
Outdoor platforms and walk ways	50
Outdoor plant areas	20
Switchyard & Transformer	10
areaGeneral onEquipment	30
Roads	15

Critical lighting shall be designed such that at all junctions, exit passages & strategic locations the Lux level shall be maintained above 10 Lux. Installite fixtures with built in battery backup shall be considered.

Lighting design shall be performed using Dialux Software version 4.5 or its latest version/ Original Equipment Manufacturer (OEM) validated software. The validation report along with software and data files shall be acceptable to GWSSB.

Various design factors shall be considered as following.

Maintenance Factor for Outdoor / Indoor      0.6 (0.7 for LED) / 0.7 (0.8 for LED)  
Area

Reflectance Factor for Wall / Ceiling / Floor    30 % / 10 % / 30 %

Uniformity (Minimum / Average)                      50 % minimum for Indoor and 30 % for  
Outdoor

Lighting panels shall be provided in various areas and circuit wiring to the lighting fixtures shall be made from these lighting panels. Lighting panel shall comprise of 125 Four Pole MCCB with ELCB / RCCB for incomer and 16A/10A MCBs for each out-going single phase circuits.



Lighting fixtures and fans will be grouped on the circuit wherever required. However, separate circuits shall be used for receptacles wiring.

For the purpose of calculating connected loads of various lighting circuits, a multiplying factor of 1.25 will be assumed to the rated lamp wattage for mercury vapour, sodium vapour and fluorescent lamp fixtures to take into account losses in the control gear. Also, a loading of 100 watts and 500 watts shall be assumed for single phase 5 Amps and 15 Amps receptacles respectively.

Lighting fixtures, receptacles, switches, conduits and junction boxes shall be properly earthed using 12 SWG GI wire unless specified otherwise.

Receptacles of 5A and 15A, single phase, 3pin shall be provided with switch. Receptacles in offices and control rooms shall be decorative type and in other areas shall be industrial type. Three phase receptacles shall be associated with TPN switch housed in the same enclosure. The receptacle shall become live only when the associated switch in "ON" position. The enclosure for all outdoor receptacles shall be provided with degree of protection of IP 55.

Generally, maintenance factor of 0.8 shall be considered for lighting fixtures.

#### **Earthing & Lightning Protection System**

The safety earthing and lightning protection system will be generally on the basis of following codes and standards (including their latest editions).

1. IS: 3043 (1987) (Reaffirmed in 2006): Code of practice for Safety Earthing.
2. IEEE 80 - 2000.
3. IS / IEC 62305 (2013): Code of Practice for the protection of buildings and allied structures against lightning.
4. CEA guidelines - 2010: Measures related to safety & electric supply.

The fault levels considered shall be as follows.

System Voltage	Fault Level in kA (*)
66 KV	31.5 kA for 1 sec
11 KV	21.9 kA for 1 sec
3.3KV	26.2 kA for 1 sec
415 V	50 kA for 1 sec

(\*) Contractor to design on the basis of actual impedance and adequacy calculations for sufficiency of earth conductor size shall be provided.

Following factors shall be considered for sizing the earthing conductor:

- a) Design Ambient Temperature : 50°C
- b) Allowable temperature-rise for steel welded joints : 500°C
- c) Fault clearing time : 1 Second
- d) Overall earthing resistance to be achieved as per IEEE Std. 80 – 2000 :  $\leq 1$  Ohm for transmission substation.  
 $\leq 5$  Ohm for distribution substation.

Measurement of soil resistivity shall be done using Wenner's four (4) electrode method as described in IS 3043 -1987(Reaffirmed in 2006) including its latest amendment.

The soil resistivity of the plant area has not yet been measured; the same should be carried out during detailed engineering by successful Contractor.

After soil resistivity measurement; length of conductor, quantity of earth electrodes and quantity of test pits shall be finalized based on these design criteria & the requirements specified in earthing requirements.

**DETAILED & PARTICULAR TECHNICAL SPECIFICATIONS**  
**PART II: ELECTRICAL SYSTEMS**

## **L V (415V)PMCC PANELS for Main &Auxiliary Loads**

### **Applicable Standards**

The design, manufacture and performance of equipment shall conform to the latest standards specified below. In case of conflict between standards and this specification, this specification shall govern.

General requirements	IS: 3427 / IEC: 61439-2 (2011)
Factory Built Assemblies of switchgear and control gear for Voltages up to and including 1000V AC & 1200VAC	IS: 8623 / BS: 5486 / IEC: 439
Air-Break Switches	IS: 13947-P3 / BSEN6049 / IEC: 947-3
Miniature Circuit Breakers	IS: 8828 / BSEN: 60898
Low Voltage Fuses	IS: 13703 / BS: 1362 / IEC: 269-1
Contactors	IS: 13947/ BSEN: 60947 4 / IEC: 947-1
Starters	IS: 13947/ BSEN60947-4/ IEC: 292-1 to 4
Control Switches & Push buttons	IS: 6857 / BSEN: 60947
Current Transformer	IS: 2705 / BS: 7626
Voltage Transformer	IS: 3156 / BS: 7625 / IEC: 44, 186
Indicating instruments	IS: 1248 / BS: 89 / IEC: 51
Marking and Identification of Conductors and Apparatus Terminals	IS: 11353 / BS: 159
AC Electricity Meters	IS: 722, 8530 / BS: 5685 / IEC 145,211
Degree of Protection	IS: 13947 / IEC: 947-P1
Selection installation and maintenance of switchgear and control gear	IS: 10118

Code of practice for phosphating iron and steel	IS: 6005 / BS: 3189
Specification for copper rods and bars for electrical purposes	IS: 613
Control transformers for switchgear and control gear voltage not exceeding 1000V AC	IS: 12021

### Constructional Features

The switchgear shall be metal enclosed, modular type suitable for indoor installation, dust & vermin proof, self-standing floor/ plinth mounting with a height not exceeding 2300 mm and shall have following features

1. Panels shall comply Form 4 as per IS: 8623 (1993) Part I/ IEC 61439-1/2. The form of separation shall be minimum form 4 B for better human and equipment safety.
2. Breaker up to 1250A shall be installed in two tiers and above 1250A, it shall be mounted in single tier.
3. Minimum clearance between live parts shall be phase to phase 25.4 mm & phase to neutral 20 mm at any location & shall be complying with the BIL for the panel.
4. Switchgear shall be divided into distinct vertical sections each comprising
  1. A completely enclosed bus bar compartment running horizontally.
  2. Enclosed vertical bus bars serving all modules in vertical section.
  3. A separate horizontal enclosure for all auxiliary power and control buses.
  4. Vertical cable alley of minimum 250 mm wide covering entire height
5. Operating devices shall be incorporated only in the front of switchgear.
6. Each shipping section shall have metal sheets at both ends.
7. Cable alley shall be provided with suitable hinged doors.
8. All doors shall be with concealed type hinges and captive screws.
9. Each vertical section shall be equipped with a space heater controlled by thermostat.
10. Each switchgear cubicle shall be provided with interior lighting with 11W LED luminaries inclusive of lamp with door limit – on/ off switch.

11. A power socket (240 V AC, 5/ 15 A) shall be provided in the interior of each cubicle with On-Off switch.
12. All identical equipment and corresponding parts be fully interchangeable without any modifications
13. Main and Auxiliary Buses
  1. Switchgear bus bars shall be of uniform cross section throughout the length and made of electrolyte grade Aluminium (91 E- 63401).
  2. All bus bars shall be covered with heat shrinkable black PVC sleeves. Coloured polyester tapes for phase identification shall be provided at suitable locations.
  3. Bus bar shall be adequately supported to withstand stresses developed due to short circuits. Bus bar joints shall be provided with contact grease at the joints and shall be complete with tensile steel bolts, washers and nuts
  4. The exposed bus live parts in the cable alley shall be totally covered against accidental contact by a shroud (and not by sleeve) to protect the workmen working on the switchgear.
  5. Vertical bus bars shall have Short Circuit rating same as main bus bar and shall be suitable for all connected load of vertical section.
  6. Neutral bus bar size shall be 50% of phase bus bar.
  7. Termination on bus bars at ACB, MCCBs shall be as per IEC: 60947-2. For terminations on MCCBs, where phase-phase and phase to earth clearance are not possible, Cu spreaders of suitable size shall be used along with the use of separators.
  8. Bus bar supports shall only be SMC irrespective of bus bar size. The span between the two insulators shall be adequate. Joint positions and insulators shall be properly adjusted so that they don't interfere.
  9. For the Main PCC/ MCC, Contractor shall ensure that incoming feeders from transformer shall be suitably designed for terminating cable / bus duct as provided. Contractor shall consider the necessary arrangement (dummy panel, adapter panel, rear extension etc.) if required, for terminating the bus-duct. Phase transposition, if required, will be done in the Main PMCC.
  10. Wherever Cu bus bars are provided, it shall be tinned copper & not bare Cu.

11. All mounting accessories like base channels, cross angles if required, nuts, bolts etc. shall be supplied by the Contractor.
12. All the indoor switchgear panels shall be suitable for IP54 degree of ingress protection for the enclosure. Outdoor panels shall be with minimum IP55 degree of protection.
13. All panels shall be made up of CRCA sheet steel of following thickness:
  1. Load bearing members: 2.5 mm
  2. Doors and partitions: Doors: 2.0 mm&Partition: 1.6 mm
  3. Mounting plate: 2.0 mm
  4. Gland plate: 3.0 mm for both incomer and outgoing. For single core cable these plates shall be non-magnetic.
5. All the panel wiring shall be done with PVC FRLS, multi-stranded copper wires
6. Feeder shall have hinged open-able (more than 105°) type door with panel locks. All bus-bar covers and other panel covers shall be screw fixed.
7. Suitable barriers of FRP material shall be provided between two terminals connected to different voltage supplies.
8. All doors and detachable components shall be earthed with flexible green coloured (with Yellow colored band) PVC sheathed 2.5/ 4.0 sq.mm multi-stranded Copper cable.
9. The equipment shall be given tropical and fungicidal treatment.
10. Each compartment & component shall be provided with name plates (with white letters on black background) at front, inside & rear side.
11. Equipment nameplates shall be fixed by screws/ rivets and shall not be pasted.
12. Metallic shrouding shall be provided for the isolation of main and vertical bus as well as to avoid accidental contacts with live parts.
13. Drawing pocket shall be provided on the inside of incomer feeder door.
14. Provision for Top/ Bottom cable entry shall be made to suit the site condition.
15. Lifting hooks/ eyes shall be provided in each shipping section of the equipment and shall be removable type.
16. All the panels shall be provided with 20% extra power & control terminals.
17. All unused contacts of the circuit breaker, protection, auxiliary, control relays shall be wired up to the terminal block.
18. All terminals of different control voltages shall be separate from each other.

19. Stud type terminals and ring type lugs shall be used for control cables.
20. All the control/ power wiring shall be dressed neatly & the wire running through troughs shall be provided with covers.
21. Switchgear shall be easily extensible on both sides by the addition of vertical sections after removing the end covers. It shall be provided with a metal sill frame made of structural steel channel section properly drilled for mounting the switchgear along with necessary mounting hardware. Hardware shall be zinc plated or passivated. It shall be provided with labels on the front and rear indicating the switchgear designation.
22. Any operating handle of switchgear shall not be more than 1800 mm and not lower than 300 mm from base of the panel.
23. For individual feeder modules arranged in multitier formation, it is essential that the modules are integral multiples of the unit size to provide for flexibility in changes if any at site. For safety, isolation of the vertical bus bars, insulating barrier with cut outs shall be provided to allow the power slab contacts to engage with vertical bus bars. A vertical cable alley shall be sufficiently wide for motor control modules and for circuit breaker control modules.
24. A horizontal separate enclosure for all auxiliary power and control buses, as required shall be located so as to enable easy identification, maintenance and segregation from the main power buses. Tap off connections from these buses shall be arranged separately for each vertical section.
25. All equipment associated with a single circuit shall be housed in a separate module compartment of the vertical section.
26. For draw out type modules, only the handles of control and selector switches, push buttons, knobs & cut outs for lamps and meters shall be arranged on the front doors of the respective compartments to permit operation without opening the door.
27. On-circuit breaker-controlled circuits, protective relays shall be mounted on the front door of the compartment. All other equipment pertaining to a circuit shall be mounted on the withdrawal chassis. All cut outs shall be provided with gaskets for the purpose of dust proofing.
28. Current transformers shall not be directly mounted on the buses. Current transformer on circuit breaker-controlled circuits shall be mounted on the fixed portion of the compartment.



29. In breaker compartments, external cable connections shall be carried out in separate cable compartments for power and control cables.
30. After isolation of the power and control connections of a circuit, it shall be possible to safely carry out maintenance in a compartment with the Bus bars and adjacent circuit live.
31. The withdraw-able chassis shall move on suitable guides and on suitably plated steel or stainless-steel rollers or balls to facilitate easy withdrawal.
32. Cable alleys shall be provided with suitable hinged doors. It shall be possible to safely carryout maintenance work on cable connections to any one circuit with the Bus bars and adjustment circuits live. Adequate number of slotted cable support arms shall be provided for cleating the cables.
33. Rear of single front switchgear shall be provided with removable panels. It shall be possible for one person to remove and fix the removable panel.
34. All doors shall be provided with concealed type hinges and captive screws.
35. The draw out contacts shall be only between copper/copper alloy/ aluminium fuses, which are silver or tinplated. The contact design shall be such that there should be no arcing/ deformation under the associated peak short circuit current.
36. Switchgear shall be designed in such a way that all components equipment and Bus bars operate satisfactorily without exceeding their respective maximum permissible rise in temperature under ambient temperature conditions prevailing within the switchgear cubical, with reference to ambient temperature outside the switchgear cubical.
37. Provision of ventilating louvers shall be provided with fine-screened brass or GI meshes to prevent entry of vermin and dust.
38. The various types of modules indicating the control requirements of each type together with the list of component equipment required for each type shall be as follows& as described in data sheets.
  1. For Incoming Circuit: Electrical Draw Out Air Circuit Breaker for **> 630A** and Microprocessor Based Fixed Type MCCB **≤ 630A**
  2. Outgoing Feeders: ACB/ MCCB/ MCB
  3. Auxiliary Services: Starters, capacitors, distribution boards and any other auxiliary load
4. Physical size of compartment for each type of control and current rating shall be so chosen that all the basic and additional equipment can be housed in the compartment. No

equipment associated with any particular circuit shall be permitted to be mounted in any other circuit module.

Power Distribution Board (PDB) configuration shall be one no. minimum 125 A Four Pole MCCB I/Cs and six numbers or as per actual requirement \*A TPN MCCB / MCB O/G feeders of required amperage. The O/G feeders shall be supplying to Sub DBs. The configuration of Sub Distribution Board (SDB) shall be \*A FP MCB I/C and 2 nos. 63A TPN MCB & 12 nos. 20A SP MCBs as outgoing feeders. (\*A) shall be decided during detailed engineering.

Separate instrument's compartment for indicators of flow meter(s), energy meter, level & pressure controllers shall be provided as per actual requirement of suitable size.

### **Control Voltages**

Following control voltages shall be used in LV panels.

1. All ACBs tripping/ Closing shall be suitable for 110/ 240V AC (24/ 30 or 110VDC) as applicable. The trip coil and closing coils of ACBs shall operate satisfactorily under the following conditions of supply voltage,
  1. Closing coils- 85 % to 110 % of rated voltage
  2. Trip coils- 70 % to 110 % of rated voltage.
3. Indications/ Annunciator for LV Main PCC/ MCC: 110/ 240V AC (24/ 30 or 110VDC)
4. Indications for auxiliary DBs: 240V AC
5. Space heater, 5/ 15A socket, panel illumination lamp etc. 240V AC derived from AC bus
6. 240V AC, 110V AC and other voltages shall be segregated to avoid mix-up of voltages.
7. Control transformers suitably rated of voltage ratio 415/ 240/ 110 V on the Incomer/ Bus shall be provided. For the control transformers, fuses shall be provided on the 415 V side and MCBs on the 240/ 110V side. The control transformer shall be cast resin type only.

### **Painting**

1. All sheet steel work shall be painted through 7 tank electrostatic powder coating process in accordance with the required procedure and with the applicable standards. The switchgear enclosure shall be powder coated with shade as per RAL7032.
2. The final finished thickness of paint film on sheet steel enclosure shall not be less than 80 microns. Finished painted appearance of equipment shall present an aesthetically pleasing appearance, free from dents and uneven surfaces.

**Interchangeability**

All identical equipment and corresponding parts including chassis of draw out modules of the same size shall be fully interchangeable without having to carryout modifications. For trouble free interchangeability, the draw out arrangements shall be designed such that normal dimensional variations are taken care of by self-aligning feature of the modules.

**Drawings & Documents**

Prior to fabrication of the switchgear, the Contractor shall submit following for GWSSB's approval - the dimensional drawing and design calculations indicating bus bar size, enclosure sizing with heat dissipation details, short circuit rating of all the electrical component used, internal wiring, components mounting details etc. The Contractor shall submit manufacturers catalogues of the electrical components installed in the switchgear.

**Inspection**

At all reasonable times during production and prior to dispatch of the switchgear to site, the Contractor shall arrange and provide all the facilities at their plant for inspection & testing of switchgear.

**Earthing**

1. All earth bus bars of adequate size shall be provided for the entire length of the panel. The framework of the enclosure shall be connected to this earth bus. Provisions shall be made for connection from this earth bus to the main earthing bus bar coming from the earth pit on both side of the switchgear.
2. The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bus bar. The armour of cables shall be properly connected with earthing clamp and the clamp shall be ultimately bonded with the earth bus bar.

**Labels & Name Plate**

1. Engraved PVC labels shall be provided on all incoming and outgoing feeders. Single line circuit diagram showing the arrangements of circuit inside shall be pasted on inside of the panel door and covered with transparent laminated plastic sheet.
2. A nameplate with the switchgear designation in bold letters shall be fixed at top of the central panel. A separate nameplate giving feeder details shall be provided for each feeder module door.
3. Inside the feeder compartments the electrical components, equipment, accessories like switchgear shall be provided with stickers shall suitably identify control gear, lamps, relays etc.

4. Engraved nameplates shall preferably be of 3-ply (Red-White-Red or Black-White-Black) Limacoid sheet however black engraved perplex sheet nameplates shall also be acceptable. Engraving shall be done with square groove cutters.
5. Nameplate shall be fastened by counter sunk screws and not by adhesives.

**Danger Notice Plates**

1. The danger notice plate shall be affixed in a permanent manner on operating side of the switchgear.
2. The danger notice plate shall indicate danger notice in Gujarati, Hindi and English.
3. The danger notice plate, in general shall meet to requirements of local inspecting authorities.
4. Caution name plate, "Caution Live Terminal" shall be provided at all the points where the terminals are likely to remain live and isolation is possible only at remote end i.e. incomer to the switchboard.
5. The danger notice plate shall be made from minimum 1.6 mm thick steel sheet and after due pre-treatment to the plate, the same shall be painted white with vitreous enamel paint on both front and rear surface of the plate.
6. The letters, figures, the conventional skull and bones shall be positioned on the plate as per recommendations of latest edition of IS: 2551 (1982).
7. The said letters, the figures and the sign skull and bones shall be painted in signal Red colour as per latest edition of IS 5: 1978.
8. The danger plate shall have rounded corners. Locations of fixing holes for the plate shall be decided to suit the design of the switchgear enclosure.

**Cable Entry**

1. The panel shall have provisions of cable entry from top/ bottom as per site requirement. The removable cable gland plate shall be provided to make entry dust and vermin proof.
2. The panel shall have provisions for fixing the multi-core cable glands.
3. The cable glands support plates shall be 3 mm thick.
4. Cable entries to the panel shall be from the bottom unless otherwise specified. Cable gland shall be double compression screwed type and made of brass.

**Mountings**

1. All equipment in front of panel shall be of flush mounting type.
2. All equipment shall be so mounted that the removal and replacement may be accomplished individually without interruption of services of others.

3. All equipment inside the panel shall be so located that their terminals and adjustments are readily accessible for inspection or maintenance.
4. The centerline of switches, push buttons and indicating lamps shall be matched to give a neat and uniform appearance. Likewise, the top lines of all meters, relays and recorders etc. shall be matched.

It is important to note that when pumping station is idle and transformer is required to be kept energized under no load/ part (miniscule) load condition, the necessary LV fixed capacitor bank (approx. 5% of transformer rating) shall be provided in PCC / PDB (transformer H V / LV incomers) panels and shall be manually/ automatically switched on to maintain power factor more than 0.95 but less than 0.99 (near unity). All the components for fixed type capacitor bank (to be mounted in Main LV PCC) panel shall be as indicated in specifications & data sheet. Responsibility to maintain the power factor under idle condition & when only miniscule / part load is required lies completely with the Contractor. Any power factor adjustment charges levied by power utility shall be recovered from the Contractor along with 5 % lump sum administrative charge by the GWSSB.

#### **Moulded Case Circuit Breakers (MCCB)**

1. The MCCBs shall conform to IEC 947 & the latest applicable standards.
2. All MCCBs shall be of fixed type unless otherwise specified in the specifications elsewhere.
3. MCCBs shall be of four pole/ triple pole with neutral construction arranged for simultaneous four/ three-pole manual closing and opening and for automatic instantaneous tripping on short circuit.
4. All the incomer & bus coupler MCCBs for Main LT PMCC panels shall be FP type with Microprocessor based O/L +S/C + inbuilt E/F release & all outgoings MCCBs shall be TPN with thermal magnetic based O/L +S/C + E/F releases.
5. All MCCB's shall Schneider/ Siemens/ ABB / L&T/ Mitsubishi OR Reputed & Standard makes from the approved make list.
6. For achieving the Earth Fault protection in thermal magnetic (TM) based MCCBs, external CBCT, Earth Fault relay & shunt trip provision shall be considered as part of complete TM based MCCB.
7. The ON, OFF and TRIP positions of the MCCB shall be clearly indicated by using LED indications.
8. MCCBs shall be with  $I_{cs} = I_{cu} = 100\%$

9. MCCB shall be capable of withstanding the thermal stresses caused by overloads and locked rotor currents of values associated with protective relay settings of the motor starting equipment and the mechanical stresses caused by the peak short circuit current of value associated with the switch gear rating.
10. All the MCCBs shall be of current limiting type and shall provide a cut off in 4-8 milli seconds for prospective currents during faults.
11. All the MCCBs shall be provided with rotary operating handle with door interlock.
12. MCCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit ratings.
13. All MCCBs shall be provided with additional 2 NO + 2 NC contacts, exclusively for Purchaser's use.
14. All the switchgear selection for motor feeders shall be Type-2 co-ordinated.

Entire LV system shall be fuse-less type & fuses shall be used only for VT/ Control Transformer primary side. MCBs shall be provided on secondary of PT/ Control transformer

#### **Miniature Circuit Breaker (MCB)**

1. MCB shall be hand operated, air-break, quick make, quick-break type.
2. Operating mechanisms shall be mechanically trip-free from the operating knob to prevent the contacts being held closed under overload or short-circuit conditions.
3. Each pole shall be fitted with a bi-metallic element for overload protection and a magnetic element for short-circuit protection. Multiple pole MCBs shall be mechanically linked such that tripping of one pole simultaneously trips all the other poles. The magnetic element tripping current classification shall be of the type suitable for the characteristics of the connected load. Where this is not specified, it shall be Type C.
4. The short circuit rating shall be not less than that of the system to which they are connected.

#### **Direct-On-Line Starters**

Direct on line motor starter shall have following components/ features

1. Direct-on-line starters shall be suitable for Class AC-3 utilization category as per IS: 13947 (Part 4), unless otherwise mentioned in tender.
2. DOL starter shall have MCCB/ MPCB, Overload Relay with SPP, Contactor etc.
3. Type 2 Co-ordination shall be ensured.

**Reversing Starters**

Motor Reversing starter shall have following components/ features.

1. Forward and reverse contactors, electrically interlocked with each other.
2. Reversing starters shall be suitable for Class AC-4 duty as specified in applicable standards, unless otherwise mentioned in tender.

**Contactors**

The power contactors used in switchboard shall have following features.

1. The contactors shall confirm to IS: 13947 & the latest applicable standards.
2. The power contactors shall be of, air-break, single throw, triple pole, electromagnetic type.
3. The insulation class of contactor's coil should be B or higher.
4. Operating coils of all contactors shall be suitable for operation on 110/ 240 V, single phase, 50 Hz, AC supply.
5. Contactors shall be provided with at least two pairs of NO and NC auxiliary contacts.
6. Contactors shall not drop out at voltages down to 70 % of coil rated voltage.
7. All the switchgear selection for motor feeders shall be Type- 2 coordinated.
8. Motor starters shall be complete with auxiliary relays, timers and necessary indications.

**Relays**

1. Main protective relays shall be **Microprocessor based** type. They shall be suitable for semi-flush mounting with only flanges projecting on the front with connections from the rear.
2. All relays shall be enclosed in rectangular shaped, dustproof cases and shall be suitable for flush mounting.
3. All protective relays shall be in draw out cases with built in test facilities.
4. Auxiliary relays and timers shall be rated to operate satisfactorily between 70 % and 110 % of the rated voltage
5. Test block and switches shall be located just below each relay for testing unless otherwise specified. All auxiliary relay and timers shall be supplied in non-draw out cases.
6. All protective relays shall be provided with at least two pair of potential free output contacts, exclusively for Purchaser's use.
7. Relay cases shall have adequate number of terminals for making potential free connections, to the relay coils and spare contacts. Paralleling of contacts if any shall be done at the terminals on the casing of the relay.

8. Each relay shall have provision for easy isolation of trip circuit for the purpose of testing and maintenance.
9. All relays shall withstand out a test voltage of 2 KV, 50 Hz RMS voltages for one minute.
10. Auxiliary seal in units provided on the protective relay shall be shunt reinforcement type.

**Thermal Overload Relays**

1. Starters shall be complete with a three element, positive acting, ambient temperature compensated, time lagged thermal overload relay with adjustable settings. The setting range shall be properly selected in accordance with the rating of the motor.
2. Thermal overload relays shall be hand reset type.
3. 'Stop' push button of the starter and hand-reset device shall be separate from each other.
4. Overload relay hand reset push button shall be brought out on the front of the compartment door. Overload relay shall be provided with at least 1 'NO' and 1 'NC' or one changeover contact.

**Timers**

Electronics timer for change over in star-delta and ATS panel should be provided.

**Switch and Contactor Ratings**

Switch and contactor rating for various motor starter modules shall be selected by the Contractor based on the specifications. Contractor shall also select appropriate ratings & ranges for thermal overload relays. These details shall be subject to the GWSSB's approval.

**Single Phasing Preventers**

1. Single phasing preventer relay shall be provided to protect motors against single phasing.
2. It should operate satisfactory from 320/ 480V. Timing range of delay start 0 - 45 seconds.
3. Toggle switch for Auto SPP bypass should be provided on front of unit.
4. The relay shall not operate for supply voltage unbalance of  $\pm 5\%$ . After sensing single phasing, the relay shall operate with a time delay of 2 to 3 seconds.
5. The relay shall not operate for a 3- phase power supply failure. The relay shall be of the hand-reset type with a hand-reset push button. Resetting shall be instantaneous and independent of the adjusted time delay in the tripping of the unit. Visual indication for the operation of the relay shall be provided.
6. The relay shall be suitable for application to protect reversible and non-reversible motors.
7. The relay operation shall be independent of the motor KW rating, the loading conditions prior to the occurrence of the single phasing and RPM of the motor.



8. The relay shall be of the fail-safe type and shall operate to trip the motor when the relay internal wiring is accidentally open circuited.

### **Power & Control Wiring Connections**

1. Terminals for both incoming and outgoing cable connections shall be suitable for 1.1 K V grade Al/ Cu conductor XLPE armoured cable and shall be suitable for connections of solder less sockets for the cable size.
2. Main PMCC incomer feeder shall be suitable for cable termination / bus duct connections using Aluminium Bus bars.
3. Both control and power wiring shall be suitable for Bus Duct/ Cable termination as per guidelines mentioned in transformer specifications.
4. Both control and power terminals shall be properly shrouded. Power terminals shall be of stud type.
5. 20 % spare terminals shall be provided on each terminal block. Sufficient terminals shall be provided on each terminal block so that not more than one outgoing wire is connected to per terminal.
6. Suitable barriers of enclosures shall preferably separate terminals strips for power and control from each other.
7. Wiring inside the modules for power, control, protection and instruments etc. shall be done with use of 1.1 KV grades, multi-stranded Cu, PVC FRLS wiring.
8. Power wiring inside the starter module shall be rated for full current rating of respective contactor but not less than 4.0 sq. mm & 2.5 sq. mm copper wire shall be used for current transformer circuits.
9. Other control wiring shall be done with 1.5 sq. mm copper conductor wires.
10. Wires for connection to the door shall be flexible. All conductors shall be crimped with solder less sockets at the ends before connections are made to the terminals.
11. There shall be control transformer for control power supply (110/ 240V AC) and separate control bus.
12. Particular care shall be taken to ensure that the layout of wirings is neat and orderly. Identification ferrules shall be fitted to all the wirings terminations for ease of identification and to facilitate checking and testing.
13. Washers shall be used for all Copper and Aluminium connections.
14. Final wiring diagram of power and control circuit with ferrules nos. shall be submitted along with the panel as one of the documents against the contract.

**Terminals**

1. The outgoing terminals and neutral shall be brought to a cable alley suitably located and accessible from the panel front.
2. The current transformer for instruments metering shall be mounted on the disconnecting type terminal blocks. No direct connection of incoming or outgoing cables to internal components of the distribution board is permitted; only one conductor may be connected in one terminal.

**Wire Ways**

The horizontal PVC wire way with screwed covers shall be provided at the top to take interconnecting control wiring between different vertical sections.

**Indicating Instruments**

1. All analogue indicating meters shall be 144 x 144 mm size taut band with 240° Scale. All indicating meters shall be provided as per enclosed electrical Single Line Diagram.
2. Ammeters for motor feeders shall have suppressed scale up to 6 times beyond full load.
3. Dials shall be parallax free and white with black numbers and letterings & pointer shall be of knife-edge type. Such instruments shall be provided with zero adjustor accessible from the front.
4. Instruments shall have an accuracy class 1.0 or better.
5. Instrument dials shall be white with black numbers and lettering.
6. Ammeter and current coils of wattmeter's and ammeters shall continuously withstand 120 % of rated current and 10 times the rated current for 0.5 second without loss of accuracy.
7. Voltmeters and potential coils of voltmeters shall withstand 120% rated voltage continuously and twice the rated voltage for 0.5 seconds without loss of accuracy.

**Metering Instruments**

1. Multifunction meters shall be provided for incomers, main pump motor feeders and outgoing feeders of 250A & above. Size of the MFM shall be 96 x 96 sq. mm & provided with following metering features.
  1. Current, Voltage, Energy (kWh), MD (kW, kVA), PF & Hz etc.
  2. **MFM shall be Standard & reputed makes.**
  3. MFM shall be with accuracy class 1.0 or better & having RS 485 communication port.

4. Multifunction meters shall be suitable for operation from the secondary of CTs and VTs. They shall be provided with a separate 3 phases, 4 wires type test terminal blocks for testing of meters without disturbing CT and VT secondary connections.
5. Current coils of meters shall have a continuous overload capacity of 120 % for both accuracy as well as thermal limits. The coil shall withstand at least 10 times rated current for 0.5 second without loss of accuracy.

### **Current Transformers**

1. Current transformers shall be of cast resin type. Insulation Class shall be Class 'E' or better.
2. Current transformer shall have a short time withstand rating equal to the short time withstand rating of the associated switchgear for one second for breaker feeders.
3. Unless otherwise specified, the minimum performance requirement of current transformers is as follows
  1. Measuring CTs: 15 VA, accuracy class 1.0 or better.
  2. Protective CTs: 15 VA, accuracy class 5P20.
3. The abovementioned burdens are minimum required & it will be Contractor's responsibility to coordinate the current transformer burden with the requirements of relays, instruments and leads associated with that particular current transformer. Contractor has to provide sufficiency calculations for the same.
4. Current transformer (CT) shall have polarity markings indelibly marked on each transformer and at the lead terminations at the associated terminal block
5. CT shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit current
6. Test links shall be provided in both secondary leads of the CTs to easily carry out current and phase angle measurement tests.
7. Identification labels giving type, ratio, output and serial numbers shall be provided.

### **Push Buttons**

1. Push buttons shall have two normally open and two normally closed contacts unless otherwise specified. The contacts shall be able to make and carry 5A at 110V DC and shall be capable of breaking 1A inductive load at 110V DC. They shall be provided with inscription plates engraved with their functions.

2. Emergency stop' push buttons shall be of Mushroom type, lockable in the pushed position and shall be shrouded to prevent accidental operation. Key shall not be required for the operation of the push button.
3. The Internal wiring and terminal blocks shall meet the relevant requirements.

**Auxiliary Transformer**

Any auxiliary voltage required for any of the component inside the switchgear shall be derived from the main supply by providing adequately rated auxiliary transformer mounted inside.

**Indicating Lamps**

Indicating lamps shall be

1. Clustered LED type and of low watt consumption.
2. Provided with series resistors.
3. Provided with translucent lamp covers of colours 'Red', 'Green' and Amber' etc. as required.
4. Indicating lamp shall be of the double contact, bayonet cap type rated for operation at either 110 V AC or at the specified AC/ DC system voltage as applicable.

**Control & Selector Switches**

Control and selector switches shall be

1. Rotary type with enclosed contacts.
2. Adequately rated for the purpose intended (Minimum acceptable rating is 10A continuous at 230V AC and 1A (inductive break) 220VDC.
3. Provided with escutcheon plates clearly marked to show the positions.
4. Control switches shall be spring return to normal type & provided with pistol grip type handles.
5. Selector switches shall be maintained contact stay put type. Switches in ammeter circuits shall be of break type contact. Selector switches shall be provided with oval handles.

**Space Heaters**

1. Adequately rated anti-condensation space heaters shall be provided, one for each control panel, for each switchboard and for each marshalling kiosk.
2. Space heater shall be of the industrial strip continuous duty type, rated for operation on 240 V, 1 phase, 50 Hz, AC system.
3. Each space heater shall be provided with a single pole MCB with overload and short circuit release, a neutral link and a control thermostat to cut off the heaters at 35<sup>0</sup> C.

4. Space heater indicated in the breaker modules represents the space heater for each vertical section of the switchboard. Where breakers are mounted in two-tier formation, then only one space heater with associated MCB and thermostat is adequate for the vertical section

### **Cubicle Lighting/ Receptacle**

1. Each control cabinet, marshalling box etc. shall be provided with interior lighting by means of 11 W LED luminaries with door operated ON / OFF switch.
2. A 240 V, 1 phase, AC receptacle (socket) plug point shall be provided in the interior of each panel with MCB.

### **Local Push Button Stations**

#### **Constructional Features**

The constructional features of the local push button stations shall be as follows

1. Metal enclosed, weatherproof, suitable for mounting on wall or steel structures. The enclosure shall be die-cast aluminium or sheet metal of 2 mm thickness.
2. Dust and vermin proof.
3. Provide a degree of protection of not less than IP55.

### **Earth Leakage Relay**

For the protection against the rise of damaging / dangerous and possible lethal electric shocks, automatic disconnection of supply device i. e. ELR should be incorporated in PMCC panel suitably designed as per relevant IS / BSS in accordance with Indian electricity rules 1985 & statutory requirements of power utility i. e. UGVCL. Separate earth leakage breaker also shall be provided in the starters. The relay shall be voltage / current operated. The Minimum range should be 320 to 480 volts with suitable time delay. ELR should be of adjustable from minimum 0.5 to 2.5 amperes with CBCT with time delay.

**Routine and Acceptance Tests** to be conducted by the manufacturer at their own risk and cost in presence of GWSSB's representative during inspection & testing at manufacturer's works.

Following Routine tests as per IS: 13947 and IEC: 60947 standards & other specified relevant IS standards shall be performed by the manufacturer and witnessed by GWSSB's representative on LV Switchgear panel complete with the accessories.

1. Dielectric test on main circuit
2. Test on auxiliary and control circuit
3. Measurement of insulation resistance of the main circuit

4. Tightness of main circuit
  5. Design and visual check
  6. Dimensional check and BOM verification
  7. High Voltage test on power & control circuit
  8. Functional & mechanical operation test of all components
  9. Measurement of thickness of sheet steel & paint
  10. Verification of wiring as per approved schematic
1. Following Type Tests reports as per IS: 13947 and IEC: 60947 to be submitted for the same rating & type of LV Switchgear panel conducted in past for review of GWSSB at the time of inspection & testing of equipment. Type test reports should be valid and not be older than the 5 years. LV type test panel certificate for temperature rise and short circuit shall be with switchgear which shall confirm the design reliability of the panels as per IEC test standards.
1. Dielectric test on main and auxiliary circuit
  2. Temperature rise test
  3. Making and Breaking test of switching elements
  4. Degree of protection test
  5. Short circuit withstand test
  6. Electromagnetic compatibility test
7. Certified copies of all type and routine test certificates and Calibration Certificates of measurement instruments which are used during inspection shall be submitted for the GWSSB's review/ approval before dispatch of the switchgear.

**Test Certificates**

1. Testing of switchgear shall be carried out at factory or at site as per standard in presence of GWSSB's representative.
2. The test results shall be recorded on prescribed forms. The certificates for the test carried out at factory or at site shall be submitted in duplicate to the GWSSB's Representative for

approval. Components and equipment that are not fully interchangeable are liable for rejection. Contractor shall replace all such non interchangeable equipment at his cost.

### **Drawings/ Documents**

After award of contract, Contactor has to submit drawings/ documents for GWSSB's approval as mentioned below but not limited to:

1. General arrangement diagram showing dimensions of enclosure, length, widths and depth of enclosure and bill of quantity indicating the rating, make of each components and quantity.
2. Complete assembly drawings of the switchboard/ distribution board/ MCC showing plan, elevation and typical sectional views and location of cable boxes and control cable terminal blocks for external wiring connections, etc.
3. Foundation plan showing the location of channel sills, foundation, anchor bolts and anchors, floor plans and openings.
4. Schematic power and control wiring diagrams with bus bar rating with material, instrument & control transformers, switchgear rating, control interlocks, relays, instruments, space heaters details etc.
5. Metal parts shall be given tropicalizing treatment as per standards and painted with one coat of epoxy primer and two coats of light grey epoxy paint.
6. Provided with inscription plates of rear engraved Perspex with white letters on black background. The letter size shall be 6 mm.
7. Provided with two earthing terminals suitable for earthing wire /strip.
8. Provided with removable undrilled gland plate and cable glands for two nos. 5C x 2.5 mm<sup>2</sup> Copper conductor, XLPE insulated, armoured cable. The cable entry shall be from the bottom.
9. Earthing shall be provided by 8 SWG GI wire and connected to earthing system.

### **DETAILS & REQUIREMENTS FOR L V (415 V) POWER CONTROL PANELS**

(DATA SHEETS)

**Data sheet with all details & requirements as well as materials of construction for various parts, mandatory accessories, spares & services required are given in the data sheet section.**

**Contractor must go through it in depth so as to satisfy the basis, general & overall requirements of the equipment.**

## **APFC PANEL WITH CAPACITOR BANKS**

### **Scope**

This specification covers design, manufacture, testing at manufacturer's works, supply, packing, forwarding and delivery from place of storage/ manufacturer's works to erection site including transit insurance, unloading, storage at site, assembly, erection, testing, installation, commissioning and performance demonstration of the following equipment with associated accessories. It is two provided on two sections i. e. two numbers of equal & half capacity as described in data sheet in combined enclosure with MCC panel i e MCC cum APFC panel.

### **Capacitor Banks**

1. The type of capacitors shall be All Polypropylene type double layer conforming to IS: 13585 (1994) & having following specifications.
 

Supply	3 phase, 3 wire
Rated voltage	415 V
Rated frequency	50 Hz
Permissible over voltage	1.1 Vn
Permissible over current	1.5 In
Temperature category	50° C
2. The capacitor shall be vacuum impregnated with liquid dielectric having high thermal stability.
3. The capacitors shall have Low Dielectric Loss of  $\leq 0.5$  W / KVAR.
4. Each capacitor bank shall be provided with the 7% detuned filter.
5. \* kVAr is net reactive compensation required to maintain 0.99 PF at 415 V Bus i.e. excluding compensation required for detuned filters.
6. Bushing should have high mechanical strength & method of fixing should be proper so that no leakage occurs.
7. Auto/ Manual switch shall be provided in the APFC panel. For manual switching, every capacitor bank feeder shall be provided with ON & OFF push buttons along with the ON & OFF indications.
8. Minimum current rating under site conditions, of circuit breakers, contactors and cables shall be at least 150% of rated capacitor current, to take care of harmonics.
9. Contactor for switching of capacitor banks shall have AC-6b utilization category according to IEC 60947-4-1 & sized accordingly.



10. All the components shall be suitable for capacitor duty application.
11. The capacitor banks shall be complete with all parts that are necessary or essential for efficient operation. Such parts shall be deemed to be within the scope of supply whether specifically mentioned or not. Capacitor shall be designed to improve the power factor to 0.99 lagging.
12. It shall be complete with the required capacitors along with the supporting post insulators, steel rack assembly, Al/ Cu bus bars, Al/ Cu connecting strips, foundation channels, fuses, fuse clips, etc. The steel rack assembly shall be hot dip galvanized.
13. The capacitor bank may comprise of suitable number of single-phase units in series parallel combination. However, the number of parallel units in each of the series racks shall be such that failure of one unit shall not create an over voltage on the units in parallel with it, which will result in the failure of the parallel units. The assembly of the banks shall be such that it provides sufficient ventilation for each unit.
14. Each capacitor case and the cubicle shall be earthed to a separate earth bus.
15. Capacitor shall conform to IS: 2834.
16. The units shall be capable of continuously withstanding satisfactorily any overvoltage up to a maximum of 10 % above the rated voltage, excluding transients.
17. Each capacitor unit/ bank shall be fitted with directly connected continuously rated, low loss discharge device to discharge the capacitors to reduce the voltage to 50 volts within one minute upon disconnection, in accordance with the provisions of the latest edition of IS:2834.
18. Individual capacitor protection shall be provided with required rating of MCB of required curve characteristic. Fuses are not acceptable.

### Control Cubicles

1. Capacitor and capacitor control shall be housed in a metal enclosed cubicle. Capacitor shall be housed in the lower compartment and capacitor control unit at the top compartment, the two compartments being segregated. Control cabinets shall be free standing floor mounted type and shall meet the requirements of Metering, Protection & related provisions for APFC panel as tabulated below.

Panel Section	Breaker Type	Protection	Metering	Indications	Other

Incomer	MCCB (TPN, Fixed Type)	TM based O/L, S/C release, APFC Relay, E/F Relay with CBCT & Shunt Trip	Analogue A, V	R, Y, B, On, Off, Trip	ETPB, A/M SS, Annunciator
Outgoing	MCCB (TP, Fixed Type)	TM based O/L, S/C release	A, AS	On, Off, Trip	Start, Stop Push Buttons

2. APFC panel shall have AI bus bars sized for appropriate SC rating for 1 sec & to carry continuous rated current.
3. All CTs/ VTs shall be cast resin type.
4. All the MCCB's shall be current limiting type. Necessary auxiliary contact block required is included in Contractor scope.
5. One contact of power factor correction relay shall be provided for annunciation "POWER FACTOR LOW". The relay shall switch on/ off capacitor banks for loads from 5% to 100%. The annunciation window shall be with test, accept and reset push button & hooter.
6. Capacitor switching and automatic power factor correction panel shall be designed in such a way that power factor of 0.99 lagging shall always be maintained. Timings to cut in capacitors shall be provided in such a manner to facilitate capacitor discharging before next switching and shall also avoid hunting due to temporary fluctuations of load. The timer shall be provided in both auto and manual mode.
7. The Automatic power factor correction panel and capacitor panel are integral type, prewired including power connections. Due consideration shall be given for adding/removal of capacitor or other components and maintenance considerations. Contractor shall submit General Arrangement drawings of capacitor and capacitor control panel, with description of power factor control panel with its components.
8. For control circuit 415/ 240/ 110V AC control transformer shall be considered. VA burden to be decided by the Contractor. Minimum clearance between live parts shall be phase to phase 25.4 mm & phase to neutral 20 mm.

9. Bus bars shall be sleeved with coloured heat shrinkable sleeves. All the Bus bar supports shall be SMC type only.
10. Degree of protection shall be IP 52 for the enclosure, epoxy painted, powder coated with colour shade RAL7032 for exterior & interior with minimum thickness 80 micron.
11. All necessary auxiliary contactors are included in scope.
12. Contractor shall note that verification of double layer construction shall be done on any one of the capacitor banks during inspection by opening the capacitor bank at no extra cost.
13. The cubicle shall be fabricated out of 2.0 mm thick cold rolled sheet steel & shall comprise of:
  1. Isolating MCCB
  2. Contactors with overload element
  3. Sequencing devices, timers and auxiliary relays for automatic sequential switching of capacitor units in and out of circuit.
  4. Auto-Manual selector switch
  5. Microprocessor based Automatic Power Factor Correction (APFC) Relay of minimum 12 stages.
  6. Push button for opening and closing the power circuit
  7. Red and Green lamps for capacitors ON/ OFF indication
  8. Protective relays to protect the healthy capacitor units when one unit fails in a series connection
  9. Space heater and cubicle lighting & receptacles.

### **Principle of Operation**

On deviations from set power factor, the power factor controller shall release command signals to switch on/ switch off capacitor bank stages and maintain the set power factor.

### **APFC Relay**

APFC relay shall have following standard features.

1. The Automatic Power Factor Correction relay shall be of Microprocessor based type and shall automatically switch ON/ OFF the capacitor banks to attain the value of “PF” close to the set value.

2. Switching shall follow first in first out (FIFO) method to ensure uniform use of all capacitor banks. At least eight steps or as decided by EIC shall be provided for switching.
3. To measure/ monitor power factor and VAR continuously. Status of switching step shall be displayed through LED.
4. Following adjustment shall be available in APFC Relay.
  1. Power factor
  2. Dead band capacitive region with respect to set power factor (PF)
  3. Inductive region with respect to set PF
  4. Operating time for programmable switching steps
  5. Auto/ Manual selector switch
  6. Manual step control
7. All control knobs, LEDs for display and selector switches shall be mounted on the front face of panel.
8. It should be fully programmable. There should be a choice for customer to select operating sequence up to 4 to 5 which will have maximum number of steps of capacitors equal to fourteen (14). The sequence shall be arithmetic 1, 2, 3.....13, 14.
9. Operating time selection of time interval designation between switching stages shall be possible using time selector switches. The device shall take care that any stage which has just been switched out will only be reconnected by the pulse counter, after 60 seconds has elapsed so that it has safely discharged. This is a requirement for 415 V capacitors.
10. Loss of voltage element: This would prevent abnormal switching surges on loss of supply as well as it would control the switching ON / Off surges.
11. Dead band features: Relay response sensitivity adjustable using dead band so that hunting is prevented.
12. Auto / Manual control: This would help testing and commissioning at site as well as ease in operation when either mode fails during service time.

**Performance Tests**

1. Contractor shall carry out all routine tests as specified in relevant IS/ IEC standards on all major components and furnish copies of test reports for GWSSB's approval. Wherever

required, Contractor shall conduct the necessary type tests in the presence of GWSSB's representative.

2. Contractor shall also carry out all routine and functional tests as specified in the relevant IS on the assembled switchgear panels in the presence of the GWSSB's representative at works before dispatch and furnish copies of test reports for approval. If required stage inspection will be carried out by the PMC / GWSSB.
3. During inspection, Contractor shall furnish copies of routine test report for all bought out items for Purchaser's approval.
4. Primary Injection Test for various currents & time settings shall be provided in routine test.
5. All the components shall be tested for their entire operating range & certification for the same shall be provided at the time of inspection.

### **Maintenance Requirements**

1. As far as possible the switchgear shall be so designed that no special tools are necessary for installation and maintenance. However, if special tools are required, the Contractor shall supply one complete set of such tools along-with the equipment.
2. Contractor shall furnish detailed inter panel wiring diagrams, internal wiring diagrams, detailed component layout drawings to carry out maintenance work.

### **Drawings / Documents Required**

1. Dimensioned general arrangement drawings of capacitor and capacitor control panel.
2. Justification for number of steps for switching.
3. Fully dimensional general arrangement drawings of capacitor and capacitor control panel with elevation side view, sectional view and foundation details.
4. Complete schematic and wiring diagrams for capacitor control panel.

### **DETAILS & REQUIREMENTS FOR L V (415 V) APFC PANEL WITH CAPACITOR BANKS(DATA SHEETS)**

**Data sheet with all details & requirements as well as materials of construction for various parts, mandatory accessories, spares & services required are given in the data sheet section.**

**Contractor must go through it in depth so as to satisfy the basis, general & overall requirements of the equipment**

## **CABLES & CABLING SYSTEM**

### **Scope**

It shall be inclusive of supply, installation, testing & commissioning of power, control and instrumentation cables, cable terminations, cable accessories, stripping of cable insulation, supplying and fixing of Aluminium lugs for aluminium cables & tinned plated copper lugs for copper cables and crimping the same to the conductor, supply and fixing of double compression cable glands including all labour supply and consumable material required for jointing/termination. The rate shall also include the laying of cable in ground/ in cable trays / cleating to structure etc.

### **Applicable Standards**

The cables shall confirm to the latest applicable standards specified below. In case of conflict between standards and this specification, this specification shall govern.

PVC insulated cables(for voltage up to 1100 V)	IS: 694
HRPVC & PVC insulated cables heavy duty	IS: 1554
Cross linked polyethylene insulated PVC sheathed cables	IS: 7098
Low frequency cables and wires with PVC insulation & sheath	IEC: 189-1 & IEC-189-2
PVC insulation and sheath of electric cables	IS: 5831
Polyethylene insulation and sheath for electric cables	IS: 6474
Conductors for insulated electric cables	IS: 8130
Methods of test for cables	IS: 10810
Specification for drums of electric cables	IS: 10418
Specification for PVC insulated cables for electricity supply	BS: 6346
Specification for PVC insulation and sheath of electric cables	BS: 6746

**Constructional Features**

1. HV power cables shall conform to 11 KV / 0.415 KV Earthed grade (E), 3 core, stranded, Aluminium conductor, screened by extruded semi-conducting compound, cross-linked poly ethylene (XLPE) insulated, cores screened with non-magnetic metallic tape laid up with inner and outer extruded PVC sheath compound Type-ST2 and galvanized steel strip armouring. The cables shall generally conform to IS: 7098-1985 with relevant parts thereof.
2. Armouring shall confirm to latest version of IS: 3975.
3. LV Power cables shall be 1.1 KV grade, 4/ 3.5/ 3 Core, multi-stranded, Al/ Cu conductor, XLPE insulated, extruded inner & outer PVC sheath compound type ST2 and galvanized wire (up to 6 sq. mm)/ steel strip (>6 sq. mm) armoured cables. All single phase, Lighting cables, UPS cables shall have 100% Neutral.
4. All the control cables shall be 1.1 KV grade, no. of cores (as per requirement/ application with minimum 2 spare cores for 7C & above), multi-stranded, Copper conductor, XLPE insulated, extruded inner PVC & outer PVC FRLS sheath compound type ST2 and galvanized steel round wire armoured.
5. All control cables shall be with following specific requirements
  1. Copper conductor stranded class 2
  2. XLPE Insulated
  3. Provided with inner extruded PVC and outer PVC FRLS sheath of extruded black PVC compound.
  4. Galvanized steel armoring in the form of GI round wire.
  5. Core identification shall be by printed numerals.
  6. The insulation over the individual conductor core will be colour coded.
  7. Minimum 2 spare cores for above 7C.
8. The DC power supply cable shall be two core, multi-stranded copper conductor, armoured cables with inner extruded PVC & outer PVC FRLS sheath. All control wiring shall be PVC FRLS insulated.

9. All the power, control & instrumentation cables used in the hazardous area shall be flame proof type suitable for the intended application.
10. Earthing cable shall be Single core multi-stranded Cu, 1.1 K V grade, XLPE insulated, un-armoured green coloured outer sheath with yellow strips/ band cable to be laid in trays, underground, trenches etc.as applicable.

**11. Submersible Cables(If Required)**

Multi core flexible Cu conductor XLPE insulated & PVC sheathed heavy duty cable suitable for submersible application (in case of submerged pumps) shall be manufactured as per governing standards. High purity electrolytic grade, annealed Cu conductor shall be used. Cables shall be extruded inner & outer PVC sheathed. PVC compound shall be dielectric grade & shall be impervious to water, oils & grease etc. Similarly, double PVC sheathing shall also be done as per IS: 5831/ 1984. Flexible inner sheath & high abrasion resistant flexible outer sheath is required for these cables. Double PVC sheathing shall be done so as to withstand abrasion & prevent ingress of water along the interstices of the cable. Core identification shall be by printed numerals. Conductors shall be as per IS 8130. Cable shall be constructed as per relevant IS/ IEC standards.

**Cable Colours**

1. All cable cores shall be colour coded throughout their length and shall be so connected between switchboard, distribution board, plant and accessories, that the correct sequence or phase colours are preserved throughout the system.
2. The colour coding should be as follows
  1. 3 phase Red, Yellow and Blue
  2. single phase or DC supply Red and Black
  3. earth Green/Green with Yellow coloured band
  4. control Grey (DC)

**Cable Conductors**

1. Cables up to 4.0 sq.mm shall be Cu multi-stranded conductor with galvanized steel round wire armoured & balance cables shall be Al multi-stranded conductor with galvanized steel round wire/ flat strip armoured.
2. Single core cable shall have non-magnetic material armouring.
3. Lighting final distribution circuits shall be of a minimum cross-section of 1.5 mm<sup>2</sup>.
4. Small control cables shall be of a minimum cross-section of 1.5 mm<sup>2</sup>.



5. Internal wiring of control panels shall be of a minimum cross-section of 1.5 mm<sup>2</sup> flexible and multi-stranded.
6. Instrumentation and control cabling shall be of a minimum cross-section 1.5 mm<sup>2</sup> for external use and 1.0 mm<sup>2</sup> for internal use.
7. Cable sizing shall be done as per design criteria specified in specifications.

### **Cable Numbering**

All cables shall be allocated a unique number which shall be fixed to each end of the cable using a corrosion resistant label. Necessary loop at both ends shall be provided for future use and cables of different categories shall be tagged with the following subscripts and three-digit number.

HV power	HV-P_ _ _
LV power	P_ _ _
Control	C_ _ _
Instrumentation	I_ _ _
Protection	PR_ _ _
Telecommunication	T_ _ _

### **Cable Terminations**

#### **1. Cable Lugs**

1. Cable lugs shall be of tinned copper, solder less crimping type for Cu cables & AL lugs for the AL cables.
2. The current rating of the lugs shall be same as that of the respective cable conductors.
3. Bi-metal strip/ Bi-metallic lug shall be used whenever two different metals are to be connected together.
4. Double holes extended neck (long barrel neck) type lugs shall be used in case of cables above 185 sq. mm.
5. Anticorrosion/ anti-oxidation compounds shall be used for crimping lugs. This shall especially be ensured for Al cable terminations & bimetallic terminations shall be used wherever required.
6. If termination is done with crimping tool employing crimping die then forming dies shall be used to make the sector shaped conductor into a round conductor before crimping the lugs on the conductor. The lug must not be crimped directly on the sector conductor. Before crimping the lug, the conductor shall be thoroughly cleaned

and special jelly applied over it to prevent further oxidation.

## **7. Cable Glands**

1. Glands shall generally be of the double compression hexagonal type brass glands. Earth continuity of brass glands shall be assured.
2. Double compression type cable glands shall be used. Cable glands shall be brass casting, machine finished and Nickel-plated to avoid corrosion and oxidation. Rubber components used in cable gland shall be of neoprene.
3. For single core cables, gland shall be with brass ring.
4. Glands for single core cables shall be constructed from non-magnetic materials.
5. Cable glands shall be with metric threads.
6. Where holes for cable entries are not provided it shall be the responsibility of the Contractor to mark out and drill such holes. Burrs and swarf shall be removed, care being taken to ensure that swarf and filings etc. do not enter the equipment.
7. For non-hazardous areas cable glands in situations where moisture may be present shall be double seal weatherproof type, gland shrouds shall be used and entry shall be sealed.
8. For dry indoor situations, standard industrial glands with shrouds are acceptable.
9. For hazardous areas, glands conforming to IEEE standard shall be used with double seal and shroud.

## **10. Trefoil Clamps for Single Core Cables**

1. All the single core cables shall be laid in trefoil formation only.
2. The grouping & sequencing of three single core cables arranged in trefoil formation shall be done in such a way to ensure balanced current distribution.
3. Trefoil clamp of suitable size & having non-magnetic material shall be used.
4. The Trefoil groups shall be held in trefoil clamps at an interval not exceeding 3.0 meters.
5. In addition to trefoil clamps as mentioned above, the trefoil groups of cables shall be additionally tied by means of 3.0 mm dia. nylon cord clamp at an interval not exceeding 750 mm.
6. Wherever applicable, supply & installation provision of bimetallic strip for connection between Al to Cu strip & GI to Cu strip shall be provided.

**Instrumentation Cables**

1. This specification covers the requirements for instrument signal cables, thermocouple extension cables, RTD cables and power/ control cables.
  1. Single pair shielded signal/ alarm cables shall be used between field instruments / switches and junction boxes / local control panels.
  2. Single pair shielded thermocouple extension cables shall be used between thermocouple head and junction boxes/ transmitters/ local control panel mounted instruments.
  3. Single triad shielded signal cables shall be used between RTD head and junction boxes/ transmitters/ local control panel mounted instruments.
  4. For field bus compatible instrument single pair shielded cable shall be used between instrument to junction box/ local panel and to control room.
  5. Foundation Field bus shall be Type-A cable. Construction of same shall be as per IEC 61158-2. Trunk cable shall be used of 1 Pair, 5 Pair, and 12 Pair.
  6. Separate Multi-pair/ multi-triad cables shall be used between junction boxes/ local control panel and control room as per following applications.
    1. 4-20 mA signals (for conventional HART Transmitters)
    2. Foundation Field signals
    3. Thermocouple signals
    4. Resistance Temperature Detectors (RTD) signals
    5. Switch contacts/ Proximity switch contacts
    6. Gas detectors
  7. Instrument power cables shall be used between power supply distribution boards and power consumers such as control panels, DCS/ PLC cabinets, any instruments requiring power supply, etc.
  8. Instrument control cables shall be used for valves, feedback of feeders etc.
  9. The cable design shall generally follow BS 5308 Part-1 for various cables listed in clause-e as above.
  10. Thermocouple cables design shall comply with ANSI MC 96.1.
  11. The power and control cables shall be generally as per BS 6346. For these cables, equivalent IEC/ IS specifications are also acceptable.
  12. The insulation grade shall be 1100 V AC for all cables.
  13. The primary insulation shall be cross-linked Polyethylene with temperature rating

70°C conforming to BS: 5308/ IS: 7098.

14. Inner and outer sheath/ jacket shall be made of extruded fire retardant, low smoke, low halogen, low toxic, polymeric compound having physical properties as per IS:5831-Type ST2.
15. All cables shall be armoured and suitable for operation when installed as follows
  16. Directly buried in the ground
  17. Fastened to cable ladder rack or tray in the open air
  18. In underground ducts
  19. In overhead closed cable ducts
20. Running length of the cable shall be printed at least at every 5metre interval.
21. For Multi-pair/ multi-triad cables, pair identification shall be provided with numbers at interval of not more than 250 mm as per Contractor's standard.
22. Contractor shall ensure a minimum of 20% of quantity of each type of cables supplied as spare including any special cable and in each Multi-pair cable 20% pairs shall be kept as spare.
23. A pair of communication wire shall be provided for Multi-pair/ multi-triad cables.
24. Each wire shall be 0.5 mm<sup>2</sup> of plain annealed single or multi-strand copper conductor with 0.4 mm thick 70°CXLPE insulation.
25. All cables shall be fire retardant and low smoke.

## 26. Design and Testing Standards

### 1. Instrument signal, RTD and thermocouple cables

Sr. No.	Description	Particulars
1	Conductors	BS: 6360/ IS: 8130 for instrument signal and RTD cables and ANSI MC 96.1/IEC: 60584-3 for thermocouple cables.
2	Insulation	Cross-linked Polyethylene (XLPE) as per BS: 5308 / IS: 7098.
3	Armour	Round wire armour galvanized steel as per IS: 1554 Part 1
4	Inner & Outer Sheath-PVC	Extruded Fire Retardant, Low Smoke, Low Halogen, Low Toxic, PVC having physical properties as per IS: 5831-Type ST2. Flammability and chemical

Sr. No.	Description	Particulars
		<p>properties shall be as follows</p> <ol style="list-style-type: none"> <li>Oxygen Index: 30 (minimum) at room temp as per ASTM-D-2863-77</li> <li>Temperature Index: 250<sup>0</sup> C (minimum) at Oxygen Index of 21 as per ASTM-D-2863.</li> <li>Light Transmission: 70% (minimum) as per IEC: 1034.</li> <li>Flammability test: As per IEC: 332 Part-1 &amp; Part-3 Cat. A</li> <li>Corrosivity of combustion gases: pH-index &gt; 4.3, Electrolytic conductivity &lt; 100 micro S/cm as per IEC 754-2</li> <li>Toxicity index: Maximum 05 Gases to be extracted – HCL, HBr, HF, CO, CO<sub>2</sub>, NO, SO<sub>2</sub>, HCN as per NES-713. HCL shall be first gas to be extracted</li> </ol> <p>Inner Sheath and outer sheath thickness: Minimum inner sheath thickness and outer sheath thickness shall be as per IS: 1554(P-1)1988 (should not be less than 0.5 mm).</p> <p>Outer Sheath Colour: Blue</p> <p>Inner Sheath Colour: Black</p>
5	Testing of the instrument Signal and RTD cables	BS: 5308
6	Testing / Calibration of Thermocouple cables.	ANSI MC96.1 / IEC: 60584-2
7	Dimensions	BS: 5308

## 7. Instrument power and control cables

Sr. No.	Description	Particulars
1	Conductors	IS: 8130 / BS: 6360
2	Insulation	Cross-linked Polyethylene (XLPE) as per BS: 5308 / IS: 7098.
3	Armour	Round wire armour galvanized steel as per IS: 1554 Part 1
4	Inner & Outer Sheath-PVC	<p>Extruded Fire Retardant, Low Smoke, Low Halogen, Low Toxic, PVC having physical properties as per IS 5831 Type ST2. Flammability and chemical properties shall be as follows:</p> <ol style="list-style-type: none"> <li>8. Oxygen Index: 30 (minimum) at room Temp as per ASTM-D-2863-77</li> <li>9. Temperature Index: 250<sup>0</sup> C (minimum) at Oxygen Index of 21 as per ASTM-D-2863.</li> <li>10. Light Transmission: 70% (minimum) as per IEC 1034.</li> <li>11. Flammability test: As per IEC 332 Part-1 &amp; Part-3 Cat. A</li> <li>12. Corrosivity of combustion gases: pH-index &gt; 4.3, Electrolytic conductivity &lt; 100 micro S/cm as per IEC 754-2</li> <li>13. Toxicity index: Maximum 05 Gases to be extracted – HCL, HBr, HF, CO, CO<sub>2</sub>, NO, SO<sub>2</sub>, HCN as per NES-713. HCL shall be first gas to be extracted.</li> </ol> <p>Inner Sheath and outer sheath thickness: Minimum Inner sheath thickness and outer sheath thickness shall be as per IS: 1554(P-1)1988, should not be less than 0.5 mm.</p> <p>Power Cables: Black</p> <p>Control Cables: Blue with black bands (4 bands at 90<sup>0</sup> apart)</p>

Sr. No.	Description	Particulars
5	Testing of the power and control cables.	IS: 1554 Part I, BS: 6469 / BS: 6346

### Cable Construction

14. The various mechanical/ electrical parameters indicated here are indicative and the Contractor shall be responsible to select/ design the cables as per applicable standards.

#### 1. Instrument Signal Cables (4 – 20 mA or Switch Contacts)

Sr. No.	Description	Particulars
1	Conductor (Single / Multi Pair)	7 stranded / 0.53 mm dia. (1.5 mm <sup>2</sup> ) stranded annealed tinned copper conductors of electrolytic grade copper.
2	Insulation	Cross-linked Polyethylene (XLPE) as per BS: 5308/IS: 7098.
3	Inner & outer sheath	PVC, fire retardant, low smoke, low halogen, low toxic, polymeric compound.
4	Pairs	Two insulated conductors shall be uniformly twisted together to form a pair at least 10 twists per metre.
5	Maximum DC Resistance	Shall not exceed 12.3 ohms/ km at 20 <sup>0</sup> C for cables with 1.5 mm conductor.
6	Mutual capacitance	BS: 5308 Part 1
7	L/R ratio of adjacent cores/pairs	BS: 5308 Part 1
8	Shield	Shield shall be aluminium backed mylar/ polyester tape bonded together with the metallic side down helically applied with either side having 25% overlap and 100% coverage. The minimum shield thickness shall be 0.05 mm in case of single pair and 0.075 mm in case of multi pair cable.
9	Drain wire	Drain wire shall be provided for individual pair and

Sr. No.	Description	Particulars
		overall shield with 0.5 mm <sup>2</sup> ) multi-stranded bare tinned annealed copper conductor continuously in contact with aluminium side of shield.  The drain wire resistance including shield shall not exceed 30 ohm/km. Electrostatic noise rejection ratio shall be over 76 dB.
10	Colour coding	Individual pair core insulation: Blue & Black  Inner jacket: Black  Outer jacket: Blue for intrinsically safe application and blue with black bands (4 bands at 90° apart) for non-IS applications.

## 1. RTD Cables

Sr. No.	Description	Particulars
1	Conductor (Single / Multi Triad)	7 stranded / 0.53 mm dia. (1.5 mm <sup>2</sup> ) annealed tinned copper conductors of electrolytic grade copper.
2	Insulation	Cross-linked Polyethylene (XLPE) as per BS: 5308/ IS: 7098
3	Inner & outer sheath	PVC, fire retardant, low smoke, low halogen, low toxic, polymeric compound.
4	Triads	Three insulated conductors shall be uniformly twisted together to form a Triad at least 10 twists per metre.
5	Maximum DC resistance	Shall not exceed 12.3 ohms/ km at 20°C for cables with 1.5 mm <sup>2</sup> conductor
6	Mutual capacitance	BS: 5308 Part 1
7	L/R ratio of adjacent triads	BS: 5308 Part 1
8	Shield	Shield shall be aluminium backed mylar/ polyester tape bonded together with the metallic side down helically applied with either side having 25% overlap



Sr. No.	Description	Particulars
		and 100% coverage. The minimum shield thickness shall be 0.05 mm in case of single triad and 0.075 mm in case of multi-triad cable.
9	Drain wire	Drain wire shall be provided for individual pair and overall shield with 0.5 mm <sup>2</sup> multi-stranded bare tinned annealed copper conductor continuously in contact with aluminium side of shield.  The drain wire resistance including shield shall not exceed 30 ohm/km. Electrostatic noise rejection ratio shall be over 76 dB.
10	Colour coding	Core insulation: Red, Yellow and Blue Inner jacket: Black Outer jacket: Blue for intrinsically safe application and blue with black bands (4 bands at 90° apart).

## 2. Thermocouple Cables

Sr. No.	Description	Particulars
1	Conductor Single pair cable	16 AWG or 1.5 mm <sup>2</sup> solid conductors Conductor Materials: K type T/C – Nickel/Chromium, Nickel/Aluminium (KX), Class 1.0
2	Insulation	Cross-linked Polyethylene (XLPE) as per BS 5308/IS: 7098, Colour code: Nickel/Chromium: Green Nickel/Aluminium: White
3	Pairs	Two insulated conductors shall be uniformly twisted together to form a pair at least 10 twists per metre. The lay length of adjacent pairs/ triads in case of Multi-pair cables shall not be equal, to reduce cross-talk.
4	Mutual capacitance	BS: 5308 Part 1
5	L/R ratio of adjacent triads	BS: 5308 Part 1

Sr. No.	Description	Particulars
6	Core inductance	Shall not exceed 4 mH/km. However, for J-type thermocouple inductance could be 8 mH/km.
7	Shield	Shield shall be aluminium backed mylar / polyester tape bonded together with the metallic side down helically applied with either side having 25% overlap and 100% coverage. The minimum shield thickness shall be 0.05 mm in case of single pair and 0.075 mm in case of multi pair cable.
8	Drain wire	Drain wire shall be provided for individual pair and overall shield with 0.5 m m <sup>2</sup> multi-stranded bare tinned annealed copper conductor continuously in contact with aluminium side of shield. The drain wire resistance including shield shall not exceed 30 ohm/km. Electrostatic noise rejection ratio shall be over 76 dB.
9	Colour coding	Outer sheath colour - Green Inner sheath colour - Black

All thermocouple extension cable shall be matched and calibrated in accordance with IEC: 60584-2/ ANSI MC 96.1.

### 3. Instrument Control Cables

Sr. No.	Description	Particulars
1	Conductor 2 Core / Multi-core type	7 stranded / 0.53 mm dia. (1.5 mm <sup>2</sup> ) annealed tinned copper conductors of electrolytic grade copper.
2	Insulation	Cross-linked Polyethylene (XLPE) as per BS: 5308 / IS: 7098

Sr. No.	Description	Particulars
3	Inner & Outer Sheath	PVC, fire retardant, low smoke, low halogen, low toxic, polymeric compound.
4	Maximum DC Resistance	Shall not exceed 12.3 ohms/ km at 20 <sup>0</sup> C for cables with 1.5 mm <sup>2</sup> conductor
5	Core Identification	IS: 1554/ BS: 6746

#### 4. Instrument Power Cables

Sr. No.	Description	Particulars
1	Conductor	7 stranded/ 0.67 mm dia. (2.5 mm <sup>2</sup> ) annealed tinned copper conductors of electrolytic grade copper. The size of the conductor specified here is minimum however, the exact size of the conductor shall be selected based on the length of cable and power consumption. For higher conductor sizes, Aluminium can be considered.
2	Insulation	Cross-linked Polyethylene (XLPE) as per BS: 5308/ IS: 7098
3	Core Identification	IS: 1554/ BS: 6746
4	Colour coding	Outer sheath colour –Black Neutral wire insulation colour – Black Phase wire insulation colour – Red Ground wire insulation colour– Green

#### 5. Ethernet Cables

6. EIA/ TIA 568 A Category 5, 4 pair 0.5 mm<sup>2</sup> (24 AWG) solid conductors, with plastic foil wrapping.
7. Overall screen to consist of aluminium bonded polyester tape and tinned copper wire.
8. Overall sheath shall be light grey PVC.

#### 9. Fibre Optic Cables

10. 62.5/ 125micron multimode, graded index, glass silica fibre core, mechanical protection provided by round galvanized steel armour with polyester laminated tape layered over inner sheath.
11. Outer sheath shall be orange.
12. HDPE conduit shall be orange colour.
13. Any other special cables such as co-axial cable or cables with glass insulation, required for instruments shall also be supplied as per requirements.
14. Contractor shall ensure that these cables are armoured type and shall meet all other requirements specified above, as applicable.

**Cable Drums**

1. Cables shall be supplied in non-returnable wooden drums. The wood used for construction of the drum shall be properly seasoned and free from defects and wood preservative shall be applied to the entire drum. All ferrous parts shall be treated with a suitable rust preventive coating to avoid rusting during transit or storage.
2. Before winding the cables on drums, Contractor shall obtain GWSSB's approval for the drum lengths. Cable ends shall be sealed by non-hygroscopic sealing caps.
3. Contractor has to ensure reference of an arrow and suitable accompanying wording which shall be stencilled on the sides of the drums indicating which way it should be rolled. The number on each drum shall be either branded at the end of the drum or stamped on the metal attached to an end of the drum. The cable shall be placed on the drum in such a manner that it will be protected from injury during transit. Each end of the cable shall be firmly and properly secured to the drum. The drum shall be securely blocked in position so that the cable will not be displaced during transit. Cable ends shall be sealed by non-hygroscopic sealing caps.
4. It shall be the Contractor's responsibility to prepare the drum cutting schedule so that cable wastage is minimum while cutting.
5. Contractor shall obtain GWSSB's approval for the drum lengths.
6. The following information shall be given on the drums as a minimum:
  1. Drum identification number
  2. Voltage grade
  3. Type of cable.
  4. Number of cores and cross-sectional area
  5. Cable quantity

6. Purchaser's order number and item number
7. Total weight of cable and drum

### **Tests Before and After Laying of Cables at Site**

Following Routine & acceptance tests on each drum as per IS: 10810, IS: 7098 standard & other specified relevant standards shall be performed by the manufacturer and witnessed by GWSSB's representative.

1. For 1.1 KV Power & Control cables
  1. Dimensional & visual check
  2. Conductor resistance test
  3. Insulation Resistance Test
  4. High voltage test
5. For 11 KV / 3.3 K V power cables
  1. Design and visual check
  2. Conductor resistance test
  3. Very low frequency AC HV test (instead of DC test)
  4. Insulation resistance including P.I. at rated voltage
  5. Capacitance and tan delta
  6. AC leakage current
  7. Partial discharge measurement
8. All HV cables shall be subjected to DC or AC (preferably DC) high voltage test after terminating but before commissioning as per Table 6.0 in IS: 1255 (Code of practice for Installation & Maintenance of Power Cables up to and including 33 K V).
9. Cables shall be checked for insulation resistance before and after jointing. The voltage rating of the Megger for cables of different voltage grades shall be as indicated below.

<b>Voltage Grade</b>	<b>Megger rating</b>
1.1 KV	500V
11 KV	1000V

10. Following tests in the presence of GWSSB's representative shall be carried out at site before commissioning of cables.

1. Insulation Resistance test between phases and phase to Neutral and phase to earth.
2. Continuity test of all the phases, neutral and earth continuity conductor.
3. Sheathing continuity test.
4. Earth resistance test of all the phases and neutral.

**5. Instrument Cable Testing**

Contractor shall submit routine and Acceptance test certificates, in original at the time of delivery of cables.

1. Type Test: Certificate from independent test house for the following tests shall be furnished by the Contractor for the FRLS low halogen sheathed cable.
  2. Flammability Test as per IEC: 60332, Part-III, Cat A.
  3. Electrostatic noise Rejection test.
  4. Oxygen Index, Temperature rating, light transmission, pH Index, electrical conductivity and toxicity index for the cable
5. Routine Test and Acceptance test: Each of the following tests to be carried out by Contractor during various stages of manufacturing. Purchaser shall review the related documentations. In addition, the following test shall be carried out for checking properties of low halogen FRLS sheathing material.
  6. Light Emission test as per IEC: 1034. Acceptance norms shall be minimum 70%.
  7. Determination of the degree of acidity of gases evolved during combustion as per IEC 754-2 (pH value to be minimum 4.3 and conductivity to be maximum 100 micro Siemens/cms.
  8. Toxicity Index as per NES-713, Value shall not exceed 5
  9. Tear Resistance as per BS: 7655 Section 6.1
  10. Abrasion test method as per BS: 6724 Annexure E
11. All above tests shall be carried in presence of GWSSB's representative. Immediately after completion of the electrical test the ends of the cable shall be sealed to prevent ingress of moisture with suitable rubber/ PVC caps.

**12. Identification Marks on Instrument Signal Cables**

Outer Embossing: Following embossing should be in bold fonts at outer sheath at every five (5) meters intervals.

13. Type of Cable i.e. Signal Cable
14. No of Pairs i.e. 1, 6, 12 etc.
15. Core Size i.e. 1.5 sq. mm etc.
16. Sequential meter marking shall be embossed at every one (1) meter interval
17. Individual pairs Embossing and identification  
Core no shall be printed on each core for identification at regular interval of 250 mm or so.
18. The pair numbers shall be available on individual pair by method of polyester number tape also.
19. Identification marks on Instrument Control Cables  
Following embossing should be in bold fonts at outer sheath at every 5 meters intervals.
20. Type of Cable i.e. Control Cable
21. No of Cores i.e. 2, 4, 10, 12, 24 etc.
22. Core Size i.e. 1.5 sq. mm
23. Sequential meter marking shall be embossed at every one (1) meter interval
24. Identification marks on Instrument Thermocouple Cables  
Outer Embossing  
Following embossing should be in bold fonts at outer sheath at every five (5) meters intervals.
25. Type of Cable i.e. T/C Cable
26. No of Pairs
27. Core Size i.e. 16 AWG
28. Temperature Range
29. Sequential meter marking shall be embossed at every 1 meter interval.
30. Individual pairs Embossing and identification: Each core of pair shall be numbered for identification at regular interval of 250 mm or so.

### **31. Cable Gland**

1. Cable glands required for glanding all cables at both ends shall be supplied by Contractor.
2. A minimum of 20% of cable glands shall be supplied as spare.
3. Cable glands shall be of SS 316 and double compression type suitable for armoured

cables.

4. All cable glands shall be weatherproof to IP-66. Flameproof glands wherever required shall be supplied with Ex (d) certification suitable for Gas Groups IIA / IIB / IIC.
5. All cable glands shall be with LSF shrouds.
6. For all field items and junction box end, NPT threaded cable glands shall be used and for control room / control panel end, cable glands shall be ET threaded types.

#### **7. Junction Boxes**

1. In order to make the most economic use of cable tray and trench capacity, multicore / multi-pair cabling shall be utilised in order to connect instrumentation groups by using suitably located junction boxes.
2. The junction boxes shall have weather protection suitable for the area in which they are to be installed and for the type of circuit.
3. They shall be readily accessible for maintenance and clearly labelled.
4. Junction box shall be constructed of die cast aluminium and provide degree of protection IP 65.
5. Wires and terminals for the digital and analogue signals shall be segregated within junction boxes.

#### **Drawings/ Documents Required**

1. As a part of the Bid, Contractor shall furnish the following
  1. General information
  2. Principal technical data
3. After award of contract it shall be the responsibility of Contractor to work out a detailed layout for the complete plant cabling system. The layout drawing shall be furnished for the approval of GWSSB's representative before commencement of installation including cable trays, cable racks/ trenches, accessories, tray supports, conduits etc.
4. Contractor to submit following drawings/ details after award of contract
  1. Cable Sizing calculations
  2. Details of Installation of cables in trenches, on cable trays, directly buried etc. at all locations inside the plant.
  3. Cable routing lay out inside and outside the plant with route marker provided at 30 meters intervals.
  4. Bill of quantities of cables, lugs and glands.



5. HV Cable termination and mounting kits layout drawing.
6. Following Type Tests reports as per relevant standard to be submitted for the same rating & type of Cables conducted in past for review of GWSSB's representative by the Contractor at the time of inspection & testing of equipment. Type test reports should be valid and not be older than the 5 years.
  1. Annealing test
  2. Tensile test
  3. Wrapping test
  4. Test for thickness of insulation & sheath
  5. Physical test for insulation & sheath
  6. Tensile strength and elongation at break of insulation and sheath
  7. Loss of mass test
  8. Ageing in air oven
  9. Shrinkage test
  10. Heat shock test
  11. Insulation resistance test
  12. High voltage test
  13. Flammability test

#### **DETAILS & REQUIREMENTS FOR CABLES(DATA SHEETS)**

**Data sheet with all details & requirements as well as materials of construction for various parts, mandatory accessories, spares & services required are given in the data sheet section.**

**Contractor must go through it in depth so as to satisfy the basis, general & overall requirements of the equipment.**

#### **CABLE CARRIER SYSTEM**

##### **Cable Trays & Accessories**

##### **General**

The cable carrier system covers the supply of cable racks, cable trays and its supporting accessories.

##### **Applicable Standards**

Sr. No.	Description	Standards
1	Steel for general structural purposes	IS: 2062

2	Dimensions for hot rolled steel beam, column channel and angle sections	IS: 808
3	Code of practice for use of metal arc welding for general construction in mild steel	IS:816
4	Hot deep galvanizing of iron & steel	IS: 2629
5	Methods of testing uniformity of coating of zinc coated articles	IS: 2633
6	Hot dip zinc coatings on structural steel and other allied products	IS: 4759

1. Cable trays shall be of Galvanised Steel/ Fibre Reinforced Plastic and of ladder/ perforated/ solid type, complete with all necessary coupler plates, elbows, tees, bends, reducers, stiffeners and other accessories and hardware as detailed in the relevant drawings. All hardware (i.e. bolts, nuts, screws, washers etc.) shall be hot dip galvanized.
2. Cable trays of ladder and perforated types and the associated accessories such as coupler plates, tees, elbows etc. shall be fabricated from 14 gauge (2.0 mm thick) mild steel sheets. Cable tray covers shall be fabricated from 16 gauge perforated (1.60 mm thick) MS sheets.
3. The cable trays shall be supplied in standard lengths of 2500 mm and clear inside widths of trays shall be as follows:
  1. Perforated type trays: 150, 300, 450 and 600 mm
  2. Ladder type trays: 300, 450, 600 and 750 mm
3. Cable trays, accessories and covers shall be painted with one shop coat of red oxide zinc chromate primer and two site coats of aluminium alkyd paint for indoor use.
4. For outdoor use, cable trays, accessories and covers shall be either galvanized or made of aluminium as specifically mentioned in the layout drawings.
5. For use in corrosive atmospheres both indoors and outdoors, the cable trays, accessories and covers shall be as narrated in serial no. (e).
6. The spacing of rungs for ladder type of trays shall be 250 mm unless otherwise noted.
7. All finished cable trays and accessories shall be free from sharp edges, corners, burrs and unevenness.

### Galvanizing

Wherever galvanizing has been specified, the hot dip process shall be used. The galvanized coating shall be of uniform thickness. Weight of Zinc coatings for various applications shall not be less than those indicated below.

a) Fabricated Steel

Thickness less than 2 mm but not less than 1.2 mm	340 gms / sq mm
Thickness less than 5 mm but not less than 2 mm	460 gms / sq mm
Thickness 5 mm and over	610 gms / sq mm

b) Fasteners

Up to nominal size M 10	270 gms / sq mm
Over M 10	300 gms/ sq mm

Galvanizing shall be carried out only after drilling, punching, cutting, bending and welding operations have been carried out. Burrs shall be removed before galvanizing. Any site modification of galvanized parts should be covered well by zinc rich primer and Aluminium paint.

## **EARTHING & LIGHTNING PROTECTION SYSTEM**

### **Scope**

1. The scope includes collection of data, design of the system as per relevant National/International Standards preparation of layout drawing supply of earthing conductors, earth electrodes, earthing strips installation and approval to the satisfaction of electrical inspector under this tender specification.
2. Earthing system shall be provided to ensure equipment safety, personnel safety and facilitate designed operation of protective switching during earth fault conditions in the associated system.

### **Applicable Standards**

The earthing and lightning protection system shall conform to the CEA guidelines and the latest applicable standards indicated below.

Code of Practice for Earthing	IS: 3043
Code of Practice for the Protection of Building	IS: 2309

and allied structure against Lightning

Hot dip galvanizing IS: 2629, 2633, 4759

Structural steel IS: 2062 & 808

Welding IS: 816

### **Earthing& Lightning system**

1. The design basis for designing earthing conductor is indicated under design criteria for electrical system. Earthing system shall be provided for complete plant i.e. pumping stations, switchyard and all electrical equipment as per the latest edition including all official amendments and revisions of IS: 3043 and CEA guidelines.
2. All materials and fittings used in the earthing installation shall conform to the relevant Indian Standards or shall be approved by the EIC& CEIG.
3. Contractor has to carry out soil resistivity test at, at least 4 locations for which locations shall be provided by GWSSB's representative. Testing is to be done at each site.
4. Soil resistivity shall be carried out by Wenner four electrode method as described in IS: 3043. Contractor has to carry out the test in presence of GWSSB's representative & test shall be carried out keeping electrode spacing as 1, 2, 4, 6, 8, 10, 15, 25 M (each, along all 8 directions) as per normal practice and report has to be submitted. Polar curves shall be used for measurement of mean soil resistivity, which shall be used in finding earthing resistance at a particular location. Mean soil resistivity values shall be approved by GWSSB's representative.
5. The Contractor shall base his earthing calculations on actual measurement carried out by him in the presence of GWSSB's representative.
6. Copper Strip / Galvanized Iron flat or wire shall be used as earthing conductor as per specifications / actual requirements & data sheets.
7. The conductor sizes & types shall be as per specified in the technical specifications. Contractor to note that, the sizes indicated are minimum required & earthing conductor sizes shall be approved by the GWSSB's representative on the basis of adequacy calculations with justifications submitted by Contractor.

8. The underground joints in the system shall be properly welded or brazed and the bolted type connection shall be made with structures/ equipment. Petroleum jelly shall be applied to contact surface of the bolted joints, which will be covered with bituminous compounds and tapes.
9. Earthing conductor shall be protected against mechanical damages considering the installation conditions.
10. The earthing system shall comprise one or more earth electrodes, earthing grid or a combination of these in order to obtain the required earth electrode resistance of less than one (1) Ohms/ or as per IEEE Standards 80 -2000.
11. For equipment earthing, two earthing leads will be used if rated voltage of the equipment is 125 volts & above and one earthing lead will be provided for equipment rated below 125 volts.
12. The earthing conductors in outdoor areas shall be installed at a minimum depth of 600 mm below FGL.
13. Earth pit of minimum bore dia. **150 mm size** with earthing electrode consisting pipe in pipe technology (Outer dia. of 50 mm & inner dia. of 25 mm with length of minimum **2.0meters** with back filling compound of minimum 25 Kg for each) as per IS: 3043 for all HV / LV equipment viz. **two pole structure (alternatively) load break switch unit, transformers including gate & chain link fencing, VCB HV switchgear panel, 3.3 K V motor switchgear panels, APFC – PDB–SDBpanels, 0.415 KV L V induction motors** totally **minimum 18 sets** along with grid of necessary length of double **GI strip / flat**(double flat size: **25 x 6 mm** to suit maximum short circuit current & design criteria) bolted / jointed / connected to the required point of DP with end socket as per direction and duly tested by earth tester conforming to IS as per drawing and specifications complete.
14. Maintenance free UL listed earthing system made of copper bonded rod of minimum **3.0 meters** approximate length (17.2 mm dia. with minimum copper bonding of 0.25 mm suitable for 25 KA fault current with 95 % pure carbon based earth enhancement material of 30 Kg for each with pit cover) as per relevant IS for **LA of two pole structure and each transformer neutral** totally **minimum 08 sets** along with grid of **Copper** strip of minimum **25 mm x 6 mm** size bolted/ jointed / connected complete to the transformer neutral with end socket as per direction and duly tested by earth tester conforming to IS as per drawing and specifications complete.

15. All grounding (eathing) pits are to be interconnected with suitably sized earthing grids of GI and copper strips.
16. Maintenance free UL listed earthing system made of copper bonded rod of minimum 3.0 meters approximate length (17.2 mm dia. with minimum copper bonding of 0.25 mm suitable for 25 KA fault current with 95 % pure carbon based earth enhancement material of 30 Kg for each with pit cover) as per relevant IS for **PLC based SCADA instrumentation panels** set along with grid of **copper strip of minimum 25 mm x 6 mm size.**
17. Where multiple rods are to be used, they shall be separated by a distance of minimum 2000 mm.
18. Each earth electrode shall be welded at the top to a mild steel plate to which the earthing strips shall be connected. These connections shall each be housed in individual inspection chamber set which shall project 100 mm above the finished ground level and shall allow disconnection for testing of individual electrodes. The chamber shall be permanently marked 'Electrical Earth'.
19. All materials used for the earth electrode installation shall be purpose made for the application and site conditions and shall be approved by the GWSSB's representative.
20. All civil works, such as excavation, boring, provision of back filling compounds in adequate quantity, backfilling for the installation of the earth electrodes and the earth pit/ inspection pit shall be in the scope of Contractor.
21. After the earth installation has been completed the Contractor shall demonstrate to the GWSSB's representative that the resistance of the electrodes to earth and the continuity of the earth network are within the limits specified. Any additional earth electrodes and test instruments required for the tests shall be provided by the Contractor.
22. Main equipotential Bonding Conductor  
Main equipotential bonding conductors shall be provided to connect the earth electrode system to conductive parts forming the works.
23. Circuit Protective Conductors An independent circuit protective conductor shall be provided for each circuit and may comprise one or any of the following as appropriate.
  1. A separate core within a multicore cable.
  2. A separate conductor installed within a conduit or trunking. Steel conduit or trunking shall not be used as a circuit protective conductor.

3. The metal sheath of an armoured cable. The sheath shall be bonded to the metal work of the apparatus and to the apparatus earth bar, if any.
4. the copper sheath of a mineral insulated copper sheathed cable
5. An independent earthing conductor G I run adjacent to the circuit it protects.
6. The size of the circuit protective conductor shall be calculated in such a manner as not to take into consideration the contribution of any other parallel or fortuitous earth paths.
7. The armouring of the supply cable shall not form the sole means of earthing a switchboard or large electrical load.

#### **8. Instrumentation Earth**

1. An instrumentation earth bus shall be provided in each control panel. This shall comprise a Copper strip / flat of cross section not less than 25 x 6 mm and length to suit the number of connections. It shall be mounted on at least two insulated supports and be provided with a single earth connection to the control panel electrical power earth.
2. If due to the physical size of a control panel more than one instrument earth bar is required the additional bar shall be connected again with a single earth connection to the same point as before on the control panel electrical earth bar. In this fashion all instrument earths shall be connected radial from the same earth point.
3. All signal cable screens (analogue and digital) shall be terminated on to the instrument earth bar. Signal cable screens shall be earthed at the control panel end only. Screens at the field end shall be tied back and insulated.
4. Surge Protector Devices (SPDs) associated with the control and instrumentation system shall be earthed to the instrument earth in accordance with the SPD manufacturer's recommendations.
5. Separate electronic earthing system with dedicated earth pit shall be provided by the bidder for I&C equipment.

#### **Important Instructions for Earthing**

1. Each pole of lightning arrestors shall be earthed with separate earth pit.
2. Two-earth conductor shall connect outdoor CT secondary winding to earth grid.
3. The switchyard fencing shall be earthed at every alternate block and the switchyard gate shall be earthed with flexible GI flat / wire.
4. All the earthing material with laying etc. shall be included in the scope.

5. The entire plant will have an earth grid laid in trenches/ traysburied in the ground outside. The main earthing grid shall be embedded at a minimum depth of 600 mm below FGL which shall be connected to earth electrodes.
6. All interconnections of the earthing grid conductors will have welded type joints except at electrodes with disconnecting facility and at equipment with bolted connections. All indoor earthing grids will be suitably interconnected to the external earthing grid.
7. Each steel/ RCC column of the building will be interconnected to the floor-earthing grid. Steel columns, steel strips / conduits, cable trays etc. will not be used as earth continuity conductors.
8. Disconnecting type facility shall be provided between Earthing grid & each earth electrode.
9. All connection between the conductors shall be welded/ brazed type. Metallic pipe, conduit, structures shall be bonded to lightning protection conductors to prevent the side flashover. But no metallic pipe, conduit, structure shall be used as air termination conductor or down conductor.
10. The down conductors shall be fixed with embedded brass posts (on concrete columns) with nuts & bolts used for fixing the saddle/ clamp (direct drilling of down comer and fixing with screw shall not be acceptable).
11. Cleats for 'earthing and lightning protection systems' shall be of GI.
12. The lightning protective conductor shall not be connected with the earthing above ground however both the systems shall be interconnected below ground.
13. The earth pits may require boring & drilling in the soil & the same shall be considered in Contractor's scope.
14. Earth electrode with disconnecting facility shall be provided so that the resistance of the independent earth electrode may be measured.
15. Internal earth bus of each panel shall be connected to both ends to the earthing system by means of earthing conductor.
16. Metallic frames of all current carrying equipment, structures supporting and adjacent to current carrying conductors, lightning protection system conductors, metallic structures, metallic stairs, hand rails, fences shall be connected to a single earthing system. Neutral points of various systems shall be connected to the dedicated treated earth pits and these earth pits shall be interconnected to each other below ground.



17. All connections in the equipment earth conductors buried in ground (or otherwise) shall be cad welded/ brazed, whereas connection at equipment end shall be of bolted type. All connections shall be of low resistance. All bimetallic connection shall be treated with suitable compound to prevent moisture ingress. For Bimetallic bolted connection, bimetallic washers shall be used. All bolted joints shall have minimum two bolts to ensure proper surface contact. Termination of stranded conductors at earth inserts shall be with ring type/ lugs.
18. Galvanized conductors shall be touched up with zinc-rich paint where holes are drilled at site for bolting to equipment/structure.
19. Suitable earth risers approved by the EIC shall be provided above finished floor/ ground level, if the equipment is not available at the time of laying of the main earth conductor. The minimum length of such risers inside the building shall be 200 mm and outdoor shall be 500 mm above ground level.
20. Metallic conduits and pipes shall be connected to the earthing system unless specified otherwise.
21. All cable trays will be earthed at minimum two places by suitable sized GI flats to main earthing system earth conductor. The cable trays shall also be earthed at a regular interval of not more than 10 meters by 25 x 6 mm G I flat.

### **Earthing Pits**

1. Adequate number of earthing pits shall be provided in conjunction with earthing grid for the earthing system. The minimum spacing between two adjacent earthing pits shall not be less than 2000 mm and shall be kept 1500 mm away from footings of the structure.
2. Earthing pits shall be located in ground, which has a reasonable chance of remaining moist.
3. A galvanized iron strip of adequate size (as per calculations) shall be provided from plate electrode to about ground level to facilitate jointing with earth conductors. Each earth electrode ending at the pit shall be connected to suitable linking strips to connect and disconnect the earthing suitably.
4. Earthing chamber shall be of RCC/ brick chamber of 600 mm x 600 mm, with removable 6 mm thick MS chequered plates. The covers shall have holes for handling. Earthing pits (chambers) shall be painted Green and the earth-pit number shall be marked on it.

5. Earthing cables crossing other metallic structures such as conduits pipelines etc. shall be minimum 300 mm away from such structures.
6. Earthing conductors shall be protected against mechanical damage.
7. All earth lead connections shall be as short and direct as possible and shall be without kink.
8. The main earth loop in plant area shall be generally routed along cables. When equipment is located away from main earth loops, suitable sub-loops shall be run up to them for deriving connections for individual equipment. The entire earthing system shall fully comply with the CEA guidelines and requirements.
9. The Contractor shall have to carry out any changes as desired by the Electrical Inspector or the EIC, in order to make installation conforming to the CEA guidelines 2010 and IS: 3043.

### **Lightning Protection**

1. The lightning protection system need will be established by calculating the risk factor value of each building, structure etc. as per procedure given in IS/ IEC: 62305-2010 and if found necessary the same shall be provided by the Contractor.
2. For Lightning protection of Civil Structures including RCC Buildings, fixing of 25x6 mm GI earth strip to roof as per IS/ IEC standards, saddle clamp, down comer connector etc. as required with all hardware shall be in Contractor's scope.

### **Galvanizing**

1. Wherever galvanizing has been specified, the hot dip process shall be used. The galvanized coating shall be of uniform thickness. Weight of Zinc coatings for various applications shall not be less than those indicated below.

<b><u>Fabricated Steel</u></b>	
Thickness less than 2 mm, but not less than 1.2 mm	340 gms/ sq.m
Thickness less than 5 mm, but not less than 2 mm	460 gms/ sq.m
Thickness 5 mm and over	610 gm/ sq.m

<b><u>Fasteners</u></b>	
1. Up to nominal size M10	270 gms/ sq.m
2. Over M10	300 gms/ sq.m

3. Burrs shall be removed before galvanizing. Any site modification of galvanized parts should be covered well by zinc rich primer and aluminium paint.
4. Contractor shall ensure to use calibrated test equipment having valid calibration test certificates from standard laboratories traceable to National Standards.

### **Drawings/ Documents Required**

The Contractor should prepare Layout drawings, after award of contract and before commencement of work for Purchaser's approval, showing the location of earthing grid, electrodes, interconnection grids and earthing leads to various equipment, down comers, isolating links etc. should be accompanied by design calculations.

### **DETAILS & REQUIREMENTS FOR EARTHING & LIGHTNING PROTECTION SYSTEM(DATA SHEETS)**

**Data sheet with all details & requirements as well as materials of construction for various parts, mandatory accessories, spares & services required are given in the data sheet section.**

**Contractor must go through it in depth so as to satisfy the basis, general & overall requirements of the equipment.**

## **LIGHTING, RECEPTACLE & VENTILATION SYSTEM**

### **Scope**

1. The scope of the Contractor shall include design, supply and installation of all equipment necessary for a complete lighting and receptacle system. The lighting system includes Lighting fixtures (indoor/ outdoor), lamps, lighting panels (LP), switchboards, Receptacles, JB's, cables/ wires for lighting/ receptacles, conduits etc. The supply of street light/ flood light poles as per IS: 2713 is also included in the Contractor's scope.

2. The various types of lighting fixtures with lamps shall be installed based on the mounting arrangement shown in the typical drawings enclosed with the specification. Installation scope shall include all material to mount the fixtures in proposed manner.
3. The various types of lighting fixtures as specified in this specification shall be assembled, installed, tested & commissioned by the Contractor.
4. The type of lighting fixtures and receptacles, illumination level and approximate quantity required shall be generally as per design criteria.
5. Lighting system installation shall be as per the tender specifications.
6. It shall be the responsibility of the Contractor to work out complete detailed requirement of lighting and receptacle system for the whole plant and staff quarters including area lighting as per specification and accordingly procure and install them.

### **Emergency Lighting**

Emergency lighting shall be designed such that at all junctions, exit passages & strategic locations, Lux level shall be maintained above 10 Lux. Emergency light fitting shall be 240 V self-contained 2 x 10 W fluorescent tube with built in Ni-Cd battery having charging facility and six hours back-up time. The emergency light fittings shall be provided at strategic locations of each house/ area. Emergency fixtures shall come in service when AC supply fails. Pump room and Electrical room shall be considered for Emergency lighting.

### **Applicable Standards**

The design, manufacture and performance of equipment shall conform to the latest standards specified below. In case of conflict between the standards and this specification, this specification shall govern.

#### **1. Lighting Fixtures & Accessories**

Electrical lighting fittings general and : IS: 1913/ BS: 4533

Safety requirements

Code of practice for industrial lighting : IS: 6665

Code of Practice for Interior Illumination: IS: 3646

Code of Practice for Lighting of Public : IS: 1944

Thoroughfares

Calculation of co-efficient of utilization	:	IS: 3646 (Part - III)
Industrial lighting fittings with metal Reflectors	:	IS: 1777
Decorative lighting fittings	:	IS: 5077
Dust proof electric lighting fittings	:	IS: 4012
Dust tight electric lighting fittings	:	IS: 4013
Flood lights	:	IS: 10322/BS: 4533
Luminaries for street lighting	:	IS: 10322 Part 5
Water tight electric lighting fittings	:	IS: 3553/ BS: 4533, 5225(I)
Bayonet lamp holders	:	IS: 61184 / IEC: 61
Edison screw lamp holders	:	IS: 10276/BSEN 60238
Bi-Pin lamp holders for tubular	:	IS: 3323
Fluorescent lamps		
Starters for fluorescent lamp	:	IS: 2215/BSEN 60155
Holders for starters for tubular	:	IS: 3324/BSEN 60400
Fluorescent Lamps		
Ballast for use in fluorescent lighting	:	IS: 1534 (Part 1)/
Fittings		BSEN 60920 & 60921
Transistorized ballast for fluorescent	:	IS: 7027
Lamps		
Ballast for HP mercury vapour lamp	:	IS: 6616
Capacitors for use in fluorescent HPMV	:	IS: 1569/BSEN 61048
LP sodium vapour discharge circuits		& 61049 / IEC: 586

Vitreous enamel reflector for tungsten	:	IS: 8017
Filament lamp		
Tubular fluorescent lamps	:	IS: 2418 (Part-1)/ BSEN 60081/ IEC: 81
High pressure mercury vapour lamps	:	IS: 9900/BS: 3677/ IEC: 188
Tungsten filament general electric lamps	:	IS: 418/IEC: 432
Cast acrylic sheets for use in Luminaries	:	IS: 7569
Screw less terminal and electrical	:	IS: 10322
Connections for lighting fittings		
High pressure sodium vapour lamps	:	IS: 9974
Emergency lighting units	:	IS: 9583
Ignition proof enclosures, dust-tight for	:	IS: 11005
Electrical equipment Luminaries	:	IS: 10322(Part I to V)

## 2. Lighting System Equipment

### General Requirements

The Lighting system includes following items.

1. Lighting fixtures complete with Lamps and accessories
2. Lighting system equipment
3. Light control switches, receptacle units with control switch units, lighting wires, conduits, earth wires and other similar items necessary to complete lighting system.
4. Lighting fixture supports, street lighting poles and flood light towers/ poles.
5. Lighting main distribution board, lighting panels.
6. Multi core cables for street, boundary and flood lighting.

### Lighting Layout

1. It shall be the responsibility of the Contractor to work out a detailed layout for the complete plant in order to provide the levels of illumination as indicated in the relevant standards

2. The types of fixtures to be used in various areas are also indicated in the above-mentioned drawing. The Contractor shall be responsible for measuring the levels of illumination and uniformity after installation and establish compliance with the specification.

3. The lighting system will comprise the following.

Normal AC Lighting: Normal lighting in all indoor and outdoor areas will be operated on 230V, 1Phase, 50 HZ AC supply.

Arrangement for bus-bars, main : IS: 5578/ 11353/ BS: 159

Connections and auxiliary wiring and marking

Enclosed distribution fuse boards and : IS: 2675/BS EN 60439

Cutouts for voltages not exceeding 1000 V

General requirements for switchgear & : IS: 13947

Control gear for voltages not exceeding 1000 V

Code of practice - installation and : IS: 10118/BS: 6423

Maintenance of switchgear BS 6626, BS 6867

Factory built assemblies of switchgear & : IS: 8623/BS: 5486/ IEC: 439

Control gear for voltages up to and including

1000 V AC and 120 V DC

Miniature air-break circuit breakers for : IS: 8828/BS EN 60898

AC circuits

HRC cartridge fuse links up to 650 V : IS: 9224/BS: 88/IEC: 269

'D' Type fuses : IS: 8187

Current transformers : IS: 2705/BS: 7626/ IEC: 185

Voltage transformers : IS: 3156/BS: 7625/ IEC: 186

Direct acting electrical indicating instruments: IS: 1248/BS: 89/IEC: 51

AC electricity meters : IS: 722/BS: 5685

Electrical relays for power system protection	:	IS: 3231/BS: 142/IEC: 255
Switches for domestic and similar purposes	:	IS: 3854/BS: 3676
Three pin plugs and socket outlets	:	IS: 1293/BS: 546
Boxes for enclosure of electrical accessories	:	IS: 5133(1)
Rigid steel conduits for electrical wiring	:	IS: 9537/BS: 31
Accessories for rigid steel conduits for	:	IS: 3837/BS-31
Electrical wiring		
Flexible steel conduits for electrical wiring	:	IS: 3480
Rigid non-metallic conduits for electrical:	:	IS: 9537/BS: 4607(2)
Installations		
Fittings for rigid non-metallic conduits	:	IS: 3419/BS: 4607(2)
PVC insulated cables for working	:	IS: 694
Voltages up to and including 1100 V		
Tubular steel poles	:	IS: 2713
Specification for copper rods and bars	:	IS: 613
For electrical purposes		
Code of practice for phosphate iron& steel	:	IS: 6005/ BS: 3189
Fittings for rigid steel conduits for	:	IS: 2667
Electrical wiring		
National Building Code of India (NBC)	:	NBC 2005

### Other Design considerations for Lighting

1. Lighting panels shall be provided in various areas and circuit wiring to the lighting fixtures shall be made from lighting panels. Lighting panel shall comprise of Four pole MCB + RCCB (100 mA) for incomer and SP MCB's for each outgoing single-phase circuit.



2. The wiring for lighting circuits in indoor areas will be done by wires run in PVC / GI conduits. For outdoor lighting, wiring will be done by using armoured cables.
3. Lighting cable from Main lighting DB (MLDB) to lighting panels shall be Cu / Al conductor, XLPE insulated, 1.1KV grade, laid in cable trays otherwise cleated along the wall/ column/ beam.
4. For lighting fixtures (Pump room) 1100V grade, 4C x 2.5 sq. mm PVC insulated, multi-stranded copper conductor armoured/ unarmoured cables shall be used.
5. For lighting fixtures (For Office, electrical room, toilets etc. areas) 1100V grade, FRLS PVC, multi-stranded Copper conductor wires of area not less than 1.5 sq. mm laid in min. 20 mm dia. PVC / GI conduit (above false ceiling, if provided) shall be used.
6. For 5/15A decorative sockets (For office, toilets etc. areas) 1100V grade, FRLS PVC, multi-stranded copper conductor wires of area not less than 2.5/ 4.0 sq. mm. Cu laid in minimum 20 mm dia. PVC / GI conduit shall be used.
7. Wiring shall be concealed in wall below false ceiling with concealed switch board. Minor civil work like chasing wall, cut outs for conduit, switch board, Lighting Panel in wall, entries for tray, conduits etc. is in scope.
8. Lighting cable from MLDB to Lighting Panels and Lighting Panels to street light fixtures, shall be Al conductor, XLPE insulated, armoured, 1.1 KV grade, laid in cable trays otherwise cleated along the wall/ column/ beam and buried in the ground.
9. The point wiring for lighting/ receptacle/ exhaust fan/ wall mounted fan/ ceiling fan shall include conduits, conduit accessories, FRLS PVC insulated multi-stranded Copper conductor wires and earthing wires, pull boxes, ceiling rose, clamps, cleats, hardware, accessories, anchor fasteners etc. It shall include wiring from lighting panel to switchboard and receptacles & switchboard to lighting fixtures. Sheet metal switchboard embedded in wall shall be considered for receptacles and lighting switchboards on wall shall be considered for lighting.
10. For power sockets in wall/ furniture, PVC switch box of approved make with switch plate & accessories and 16 Amp piano modular switches and 5/15A sockets etc. as applicable shall be considered. For all types of point wiring the receptacles with switches shall be included in the point wiring rate.
11. Lighting switchboard consisting of (\*) no. of 6A piano switch without indicator, 1 no. 6A piano switch with indicator, 1 no. white coloured cover plate for (\*) module (4/ 6/ 8/ 12 module), 1no. 2/ 3 pin shuttered socket of 5/ 15A and metal flush box.

12. Decorative socket switchboard consisting of (\*) no. of 16A piano switch with indicator, (\*) no. 2/ 3 pin shuttered socket of 5/ 15A and metal flush box, 1 no. white coloured cover plate for (\*) module (4/ 6/ 8/ 12 module).
13. Lighting fixtures and fans will be grouped on the circuit wherever required. However, separate circuits shall be used for receptacles wiring.
14. Lighting Control Philosophy as per mentioned below shall be observed. From each switch
  1. Max. 2 (3 in case unavoidable) LED / fluorescent luminaries (2x36W)
  2. Max. 4 (5 in case unavoidable) LED / down lighters luminaries (2x18W)
3. All MH fixtures, High bay T5 or latest available energy efficient fixtures, Street Light fixtures shall be controlled directly from respective Lighting Panels, through MCB.
4. Each lighting panel/ Receptacle DB shall have minimum 2 spare circuits of 10/ 16A SPN outgoing feeders. A circuit consists of R, Y, and B Phase each.
5. Lighting for staircase shall be controlled with flushed modular switch. The conduit for main staircase shall be concealed. Lighting for all staircases shall be with 2way switch Contractor shall note that any chasing in walls or cutouts or openings such as fixing of LPs, DBs, switchboards, concealing conduit in wall etc. in walls required shall be made before plastering of brickwork wherever applicable and installation rates quoted shall be inclusive of chasing, cutting & making the plaster as per standard practice.
6. Lighting for street light fixtures/ flood light fixtures and metal halide fixtures shall be carried out with cables. The supply of cables, junction boxes, street light poles & structural steel required for mounting fixtures/ LPs etc. are in the scope of Contractor. The cable wiring shall include supply & installation of cable required from LP to the junction box mounted on street lighting pole / near indoor fixture and also between junction box mounted inside pole/near indoor fixture to control gear box and same for flood lighting, supply and installation of all termination accessories such as lugs, cable glands etc. DBO Contractor's scope shall also include excavation, preparation of soil bedding, supply and installation of protection cover, back-filling, supply and installation of cable route markers etc.
7. Point Wiring for lighting/ raw power receptacle/ emergency lighting
  1. Point wiring covers the wiring between the circuits of the lighting panel to switchboard and then from switchboard to lighting fixtures connected to that circuit of the lighting panel.
  2. For receptacle circuits point wiring shall cover wiring between the circuits of the

lighting panel to receptacles connected to that circuit of the lighting panel.

3. The scope of the Contractor shall include the supply, erection, testing and commissioning of the above LPs/ DB boards for supply of power to the various sockets required for computers, raw power points etc. The point wiring rate from these DBs shall include supply of wires, conduits, cleats/ clamps etc. as may be required and shall be in the scope of the Contractor.
4. The conduit point wiring rate for exhaust fan shall include conduits/ casing capping, conduit/ casing capping accessories, Switch boards, PVC insulated wires and earthing wires, pull boxes, ceiling rose, clamps, cleats, hardware, sheet metal switchboards fabricated out of 16 SWG sheet steel housing 5 Amp piano switches. It shall include wiring from Exhaust Fan / RDB to switchboard & switchboard to exhaust fan as applicable. Neutral for individual circuit shall be run separate from DB to individual receptacles.
5. All mounting accessories like base channels, cross angles if required, nuts, bolts etc. shall be supplied by the Contractor under the scope of this contract.
6. Required no. of 1Phase & 3Phase, industrial receptacles with respective 2P/ 4P ELCB (30mA) & 3/ 5 pin plug shall be provided for maintenance purpose.
7. Receptacle & its ELCB shall be mounted in prefabricated CRCA box of 16 SWG, epoxy painted with shade 631 of IS: 5. Earthing studs shall be provided for connecting external earthing with receptacle box.
8. The configuration of industrial receptacle units shall be as per following combination.
  9. 240V, 1Ph, 50Hz, 3pin, 15A Industrial receptacles with RCBO (30 mA).
  10. 415V, 3Ph, 50Hz, 32/63A Industrial receptacles with respective RCBO (30 mA).

## 11. Lighting Fixtures and Accessories

### 1. General

Normal supply voltage, phase and frequency	240 V, 1 Phase, 2 Wire, 50 Hz
Variation in Supply	
Voltage (AC & DC)	±10 %
Frequency	±5 %
Combined voltage & frequency	±10 %
Design ambient air temperature	50°C

2. The Luminaries shall be designed so as to facilitate easy maintenance, including cleaning, replacement of lamps/starters etc.
3. Connections between different components shall be made in such a way that they will not work loose by small vibration.
4. For each type of Luminaries, the Contractor shall furnish the utilisation factor tables to indicate the proportion of the light emitted by the bare lamps which falls on the working plane.
5. All Luminaries shall be supplied complete with lamps suitable for operation on a supply voltage and the variation in supply voltage, frequency and combined voltage and frequency of  $\pm 10\%$ ,  $\pm 5\%$  and  $\pm 10\%$  respectively.
6. The Luminaries and accessories shall be designed to have low temperature rise. The temperature rise above the ambient temperature shall be as indicated in the relevant Standards.
7. LED / Fluorescent type luminaries shall be complete with accessories like lamps, ballasts, power factor improvement capacitors, starters, re-wire able fuse and fuse base. These shall be mounted as far as possible in the luminaries housing only. If these cannot be accommodated integral with the Luminaries then a separate metal enclosed control gear box shall be included to accommodate the control accessories together with a terminal block suitable for loop-in, loop out connections. Outdoor type fixtures shall be provided with outdoor type weather-proof box.
8. LED / Fluorescent type Luminaries with more than one lamp shall be provided with capacitors connected in lead-lag circuit for correction of stroboscopic effect.
9. Each luminaire shall have a terminal block suitable for loop-in, loop-out and T-off connection by 230/ 415 V, 1 core, FRLS PVC insulated Copper conductor wires up to 4 sq. mm in size. In outdoor areas the termination at the luminaries shall be suitable for 1100 V, PVC insulated, Cu/ Al conductor, armoured cables of sizes up to 6/ 16 sq. mm conductor. Terminals shall be of stud or clamp type. The internal wiring should be completed by means of stranded Copper wire of minimum 1 sq. mm size and terminated on the terminal block. Terminal blocks shall be mounted with minimum two fixing screws.
10. Mounting facility and conduit knock-outs for the luminaries shall be provided.

## **11. Earthing**

1. Each luminary shall be provided with an earthing terminal suitable for connection to

the earthing conductor of 12 SWG GI wire.

2. Where separate control gear box is provided for housing the accessories the same shall be provided with an earthing terminal suitable for connecting earthing conductor of 12 SWG GI wire.
3. All metal or metal enclosed parts of the luminaries/control gear box shall be bonded and connected to the earthing terminal so as to ensure satisfactory earthing continuity.

#### **4. Painting/ Finish**

1. All surfaces of the Luminaries/Control gear box housing accessories shall be thoroughly cleaned and degreased. It shall be free from scale, rust, sharp edges and burrs.
2. When enamel finish is specified, it shall have a minimum thickness of 2 mils for outside surface and 1.5 mils for inside surface. The finish shall be non-porous and free from blemishes, blisters and fading.
3. The luminaire housing shall be stove-enamelled/epoxy stove-enamelled-vitreous enamelled or anodised as indicated under various types of fittings.
4. The surface shall be scratch resistant and shall show no sign of cracking or flaking when bent through 90° over ½" dia. mandrel.
5. The finish of the luminaries shall be such that no bright spots are produced either by direct light source or by reflection.
6. External control gear box provided for housing accessories shall be painted or galvanised.

#### **LED / Fluorescent Luminaries**

1. The luminaries shall be provided with CRCA sheet steel mounting rail / baton with reflector of minimum 20 SWG thicknesses and complete with all control accessories mounted on it. The finish shall be vitreous enamelled.
2. Luminaries mounted recessed in false ceiling shall be with reflector housing and spring-loaded fixing arrangement for the diffuser/ louver frame. It shall be possible to have access to the lamp and other accessories from below.
3. Luminaries shall be suitable for the number of lamps of specified wattage, direct mounting on ceiling/ wall/ column/ pendent mounting.
4. The distribution of light shall be such that at least 80% of the total luminous flux from the luminaries shall be in the lower hemisphere.

5. The luminous output of the luminaries with reflector shall not be less than 75% irrespective of type of reflector used.

#### **High, Medium and Low Bay Luminaries:LED T5 lamps**

1. Luminaries selection on the basis of height shall be generally selected considering following height criteria
  1. High Bay for mounting heights above 9 meters
  2. Medium Bay for mounting heights from 6 m to 9m
  3. Low Bay for mounting heights below 6 meters
4. High and medium bay luminaries shall be with cast aluminium/ stove enamelled housing, anodized aluminium mirror polished reflector, canopy with eye bolt for suspension, cooling fins. Glass cover shall be provided. The luminaries shall be suitable for metal halide lamp up to 400 W. The control gear accessories shall be mounted integral with the luminaries.
5. Low bay luminaries may be with sheet steel/ cast aluminium enclosure, wide angle distribution type polished reflector, acrylic cover and wire guard complete with neoprene gaskets, mounting bracket etc. The luminaries shall be suitable for metal halide lamp up to 125 watts. The control gear accessories shall be mounted integral with the luminaries.
6. All luminaries used with metal halide lamps shall be of enclosed type.

#### **Well glass luminaries**

Well glass luminaries shall be robust construction, cast aluminium/ vitreous enamelled housing, clear heat and shock resistant glass cover fixed with neoprene gaskets for sealing. For mechanical protection to the glass cover, round steel wire – guard with vitreous enamelled finish shall be provided. Additional heavy gauge vitreous enamel reflector shall be provided. The luminaries shall be suitable for incandescent lamp up to 200 watts, mercury vapour up to 250 watts for suspension mounting by conduit pipe, hook or strap.

Luminaries shall be with degree of protection IP 54 generally used indoor.

#### **Flood Light Luminaries**

##### **General purpose flood light luminaries**

1. Flood light luminaries shall be of weather proof construction with cast aluminium housing, anodised aluminium mirror polished reflector, heat resistant, toughened glass cover and necessary neoprene gaskets to prevent ingress of dust.
2. The housing shall be supported on a cast iron base and capable of being swivelled in both horizontal and vertical directions and locked in any desired position.

3. For focussing purposes, knobs, shall be provided along with sector plate indicating the angle in degrees between 0 and 90<sup>0</sup> in vertical direction.
4. The Luminaries shall be suitable for single and dual Metal Halide (MH) lamps of 150W/ 250W/ 400 W etc. as required. The same shall be mounted in a separate sheet metal enclosed/ cast aluminium weather proof control gear box.
5. The luminaries shall be provided with cable gland on the canopy in down ward direction for cable connection.
6. It shall be possible to adjust the lamp position to achieve wide beam, medium beam or narrow beam.
7. It shall be possible to replace the lamp from the canopy without opening the front glass.

### **Outdoor/ Street Lighting Luminaire**

#### **1. Fluorescent Luminaire**

1. Street lighting fluorescent luminaries shall be outdoor weather proof type for illumination of secondary roads, walkways, peripheral lighting of buildings etc.
2. The luminaries shall be of semi-cut off or non-cut off type, with CRCA sheet steel housing, vitreous enameled, plain or corrugated clear acrylic cover, complete with integral mounted control gear, neoprene gaskets, side pipe entry or top suspension type.
3. The luminaries shall be suitable for 1 x 36 watts or 2 x 36 watts fluorescent tubes and for mounting heights up to 4.5 metres.

#### **4. Metal Halide luminaire**

1. Street light MH luminaries shall be outdoor weather proof type for illumination of main roads, traffic islands etc.
2. The luminaries shall be of semi-cut off with cast aluminium housing, acrylic or prismatic cover, polished aluminium reflectors, complete with integral mounted control gear, neoprene gaskets and with rear pipe entry.
3. The luminaries shall be suitable up to 150/ 250 watts MH lamps and for mounting heights from 4 metres to 12 metres.

#### **4. Post Top- Lantern**

1. Post top lantern luminaries shall be generally outdoor weather proof type for illumination of walkways, gate posts, gardens etc.
2. The luminaries shall have cast aluminium spigot finished with corrosion proof paint for mounting, opal acrylic or high-density polyethylene (HDP) diffuser bowl,

complete with integral mounted control gear, neoprene gaskets, earthing terminal etc.

3. The luminaire shall be suitable up to 125 W mercury vapour lamp or 70W sodium vapour lamp.
4. Bollard Luminaries
  1. Bollard luminaries shall be outdoor, weather proof type for illumination of lawns, gardens, pathways etc.
  2. The luminaries shall be of FRP housing, clear acrylic cover, louvers for directing light downwards and bottom cable entry.
  3. The luminaries shall be suitable for 9/ 11/ 18 W LED.

#### **Substation Lantern**

Substation lantern shall be generally outdoor weather proof type for illumination of switch yard equipment.

The luminary shall have cast aluminum housing finished with corrosion proof paint, spigot for mounting on pole, prismatic glass refractor dome to give distribution of light in horizontal plane, anodized aluminum reflector to give light distribution at an angle 20° to 40° above the horizontal plane, complete with integral mounted control gear, neoprene gaskets, earthing terminal etc.

The luminaries shall be suitable up to 200 watts incandescent lamp, 125 W mercury vapour lamp or 70 W sodium vapour lamp.

#### **Mercury Vapour and Sodium Vapour luminaries**

Street light mercury / sodium vapour luminaries shall be out door weather proof type for illumination of main roads, traffic islands etc.

The luminary shall be of semi cut off with cast aluminum housing, acrylic or prismatic cover, polished aluminum reflectors, complete with integral mounted control gear, neoprene gaskets and with rear pipe entry.

The luminaries shall be suitable up to 400 watts mercury or sodium vapour lamps and for mounting heights from 4 metres to 12 metres.

#### **Portable Emergency Light Luminary**

Emergency light of installer luminary shall be indoor type for providing emergency light during failure of normal AC supply.

The luminary shall be with CRCA sheet steel enclosure, complete with metallised mirror reflector, leak proof re-chargeable battery rated for two hour discharge, battery charger, charger-on lamp, push button switches, automatic changeover switch/relay, two metre



length cord with plug, mounting pads and other accessories required for satisfactory operation of the luminary.

The luminary shall be suitable for connection to 240 V, 50 Hz single phase supply. On failure of normal AC supply the luminary shall pick-up automatically and on restoration of AC supply the luminary shall switch off automatically.

The luminary shall be suitable for incandescent lamp up to 40 W or fluorescent lamp up to 20 W.

### **High Mast Flood Light / Flood Light Towers**

1. High mast shall be outdoor weather proof type for illumination of main roads and area lighting, wherever found necessary. One set per head works is to be provided.
2. The high mast shall be continually tapered, polygon cross section telescopically jointed steel fabricated construction. The mast shall be hot dip galvanised internally and externally. Weather proof door shall be provided near the base to permit access to winch, cables, plug, socket etc. The mast shall be designed for wind speeds depending upon wind pressure and direction as per relevant Indian Standards. Foundation bolts shall be included in the scope of supply.
3. The moving platform shall be of steel construction hot dip galvanised and designed to hold the number of flood light luminaires specified. The control gear boxes shall be cast aluminium weather proof type mounted on the moving platform. The moving platform shall be raised or lowered with the help of winch, pulley system and stainless-steel wire ropes. The winch shall be suitable for hand operation or alternate by electric power.
4. The mast shall be suitable for mounting numbers of luminaires as required. The standard mast heights are generally from 16 to 30 meters.

### **Emergency Light Luminaries**

1. Emergency light fitting shall be 240 V self-contained 2 x 11 W fluorescent tube with built in Ni-Cd battery having charging facility and six hours back-up time. The emergency light fittings shall be provided at strategic locations of each house / area.
2. Emergency fixtures shall come in service when AC supply fails.
3. Pump room and Electrical room shall be considered for Emergency lighting.
4. In addition to above emergency fixtures, every pump station shall be provided with two nos. of portable emergency luminary, which shall be with CRCA sheet steel enclosure, complete with metalized mirror reflector, leak proof re-chargeable battery rated for two hour discharge, battery charger, charger-on lamp, push button switches, automatic

changeover switch/relay, two metre length cord with plug, mounting pads and other accessories required for satisfactory operation of the luminaries.

5. The luminaries shall be suitable for connection to 240 V, 50 Hz single phase supply. On failure of normal AC supply the luminary shall start automatically and on restoration of AC supply the luminary shall switch off automatically.
6. The luminaries shall be suitable for up to 11/ 15 WLED.

### **Accessories for Luminaries**

#### **1. Reflectors**

1. The reflectors shall be made of CRCA sheet steel/aluminium/silvered glass/chromium plated sheet copper as indicated for above mentioned luminaries.
2. The thickness of steel/ aluminium shall comply with relevant standards. Reflectors made of steel shall have vitreous enamelled finish. Aluminium used for reflectors shall be anodized/ epoxy stove enamelled/ mirror polished. The finish for the reflector shall be as indicated for above mentioned fittings.
3. Reflectors shall be free from scratches or blisters and shall have a smooth and glossy surface having an optimum light reflecting coefficient so as to ensure the overall light output specified by the Contractor.
4. Reflectors shall be readily removable from the housing for cleaning and maintenance without disturbing the lamps and without the use of tools. They shall be securely fixed to the housing by means of positive fastening device of captive type.

#### **5. Lamp/ Starter Holders**

1. Lamp holders shall have low contact resistance, shall be resistant to wear and shall be suitable for operation at the specified temperature without deterioration in insulation value. They shall hold the lamps in position under normal condition of shock and vibration met with under normal installation and use.
2. Lamp holders for the fluorescent lamps shall be of the spring loaded bi-pin rotor type. Live parts of the lamp holder shall not be exposed during insertion or removal of lamp or after the lamp has been taken out. The lamp holder contacts shall provide adequate pressure on the lamp cap pins when the lamp is in working position.
3. Lamp holders for mercury vapour and sodium vapour lamps shall be of Edison Screw (ES) type.
4. The starter holders shall be so designed that they are mechanically robust and free from any operational difficulties. They shall be capable of withstanding the shocks

met within normal transit, installation and use.

## **5. Ballasts**

1. The electronic ballasts shall be designed to have a long service life and low power loss. The ballasts shall be of the inductive, heavy duty type copper wire wound, filled with thermosetting, insulating, moisture repellent polyester compound filled under pressure or vacuum. Ballasts shall be provided with taps to set the voltage within the range of variation in supply voltage of  $\pm 10\%$  of 240 V. End connections and taps shall be brought out to a suitable terminal block rigidly fixed to the ballast enclosure. Ballasts shall be free from hum and such of those which produce hum shall be replaced by Contractor free of cost.
2. Ballasts shall be mounted using self-locking, anti-vibration fixings and shall be easy to remove without demounting the fittings. They shall be in dust tight, non-combustible enclosures.
3. All the luminaries other than Flood Light Fixtures shall have integral control gear.
4. All type of fluorescent light fittings shall be provided with high frequency electronic ballast of proven design with less than 10% THD, fully wired up to the connector block. The electronic ballast shall be suitable for operation with input voltage variation between 180 – 260V to give a constant light output.
5. All gas discharge/ MH type lamps shall be provided with control gear, with Copper wound and polyester filled low loss ballast, igniter and PF correction capacitor.
6. Contractor to provide comprehensive technical details of the luminaries and the lamps being offered. The details must be sufficient to take in to consideration maximizing of energy efficiency and minimizing overall shop power consumption.
7. In Crane bays, lighting fixtures shall be mounted with the minimum 500 mm clearances above overhead crane clearance level as asked by Crane Manufacturer.
8. All the outdoor purpose luminaries, including Street light luminaries shall be with ingress protection of IP 65 minimum.
9. All the Mid Bay & Highbay fixtures, street light fixtures shall be provided with the toughened Glass covers.
10. In case of Hazardous areas, if any- Flame proof luminaries (complete with suitable lamp & accessories) in line with the requirements of IS: 5572 shall be provided by the Contractor.

## **11. Starters**

1. Starters shall have bimetal electrodes and high mechanical strength.
2. Starters shall be replaceable without disturbing the reflector or lamps and without the use of any tool.
3. Starters shall have brass contacts and radio interference capacitors.

#### **4. Capacitors**

1. The capacitors shall have a constant value of capacitance and shall be connected across the supply of individual lamp circuits.
2. The capacitors shall be suitable for operation at specified supply voltage conditions and shall have a value of capacitance so as to correct the power factor of their corresponding lamps circuit to the extent of 0.95 lag or better.
3. The capacitors shall be hermetically sealed preferably in a metal enclosure to prevent seepage of impregnate and ingress of moisture.

#### **4. Lamps**

Lamps shall be capable of withstanding small vibrations and the connections at lead in wires and filaments/ electrodes shall not break under such circumstances.

#### **Drawings/ Documents Required**

1. As part of proposal, the Contractor shall furnish relevant descriptive and illustrative literature & drawings/ data for the respective lighting fixtures & accessories with manufacturer's catalogue numbers.
2. It shall be the responsibility of the Contractor that, on award of contract to work out a detailed lighting layout for the complete plant in order to provide the levels of illumination as indicated under design criteria and shall be furnished for the approval of the GWSSB's representative before commencement of installation.
3. Detailed room wise lighting layout with type of fixture details, mounting detail arrangement and circuit diagram showing phase wise load distribution and interconnection between switches, fixtures, lighting panel, receptacles etc.
4. Conduit layout showing room wise routing of wires from lighting panel to lighting fixtures covering primary & secondary point wiring, receptacles etc.
5. Internal road lighting and area lighting layout with type of mounting details and fixture details.
6. Street Light pole details with Foundation details

7. General arrangement of lighting panel & lighting distribution board showing plan, elevation and typical section views.

### **Lighting System Equipment**

#### **8. Main Distribution Boards and Lighting Panels**

1. Main Lighting distribution board (MLDB) shall have MCCB as incomer & outgoing feeder with Microprocessor based/ thermal magnetic release for O/L+S/C+E/F protections.
2. This MLDB shall feed to different Lighting Panels/ Lighting DBs for further distribution.
3. Where ever MLDB is not applicable, lighting feeder of appropriate rating shall be derived from the local distribution board. This feeder will feed to local LP catering to lighting requirements of that particular area.

#### **4. Constructional Features**

1. Boards and panels shall be sheet steel enclosed and shall be fully dust and vermin proof, providing a degree of protection of IP52 for indoor. Outdoor panels shall in addition be completely weather-proof with a sloping canopy for protection against rain and providing a degree of protection of IP55. The sheet steel used for frame, frame enclosures, doors, covers and partitions shall be cold rolled 2.0 mm thick.
2. The lighting panel for outdoor lighting shall have a programmable timer for automatic control of lighting along-with contactor, MCB, auto/ manual selector switch.
3. All boards and panels shall be provided with hinged doors for access to equipment. Doors shall be gasketed all round with neoprene gaskets.
4. A slotted metallic sheet shall be provided inside. Only the MCBs operating knobs shall project out of the metallic sheet slots for safe operation and neat appearance. Incomer to lighting panels shall be provided with four pole MCB + RCCB.
5. All accessible live connections/metals shall be shrouded and it shall be possible to change individual MCBs from the front of the boards/ panels without danger of contact with live metal.
6. For floor mounting type distribution boards, adequately sized mounting channels shall be supplied and for wall/column/structure mounting type panel suitable mounting straps shall be provided.

7. Adequate interior cabling space and suitable removable cable entry plates shall be provided for top/ bottom entry of cables through glands and or conduits as required. Necessary number of glands to suit the specified cable sizes shall be provided. Cable glands shall be screwed on type and made of brass.
8. Two earthing terminals shall be provided to suit the earthing conductor.
9. All sheet steel parts shall undergo rust-proofing process which should include 7 tank processing. The steel works shall then be painted with two coats of Zinc - chromate primer and two coats of final epoxy-based finish paint of colour 63I as per IS 5.

#### **10. Bus-bars**

1. Bus-bars shall be of copper conductor of hard drawn (HD) and high conductivity.
2. Bus-bars shall be provided with at least the minimum clearances in air as per applicable standards.
3. Bus-bars shall be adequately sized for the continuous current rating such that the maximum temperature of the bus bars, bus bar risers/droppers and contacts does not exceed 85<sup>0</sup> C under site reference temperature.
4. The bus bars, bus bar connections and bus bar support shall have sufficient strength to withstand thermal and electro-mechanical stresses of the MCB's let through/cut-off current associated with the specified short-circuit level of the system.
5. Bus-bar supports shall be SMC type. Separate supports shall be provided for each phase of the bus bars.
6. The neutral bus of the main 3 phase, 4 wire distribution board shall be 100% of the phase bus-bars.

#### **7. Panels/ Boards Component & Lighting Accessories**

##### **1. MCB/ ELCB**

2. MCBs shall be C curve type for lighting panels.
3. For all the lighting panels RCCBs shall be with 100 mA sensitivity & for all receptacles RCBO sensitivity shall be 30 mA.

##### **4. MCCB**

MCCB requirements shall be as per specified in the LV switchgear requirements & as specified above.

##### **5. Indicating Instruments and Meters**

6. Whenever required, instruments and meters shall be of the flush mounting type. They shall be suitably mounted so as to provide for easy access to CTs and small wiring.
7. Instruments shall be of minimum 96 mm square size, shall have provision for zero adjustment outside the cover and black numerals on white dial.
8. Ammeter/Voltmeter selector switches having 3 positions and off, with stay-put contacts rated 10A shall be provided when specified.
9. Potential fuses shall be provided at the tap-off point from the bus bars for the voltmeters.

**10. Instrument Transformers**

11. Current and voltage transformers shall be of cast resin type, with insulation class B & accuracy class 1.0 unless otherwise specified, it shall be the responsibility of the Contractor to ensure that the VA burden of the instrument transformer is adequate for the meters connected to it.
12. Test links shall be provided in both secondary leads of the CTs to easily carry out current and phase angle measurement tests. Facilities shall be provided for short-circuiting and grounding the CTs at the terminal blocks.
13. Voltage transformers shall be provided with suitably rated primary and secondary fuses.

**14. Indicating Lamps**

Indicating lamps shall be of the clustered LED type, low watt consumption.

**15. Internal Wiring**

16. Panels/ boards shall be supplied completely wired, ready for the external connections at the terminal blocks. Wiring shall be carried out with 1.1 K V grade, FRLS PVC insulated, multi-stranded Copper conductors. Conductors of adequate sizes shall be used to suit the rated circuit current.
17. Cross Ferruling i.e. engraved identification ferrules, marked to correspond with the wiring diagram shall be fitted at both ends of each wire.
18. All wiring shall be terminated on terminal blocks. Terminal blocks shall be one piece moulded rated 500 V, of reputed make of approved list, preferably stud type for higher current ratings such that wires are connected by cable-lugs and complete with nuts and washers. Terminals shall be adequately rated for the circuit current, the minimum rating shall be 20 A.

19. Terminals for circuits with voltage exceeding 125 V shall be shrouded.
20. Terminals shall be numbered and provided with identification strip for identification of the circuit.
21. Terminal blocks for CT secondary lead wires shall be provided with shorting and disconnecting/earthing facilities.

**22. Labels & Diagram Plate**

23. All door mounted equipment as well as equipment mounted inside the switchboard/panels shall be provided with individual labels with equipment designation/rating. Also, the boards/panels shall be provided on the front with a label engraved with the designation of the board/ panel.
24. Labels shall be made of non-rusting metal, 3ply lamacoid or engraved acrylic.
25. Inside the door of the 1 phase ways lighting panels a circuit diagram/description shall be fixed for reference and identification.

**26. Conduits**

27. Rigid steel/ non-metallic conduits and their associated fittings as required shall conform to applicable standards. The minimum size of conduit shall be 20 mm for surface installation and 25 mm for concealed installation.
28. Steel conduits shall be seamed by welding and hot dip galvanised. They shall be supplied in standard lengths of 5 metre.
29. Supply of conduits shall include all associated fittings like couplers, bends and tees as required for lighting system installation work.

**30. Junction Boxes**

31. Junction boxes with terminals shall be supplied for branching and terminating lighting cables when required for outdoor areas, three (3) phase receptacles etc.
32. The junction boxes shall be dust and vermin proof and shall be fabricated from 14 SWG sheet steel and shall be complete with removable cover plate with gaskets, two earthing terminals each with nut, bolt and washer. Boxes shall be additionally weather proof.
33. The boxes shall have provision for wall, column, pole or structure mounting and shall be provided with cable/ conduit entry knock outs, terminal blocks, and HRC fuses as required.
34. The terminal blocks, with specified number of terminals, shall be mounted securely on brackets welded to the back sheet of the box. The terminals shall be



600 V, grade, one-piece construction complete with terminals, insulation barriers, galvanised nuts, bolts and washers and provided with identification strips of PVC. The terminals shall be made of Copper alloy and shall be of box clamp type.

35. The boxes shall be painted with one shop coat of red oxide zinc chromate primer followed by a finishing coat of paint.

**36. Lighting Poles and Flood Light Pole Mounting**

37. Lighting poles for street lights and flood lights shall be of stepped tubular steel poles construction as per applicable standard. These poles shall be coated with bituminous preservative paint on the inside as well as embedded outside surface. Exposed outside surface shall be painted with one coat of red lead oxide primer. After completion of installation two coats of aluminium paint shall be applied.
38. Poles for mounting flood lights shall be supplied whenever required and as per typical attached drawing. Unless otherwise specified, poles shall be painted with red lead oxide primer and two coats of aluminium paint. One steel ladder shall be provided separately. The length of each step of the ladder shall be at least 300 mm and spacing between two adjacent steps not more than 300 mm.
39. The supply of poles shall be complete with fixing bracket/necessary pipe reducer for fixing the fitting and also include the necessary associated pole mounted junction boxes.
40. The required sizes of poles and the junction box shall be as indicated in the attached drawings.
41. Outdoor JB's shall be minimum IP 55 protected.
42. Cable entry for street lighting junction boxes shall be from bottom.
43. Rain water canopy shall be provided at the top for the outdoor JB's. Terminal strip shall be provided for looping loop out of cables.
44. Street lighting JB shall consist of terminal strip (3 ways) for looping in & loop out of cables. The JB shall be provided with 6A MCB (C- Curve type) for isolation of lighting fixture, as well as sufficient arrangement (earthing studs) for termination of 2 nos. earthing connections.

**DETAILS & REQUIREMENTS FOR LIGHTING, RECEPTACLE SYSTEM (DATA SHEETS)**

**Data sheet with all details & requirements as well as materials of construction for various parts, mandatory accessories, spares & services required are given in the data sheet section.**

**Contractor must go through it in depth so as to satisfy the basis, general & overall requirements of the equipment.**

## **PART IV- INSTRUMENTATION & CONTROL EQUIPMENT**

### **List of Measurements and Control**

The water pumping system shall be provided with required automation / instrumentation equipment for operation, measurement & control functions, indicated below as a minimum, but not limited to:

1. Flow Indicator Transmitter (electromagnetic) at common discharge header of pumps and Flow Indicator Transmitters (electromagnetic) at the inlet of Raw water sump as well as at the end of the rising main at Dediyaan pumping station.
2. Pressure Indicator Transmitter at & common discharge header of pumps.
3. Level Indicator Transmitter on raw water sump.
4. Bidder may propose additional instruments & control equipment for safe, reliable & efficient operation of pumping station and treatment process proposed by him.
5. Necessary alarms, status signals along with the measurements of process parameters etc. shall be displayed in SCADA operation & control system.

### **Fields Instruments/ Process Analysers Required**

Field instruments/ process analysers shall be provided as per the process requirement for proper functioning of the plant as per approved P&ID & following technical specifications.

## **Electromagnetic Flow Meter**

### **Scope**

The objective of the specification given in this section is not to specify all the details pertaining to the design, drawing and selection of equipment or product. The equipment or product supplied shall be of high standard of quality and shall comply with all currently applicable standards, regulations and safety codes. In case of differing constructional features than specified here in equal importance shall be given to adherences & fulfilment of technical parameters & accuracy. In case of difference in material (s) of construction, higher / better / superior grade of material (s) shall also be accepted after due diligence & evaluation by the EIC.

### **General**

The flow meter shall consist of flow sensor (i. e. flow tube), flow transmitter / flow computing unit and remote flow indicator cum integrator. The electromagnetic flow meter shall be manufactured as per BS EN ISO 6817 standards - measurement of conductive liquid flow in closed conduits method using electromagnetic flow meters. The flow tube flanges and transmitter housing shall be properly earthed.

Flow tube shall have waterproof construction (IP 68) and shall be suitable for installation on underground pipe lines buried directly in the soil and also suitable for above ground pipelines.

The transmitter of the flow meter shall be SMART type microprocessor based using digital technology having facilities for configuration of engineering units, flowrange and features of memory and self-diagnosis.

The transmitter shall be mounted separate from the flow tube, connected by a cable.

The flow transmitter and flow computation / evaluation unit shall be mounted in a field mounted metallic field enclosure / cabinet.

The electromagnetic flow meter shall have bi-directional measurement feature and with accuracy better or equal to  $\pm 0.5\%$  of measured value inclusive of linearity, repeatability, pressure effect etc.

Flow transmitter / flow computing unit should be microprocessor based having digital display with flow-rate indications and integrated flow values with the configuration facility from the front face.

Material of construction of the wetted parts of flow meters shall be suitable for functioning on treated / raw and chlorinated water applications.

Flow tube shall be rugged in construction and shall be suitable for continuous operation.

Flow meters shall be suitable for the water turbidity at site during various seasons.

The flow meter shall be installed in such a way that it always remains filled with water.

To avoid the effects of disturbances in the velocity profile, a straight and uninterrupted run, upstream as well as downstream from the location of the flow meter shall be provided, as required by the flow meter manufacturer.

The flow tube shall be installed at a location free from flow turbulence. In order to achieve the same, the flow tubes shall be installed in the pipe section such that straight lengths of pipe without bends or tee connection shall be minimum 5 (five) diameters on upstream and 2 (two) diameters on downstream side.

The Contractor shall finalize the exact location of flow transducers in consultation with GWSSB's EIC.

The flow meter output signals shall contain the data for flow-rate and integrated flow readings.

The output signal of the flow meter will be connected to panel mounted Flow Indicator & integrator and PLC.

Full bore electromagnetic flow meters should be designed, manufactured and calibrated according to ISO standard. The flow meter shall be capable of measuring bi directional flow. The Electromagnetic flow meters shall withstand maximum working temperature of about 60<sup>0</sup> C and working pressure of minimum 25/16 Kg/Cm<sup>2</sup> (2.5/1.0Mpa) as per specifications and data sheet.

### **General Requirements**

Flow measuring system shall consist of flow sensor / transducers, flow computer & flow transmitter, digital flow indicator & integrator and any other item required to complete the system. Flow sensors / transducers shall be rugged in construction and shall be suitable for continuous operation. The electromagnetic flow meters shall be suitable for installation on underground / above ground pipelines in pumping station / RCC chambers / open pits or buried for indication of flow rate and total consumption of water in a transmission or distribution pipe network of water supply system. Flow transducers shall have water proof construction.

To avoid the effects of disturbances in the velocity profile, a straight and uninterrupted run, upstream as well as downstream from the location of the flow sensor shall be provided, as required by the flow meter manufacturer.

The exact location of flow transducers shall be finalised in consultation with Engineer's representative. However electromagnetic full-bore type shall be provided on common discharge header of the pumping station.

The flow transmitter shall be suitable for field mounting and shall accept input from the flow transducer. It shall process the input signal and provide 4 - 20 mA DC output proportional to flow rate. Flow transmitters shall have LED / LCD display to indicate instantaneous flow rate. The flow range shall be adjustable. The flow meter shall be suitable for measuring flow at velocities of water from 0.5 to 4 m/sec.

Flow measurement shall not be affected by physical properties of water viz. temperature, pressure, viscosity, density etc. within given limits. Bidder shall provide compensating electronic circuits if required.

Bidder shall construct a suitable concrete chamber (if and as required) for enclosing flow transducer to be mounted on over / under ground pipe line. A concrete cabin shall be constructed above the chamber for housing the flow transmitter. A concrete cabin shall be constructed for housing the flow transducer and the flow transmitter to be mounted on surface pipelines.

The flow transmitter shall be microprocessor based and shall have self-diagnosis facility.

Measurement of outlet flow at pumping system will be by full bore type electromagnetic type flow meter.

### **Technical Requirements**

Electromagnetic flow meter shall be a velocity sensing electromagnetic type, Microprocessorbased signal converter, sealed housing, welded flanged tube meter for minimum 1.6Mpa working pressure unless otherwise specified. The meter shall be manufactured to highest standard available for mag meters. The meter shall be equipped with minimum six digits digital totalisers, reading in units of kilolitres and shall be accurate within 0.5% of true flow. The accuracy should be inclusive of linearity, hysteresis, repeatability and pressure effect. The meter assembly shall operate within a range of 0.5 m/sec to 4 m/sec and be constructed as follows.

**Meter tube (Sensor)** shall be fabricated from stainless steel tube and use class PN 16 flat face carbon steel flanges as specified in data sheet in accordance with IS: 1538. The internal and external of the meter tube shall be blasted to near white and lined with neoprene or polyurethane. Meter tube shall have a constant nominal inside diameter offering no obstruction to the flow.

**Coil Housing** shall be fabricated from stainless steel and / or cast steel with anti-corrosive epoxy painting for corrosion resistance and welded to the tube providing a completely sealed

environment for all coils, electrode connections and wiring harness capable of submerged or buried operation.

**Signal Converter** shall be pulsed DC coil excitation type with auto zeroing. The signal converter shall be remotely mounted away from the meter. The converter shall indicate direction of flow and provide a flow rate indication and a total of flow volume for both forward and reverse directions.

The converter shall provide an isolated 4-20 mA output into minimum 500Ω load and a frequency output of a maximum of 0-10 KHZ and a scaled pulse output. The Microprocessor based signal converter shall have a self-diagnostic test mode and a backlit display that continuously displays 'Rate of Flow' and 'Total Volume'.

The converter shall be compatible with Microsoft Windows and other software programs with built in terminal communication capabilities of RS 485, HART or other protocols for interface. The converter shall be remotely mounted up to 200 m from the sensor, and shall be supplied with all calibration complete for desired requirements.

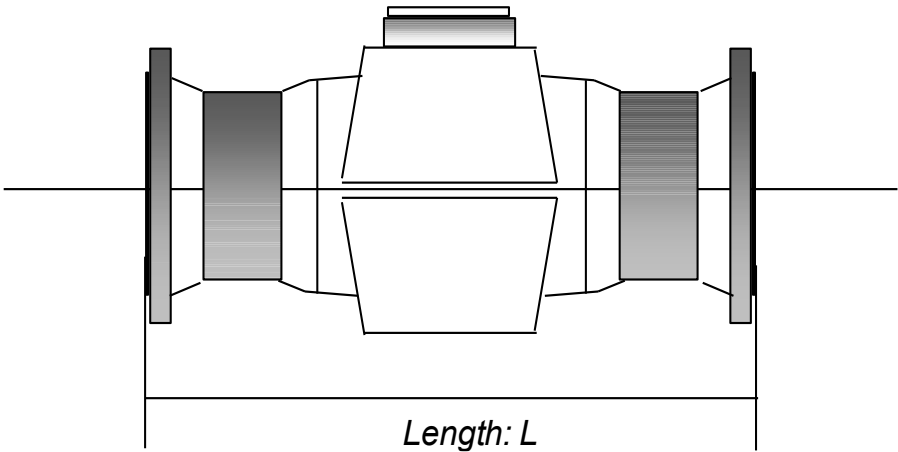
Converter shall be supplied with a programmable low flow drop out and empty pipe zero return. The signal converter housing should be die-cast aluminium with glass window. The converter cum transmitter should be fully programmable from the front fascia. The programming should be user friendly, self-prompting menu driven.

### **Signal Cable**

The cable should be capable of transmitting low signal voltage U (milli volts, pico watts) via a double shielded cable from the primary head to the signal converter. The cable should be resistance to interference from external magnetic fields. The cable should be suitable for laying in underground and in under water installation.

### **Meter size & Overall Length**

Meter size is designated by the nominal diameter (DN) of the flange. For each meter size designation, there is a corresponding fixed overall length and tolerance both as specified in Table. The length includes lining if it covers the flange face but excludes accessories such as gaskets, grounding and protection rings. Standard length of different reputed manufacturers' from among the vendor list is also acceptable. The length shown here is only for reference. Manufacturers' standards are to be followed in this regard.



Overall Length (only as a reference) of EM FM	
Meter Size in	Meter Overall Length (Applicable Tolerances Allowed)
DN (mm)	Length in mm
125	250
150	300
200	350
250	450
300	500
350	550
400	600
450	600
500	600
600	600
700	700
800	800
900	900



1000	1000
1200	1200

### **Connections**

The flow meter shall be provided with flanges at both ends, the internal diameter of which shall be equal to the nominal size of the meter. The dimensions and drillings of the flanges shall be in accordance with IS: 1538.

### **Rubber Gasket**

The flat rubber gasket shall be 3/6 mm dual thickness of SBR material and shall be suitable for making flange joints. The quality of flat rubber gasket shall be as per IS: 5382 and drilling of holes shall be as per IS: 1538.

### **Nuts and Bolts**

Nuts and bolts shall be of best quality carbon steel, machined on the shank and under the head and nut. Nuts and bolts shall be electro-galvanized. Bolts shall be of accurate length so that only one thread shall show through the nut in the fully tightened condition. Nuts and bolts shall conform to IS: 1363 and IS: 1367.

### **Material Supply**

All the flanged meters shall be supplied with one rubber gasket per flange and the required number of nuts and bolts as per the meter size. Matching pair of grounding rings shall be supplied with all the meter tube.

### **Testing & Inspection**

**Volumetric testing** of all meters must be performed and approved prior to shipment. The complete meter assembly and signal converter must be wet accuracy tested and calibrated as a unit near minimum, intermediate, and maximum specified flow ranges of the meter (full range of flow). The volume of water used to conduct the test must be shown on a shipping tag attached to the meter.

To calibrate these meters, only direct volume comparison calibration method should be used. The overall accuracy of the calibration rig should be at least three times better than the accuracy of the full-bore electromagnetic flow meter. The competent authority must certify the test facility. All the meters shall be calibrated for a minimum of 5 point.

The manufacturer should have an ISO 9001 certification. The magnetic flow meter should perform within the required accuracy of measured value without being affected by change in pressure due to demand fluctuation. The length of the sensor should be strictly as per ISO up to DN 600 mm and for other sizes it should be as per the manufacturers' standards. To avoid ingress of water in the sensor housing, sensor has to be of fully welded construction. The maximum separation level (distance) between flow sensor and the signal converter / transmitter should be at least 200 meters without signal boosters.

Supplier should have in house calibration facility and should give calibration certificate for all the flow meters. The flow meter should preferably have grounding rings only. Calibration of each meter shall be tested at in house facility of manufacturer for the sizes for which manufacturer has this facility. The test bench of such manufacturer should be certified by a reputed company. In case the bulk water meters are to be imported by the bidder than ISO or EEC certification for such calibration is required. If manufacturer has no in-house facility for calibration then each meter shall be tested from FCRI.

Supplier must have test facilities, spare parts, and personnel to maintain, instruct, train or whatever is necessary to assure that meters shall be maintained throughout the guarantee / maintenance contract period.

Alternatively, **Gravimetric** method of calibration as per ISO 4185 / IEC 17025 is also acceptable. Facility shall be accredited by NABL.

### **Quality Control Tests**

All water meters of the same size and class manufactured by the same firm under similar condition of production from the material of the same batch, components from the same source, shall be considered as a lot for quality control inspection. However, minimum 1 number of each size & class shall be tested. The sampling procedure and scale of sampling for visual inspection and other tests shall be as per Table-4 given in IS: 779.

The sample meters from a lot shall be inspected for workmanship to ensure that meter is free from any damage, cracks, imperfections and other defects and uniform in dimensions.

### **Acceptance Tests**

The flow meter having satisfied for quality control requirements shall be tested for lot acceptance.

The following acceptance tests shall be conducted in accordance with IS: 779 and IS: 2373.

Pressure tightness (Hydrostatic test) and Metering Accuracy

In addition, to above tests manufacturer shall furnished a material(s) certificate(s) for meter tube, coil housing, connection flange and electrode, if required the material may be tested at approved laboratory for reconfirmation. If desired, the calibration and other test shall be witnessed by the GWSSB or their authorised representatives.

### Packing

All the flow meters shall be packed in polyethylene bags. Smaller size meters shall be packed in cardboard boxes. The larger size bulk flow meter shall be packed in separate wooden crate, according to the size. Rubber gasket and nuts, bolts etc. shall be supplied in separate jute bags.

#### a) Minimum Technical Specification of Electromagnetic Flow Meter

Sr. No.	Description	Particulars										
1	General											
1.1	Item	Electromagnetic Flow Meter										
1.2	Service	Water Flow Measurement and Analysis										
1.3	Fluid	Raw Water/ Treated Water										
1.4	Area Classification	Non-Hazardous										
1.5	Temperature	Ambient										
2	Flow Sensor											
2.1	MOC	Anticorrosive Material suitable to drinking water application										
a	Electrode / Sensor MOC	Stainless Steel (SS) 316/ SS316L/ SS304/ SS304L/ Hastelloy/ Titanium										
b	Flow Tube MOC	Stainless Steel (SS) 304/ SS304L/ SS316/ SS316L/ metallic alloy										
c	Coil Housing MOC	Stainless Steel (SS) 304/ SS304L/ SS316/ SS316L/ Die-cast aluminum/ Carbon Steel (CS)/ Sheet steel										
d	Earthing Ring/ Electrode MOC	Stainless Steel (SS) 316/ SS316L/ SS304/ SS304L/ Hastelloy/ Titanium										
e	Liner MOC	Neoprene/ Polyurethane/ Ebonite/ Rilsan/ EPDM/ PTFE/ PFA										
2.2	Process Connection	<div><div><ul style="list-style-type: none"><li>Flanged</li><li>Reducer-Expander is accepted for pipe diameter and shall be in bidder scope. Bidder may allow to select expander/ reducer to suit the existing pipe as below.</li></ul></div><table><tr><th>Pipe Diameter</th><th>Reduction/ Expansion allowed (Maximum)</th></tr><tr><td>≥ 10 mm to &lt;750 mm</td><td>50 mm reduction of pipe line</td></tr><tr><td>≥ 750 mm to &lt;1000 mm</td><td>100 mm reduction of pipe line</td></tr><tr><td>≥ 1000 mm to &lt;1500 mm</td><td>150 mm reduction of pipe line</td></tr><tr><td>≥ 1500 mm</td><td>200 mm reduction of pipe line</td></tr></table><div><ul style="list-style-type: none"><li>The taper flange degree of reducer and expander to the flow meter shall be within 8°.</li></ul></div></div>	Pipe Diameter	Reduction/ Expansion allowed (Maximum)	≥ 10 mm to <750 mm	50 mm reduction of pipe line	≥ 750 mm to <1000 mm	100 mm reduction of pipe line	≥ 1000 mm to <1500 mm	150 mm reduction of pipe line	≥ 1500 mm	200 mm reduction of pipe line
Pipe Diameter	Reduction/ Expansion allowed (Maximum)											
≥ 10 mm to <750 mm	50 mm reduction of pipe line											
≥ 750 mm to <1000 mm	100 mm reduction of pipe line											
≥ 1000 mm to <1500 mm	150 mm reduction of pipe line											
≥ 1500 mm	200 mm reduction of pipe line											
a	Flange MOC	Carbon Steel (CS)/ SS304/ SS304L/ SS316/ SS 316L										
b	Flange Standard	IS 1538/ AWWA/ DIN/ EN 1092/ JIS/ ANSI										

Sr. No.	Description	Particulars										
c	Counter Flange	Counter flange shall be in bidder scope and Dimension of flange shall be same as flow meter flange dimension.										
2.3	Housing Ingress of Protection (IP)	IP 68 or NEMA 6P										
2.4	Pressure Rating	PN 25 (25 Kg/cm²)										
2.5	Spool Piece	<div><ul style="list-style-type: none"><li>Spool piece of each size of flow meter to be provided by Bidder.</li><li>Bidder shall have provided required Spool piece as per below table and it is to be kept at nearest GWIL office/ GWSSB office/ RWSS office/ Nearest Head work or store within 50 to 100 KM.</li></ul><table><tr><th>Flow Meter Quantity (Nos)</th><th>Spool Piece Quantity (Nos)</th></tr><tr><td>1</td><td>1</td></tr><tr><td>≥ 2 to ≤5</td><td>2</td></tr><tr><td>&gt; 5 to ≤20</td><td>5</td></tr><tr><td>&gt; 20</td><td>10</td></tr></table></div>	Flow Meter Quantity (Nos)	Spool Piece Quantity (Nos)	1	1	≥ 2 to ≤5	2	> 5 to ≤20	5	> 20	10
Flow Meter Quantity (Nos)	Spool Piece Quantity (Nos)											
1	1											
≥ 2 to ≤5	2											
> 5 to ≤20	5											
> 20	10											
3	Flow Indicator and Transmitter (Display Unit)											
3.1	Type	<div>Microprocessor Based (Remote/ Integral Mounted)<ul style="list-style-type: none"><li>Remote mounted where Buildings available</li><li>Integral type where Buildings are not available/ remote area</li><li>For Remote Location where building is not available, buried type flow meter is required along with blind display and External detachable battery.</li></ul></div>										
3.2	Accuracy	0 to ± 1% of measured value										
3.3	Ingress of Protection (IP)	<ul style="list-style-type: none"><li>≥ IP65 or equivalent for remote type display</li><li>IP 68 or equivalent for integral type display</li></ul>										
3.4	MOC	Die-cast Aluminium/ Polycarbonate/ Polyamide/ SS304/ SS316										
3.5	Power Supply	<ul style="list-style-type: none"><li>230 VAC type flow meters in case of Indoor/Where Building is available</li><li>Bidder shall provide inbuilt battery-operated flow meters in case of outdoor/ remote area (Min battery life 5 years)</li><li>In case of battery-operated flow meter, bidder must replace all batteries after completion of 5th year without any additional cost to tenderer.</li><li>If battery fails during O&amp;M period, bidder has to replace battery without any additional cost implication to client.</li><li>In case of 230 VAC flow meter, bidder has to supply and lay cable from the source of power supply to Flow Meter, also installed 1 KVA voltage stabilizer with built in Surge protector device to provide stabilized voltage to instruments.</li></ul>										
3.6	Output	Digital Output- Modbus/ HART										
3.7	Communication	Flow Meter will communicate to PLC/ Data Logger/ RTU through Digital output										
3.8	Display	<ul style="list-style-type: none"><li>Min. 2 Line LCD</li><li>Actual Flow Rate / Instantaneous Flow Rate</li><li>Cumulative Flow / Sum / Totalizers</li></ul>										

Sr. No.	Description	Particulars
		<ul style="list-style-type: none"> <li>Alarm indicator</li> <li>Actual Flow rate and Totalized reading can be display simultaneously</li> </ul>
3.9	Display	Minimum 8 Digit
3.10	Data Logger/Local storage (Internal/External)	<ul style="list-style-type: none"> <li>Flow Meter reading can be log/ store locally in data logger for every 15 minutes</li> <li>Minimum 30 days storage required in Data logger.</li> </ul>
3.11	Communication Protocol	<ul style="list-style-type: none"> <li>Push-Pull type where flow meter is 230 VAC flow meters.</li> <li>Push type where flow meter is inbuilt battery-operated.</li> <li>Communication from the Flow Meter -Remote Terminal Unit (RTU) to Centralized Monitoring Station (CMS) shall be through any cellular/ wireless technology provided through reliable Telecom Service provider (TSP).</li> <li>In case of GSM/ GPRS based communication system: required SIM cards and its subscription; recurring charges shall be borne by Tenderer/ bidder as per below. <ul style="list-style-type: none"> <li>SIM card shall be purchased from reputed TSP who have more than 25 lacks customer in Gujarat.</li> <li>SIM cards and its subscription shall be borne by bidder for first 3 year of O&amp;M period.</li> <li>After successful completion of 3rd year of O&amp;M (i.e 4<sup>th</sup> year to 8<sup>th</sup> year of O&amp;M period) subscription charges of sim cards shall be borne by department</li> <li>However, bidder is responsible for performing various activities like coordination, activation and maintenance of the same</li> </ul> </li> <li>In case of 230 VAC flow meter, Time stamped data shall be transfer from Flow meter-RTU to CMS at every 15 minutes.</li> <li>In case of battery-operated flow meter, time stamped data for every 15 minutes shall be saved locally and after every 12 hours data will be transferred from Flow meter RTU to CMS.</li> </ul>
3.12	Zero and Span adjustment	<ul style="list-style-type: none"> <li>Zero and span adjustment can be done with the help of Password.</li> <li>Protection of all parameters (calibration and revenue parameters) to be protected with the help of Factory set Password.</li> <li>Bidder shall share Password of flow meters to client at the end of every Quarter.</li> <li>Further, the release of subsequent quarterly O&amp;M charges will only allow upon successful confirmation of receiving of the same.</li> </ul>
3.13	Cable Gland	Required
3.14	Cable Length (sensor to Display Unit)	<ul style="list-style-type: none"> <li>For Remote Type Flow Meter, cable to be supply as per site requirement along with 5-meter extra cable.</li> <li>Copper cable is required- minimum 18 Gauge (0.75 mm<sup>2</sup>)</li> </ul>
3.15	Facility for online diagnosis  (Local Indication as well as Central Monitoring Station Indication)	<p>Required as following:</p> <p>Diagnostic</p> <p>Continuous self-test shall include (But not limited to):</p> <ul style="list-style-type: none"> <li>Flow Meter On-Off</li> <li>Power Supply Failure Alarm</li> </ul>

Sr. No.	Description	Particulars
		<ul style="list-style-type: none"> <li>Battery Failure Alarm</li> </ul> Major error/ alarm like non-function of device, battery failure etc. will trigger immediately at Central Monitoring System.
3.16	Data Protection:	If there is a power failure, data available on the display unit should not get erased. Flow data must be saved during power failure or during network failure and must be transferred to centralized monitoring system after services resume.

Note: Bidder should have submitted minimum technical specification compliance along with Bid submission for technical bid evaluation.

**b) Remote Terminal Unit (RTU):**

- It is bidder's responsibility to install new flow meter along with remote terminal unit for wireless communication with centralized monitoring system.
- It is bidder's responsibility to install remote terminal unit on existing flow meter for wireless communication with centralized monitoring system.

Sr. No.	Description	Particulars
1.1	<ul style="list-style-type: none"> <li>Panel-IP 54 in case of Indoor/Where Building is available</li> <li>Panel- <math>\geq</math> IP 65 in case of outdoor/ remote area</li> </ul>	To Mount Flow Meter Display, Data logger, GPRS Modem, 1 KVA voltage stabilizer with built in Surge protector device etc.
1.2	Data Logger (Internal/ External)	To Store Local Flow Data (every 15 minutes Data) and Alarm Data (Instantaneously) to be Log/ store for 30 Days
1.3	MODEM	Transmit Flow Data to Centralised Monitoring Station/ State Level Data Server
1.4	MOC	CRCA sheet
1.5	Thickness of Panel Wall	Minimum 1.5 mm
1.6	Thickness of Gland Plate	Minimum 2 mm
1.7	Panel Color	Paint Finish as per RAL- 7032 (follow 7 tank Process )

**DETAILS & REQUIREMENTS FOR ELECTROMAGNETIC FLOWMETER (DATA SHEETS)**

Data sheet with all details & requirements as well as materials of construction for various parts, mandatory accessories, spares & services required are given in the data sheet section.

Contractor must go through it in depth so as to satisfy the basis, general & overall requirements of the equipment

## **PRESSURE GAUGES**

Pressure Gauges shall be bourdon tube with diaphragm seal type with dial size of minimum 150 mm in diameter and calibrated for the required range of duty heads of pumping machinery to be installed as per range required. The colour of dial shall be white. The pointer shall be adjustable & micro-meter type. The indicator shall be incorporating with damper and shall have external zero setting mechanism and safety blow out mechanism. The glass shall be shatter proof. The over range protection shall be 25% above maximum pressure.

The gauge shall be supplied complete with sensing diaphragm unit, sealing liquid, a pressure indicator and an armoured capillary connecting the diaphragm to the pressure indicator.

The pressure indicator shall be supported on a rigid support and the capillary shall be well supported to prevent physical damage.

Pressure gauges shall be provided on individual delivery (discharge) of each pump and on common discharge header of all pumps. The gauge shall be supplied complete with impulse tubing, two valve manifolds with drain cock / calibration valve, fittings etc. The pressure gauges shall have an accuracy of 1% full scale and weather protection class IP 65. All wetted parts material shall be SS 316.

Pressure gauge shall comply with IS: 3624 / BS: 1780. Pressure gauge shall have siphon & cock arrangement. It shall be provided with snubber and Glycerine filled dial shall be provided as the gauge is subjected to pressure pulsation and / or vibrations. The internal parts of pressure gauge shall be stainless steel.

The zero and span of pressure gauge shall not change by more than  $\pm 0.1$  % of the span per  $^{\circ}\text{C}$  changes in ambient temperature.

Material(s) of construction of the components shall be as per ISO 9001: 2000 certified manufacturers' standard models.

### **DETAILS & REQUIREMENTS FOR PRESSURE GAUGE (DATA SHEETS)**

**Data sheet with all details & requirements as well as materials of construction for various parts, mandatory accessories, spares & services required are given in the data sheet section.**

**Contractor must go through it in depth so as to satisfy the basis, general & overall requirements of the equipment.**

**SAFETY EQUIPMENT AND MISCELLANEOUS ITEMS**

Following safety procedure and practice should be provided by Contractor in switchgear room/ sub-station as per latest edition of IS: 5216.

Adequate provision for metallic vitrified HV / LV danger notice boards & stickers of standard sizes are to be made.

900 mm wide antiskid insulating matting as per IS: 15652 and of reputed make to be spread in front of the 11 KV, 415V switch gear panels & power DBs, DCDB etc.

First aid box with all the standard contents.

Providing rubber hand gloves suitable for 11 / 22 KV supply.

First aid chart made of cloth for electrical shock treatment printed in English, Hindi and Gujarati duly framed with front glasses.

Charts/ drawings duly framed with front glass.

HV and LV power supply single line diagrams in adequate sizes approved by GWSSB's representative & in line with the local electrical inspector.

Routine maintenance schedule for High Voltage Switchgear, Distribution Transformers, Low voltage Switchgears, Capacitor panels, Fire Alarm System, UPS system etc.

Provision of portable type Class A, B, C, and D type fire extinguishers at various locations in line with the statutory requirements.

**Fire Safety**

The requirement of hand appliance in switchgear room, electrical equipment room shall be provided as per Clause 4.0 of Fire Protection Manual by Regional Tariff Committee, 10th edition 1988.



## **FIRE EXTINGUISHERS**

Providing fire extinguisher CO<sub>2</sub> charged of reputed make as per IS: 2878 & latest revision of capacity 4.5 Kg or as specified in price bid. Construction of cylinder shall be as per IS: 7285 & valve shall be brass forged & as per IS: 3224. Charge shall be CO<sub>2</sub> confirming to IS: 307 & filled with liquefied CO<sub>2</sub> gas filling ratio  $\leq 0.667$ . It shall be properly finished & duly painted in synthetic enamels red / fire red epoxy polyester coating. It shall be provided with wall mounting brackets.

Water Sealing & Fire Barriers at appropriate locations as specified in this specifications & good engineering practices.

### **Degree of Protection**

The enclosures of the control cabinets, junction boxes and Marshalling boxes, panels etc. to be installed shall provide minimum degree of protection as detailed here under

Installed outdoor – IP 55

Installed indoor – IP 54

The degree of protection shall be in accordance with IS: 13947 (Part I)/ IEC 947 (Part I)/ IS: 2063/ IEC 529.

### **Electrical Equipment for Hazardous Area**

The electrical equipment for hazardous areas shall be selected as per IS: 5572. Following factors shall be considered for proper selection of electrical equipment for use in Hazardous Area.

Area Classification (Zone)

Gas Classification (Group): The characteristics of the gas or vapour involved in relation to the ignition or energy and safe gap data.

Temperature Classification: The ignition temperature of the gas or vapour involved or lowest value of the ignition temperature, if more than one combustible material is present.

### Environmental Conditions

In which apparatus is to be installed. The selected electrical apparatus shall be adequately protected against corrosive and solvent agencies water ingress, thermal and mechanical stresses as determined by the environmental condition.

## **INSTALLATION, TESTING AND COMMISSIONING: MECHANICAL EQUIPMENT**

### **1. Erection - General**

- 1.1. The Contractor's staff shall include adequate and competent erection engineers with proven, suitable, previous experience on similar contracts to supervise the erection of the works and sufficient skilled, semi-skilled and unskilled labour to ensure completion of works in time. The contractor shall not remove any representative, erector or skilled labour from the site without prior approval of the Engineer-In-Charge (EIC).
- 1.2. The Contractor shall ensure that no installation or erection work shall commence until full and unconditionally approved working drawings, signed and stamped by the EIC are available at site.
- 1.3. The Contractor's erection staff shall arrive on the site on dates to be agreed by the EIC. Before they proceed to the site, however, the contractor shall first satisfy himself, as necessary, that sufficient plant of his (or his vendor's) supply has arrived on site(s) so that there will be no delay on this account.
- 1.4. One erection engineer who shall be required to be the contractor's representative shall be conversant with the erection and commissioning of the complete works. Should there be more than one erector, one shall be in charge and the contractor shall inform the EIC in writing which erector is designated as his representative and is in charge. Erection engineer is to report to the project manager.
- 1.5. The Contractor shall be responsible for setting up and erecting the plant to the line and levels of reference and of the positions, levels dimensions and alignment, appliances and labour in connection therewith. The checking of setting out of any line or level by the EIC shall not in any way relieve the contractor of his responsibility for the correctness thereof.
- 1.6. Erection of plant shall be phased in such a manner so as not to obstruct the work being done by other contractors or operating staff who may be present at the time. Before commencing any erection work, the contractor shall check the dimension of structures where the various items of Plants are to be installed and shall bring any deviations from the required position, lines or dimensions to the notice of the EIC. Plant shall be erected in a neat and workmanlike manner on

the foundations and at the locations shown on the approved drawings. Unless otherwise directed by the EIC, the contractor shall adhere strictly to the aforesaid approved drawings. If any damage is caused by the contractor during the course of erection to new or existing plant or buildings or any part thereof, the contractor shall, at no additional cost to the Employer, make good, repair or replace the damage, promptly and effectively as directed by the EIC's satisfaction.

- 1.7. The contractor shall align all equipment and holding down bolts and shall inform the Employer before proceeding with grouting in the items concerned. The contractor shall ensure that all equipment is securely held and remains in correct alignment before, during and after grouting in.
- 1.8. The approval by the Employer of the contractor's proposals for rigging and hoisting any items of the plant into final positions shall not relieve the contractor from his responsibility for damage to completed structures, parts or members thereof or other installed equipment. He shall at his own cost make good, repair or replace any damaged or injured items, whether structural, electrical, architectural, or of any other description, promptly and effectively to the satisfaction of the Employer.
- 1.9. No plants or other loads shall be moved across the floors of structures without first covering the floors with timber of sufficient size so that applied loads will be transferred to floor beams and girders of steel or concrete. If it is required to reduce bending stresses and deflection, the beams and girders shall be provided with temporary supports.
- 1.10. During erection of the plant the EIC will inspect the installation from time to time in the presence of the contractor's site representative to establish conformity with the requirements of the specifications. Any deviations and deficiencies found or evidence of unsatisfactory workmanship shall be corrected as instructed by the EIC.

## **2. Levelling and Grouting of Machinery**

- 2.1. He shall undertake sufficiently in advance chipping of any unevenness of concrete on foundations, anchor bolt pockets, cut outs etc. to achieve uniform level of reference for erection. All concrete surfaces receiving grout shall be hacked as required to ensure better bonding with grouting.
- 2.2. Contractor shall undertake the inspection of all components to be erected sufficiently in advance to check their soundness and conformity to drawings and the inspection records shall be signed by the Engineer as approval for undertaking the installation of the components. Any damage, shortfalls etc. shall be made good to the satisfaction of the EIC.
- 2.3. All grout for equipment shall be carried out using non shrinkable continuous grout materials with suitable frame work of at least 12 mm thickness. Surfaces to receive the grout shall be hacked and roughened and laitance shall be removed by wire brushing or blast of air. Concrete surface shall be

blown off by compressed air before commencing grouting. Grouting shall be done in one continuous operation from one side such that grout flows in a single wave until grout reaches all confined spaces with no air pockets and air from all confined spaces is expelled. A hydro static head of 150 mm shall be maintained during grouting operations. All grouting shall be carried out in the presence of the EIC's representative. All lines and levels shall be checked up after grout is set. Block outs shall be closed using cement concrete of the same grade as that of the parent structure.

### **3. Records, Procedures and Reports**

- 3.1. The Contractor shall maintain records pertaining to the quality of installation / erection work and inspection, testing, compliance with all technical requirements in respect of all his works as described in the previous paragraphs. The reporting formats shall be in the approved formats. The contractor shall submit such records to the Engineer after the completion of any particular work before submitting the bill of supply / progress of work. Such report shall comprise shop inspection reports, shop testing reports, material test reports, based on which dispatch clearances are provided, all the quality control reports of welding, erection and alignment records.
- 3.2. All the above-mentioned records shall be submitted in the final form duly countersigned by the EIC's representative attesting conformity to specifications and his approval of installation, and duly incorporating all the additions, alternations, and information as required by the EIC on the basis of preliminary reports giving the progress of the work. Such records notwithstanding, any records submitted earlier with bill of supply / progress etc. shall be duly bound and submitted to the EIC in six copies by the contractor on his notification of the mechanical completion of erection.

### **4. General Preparations before Completion of the Plant**

- 4.1. The following documents should be completed in accordance with the contract schedule before completion of erection. The Employer and the contractor shall preserve and control these documents in a safe and appropriate place on Site in order the both parties personnel can make use of them at any time.
  - 4.1.1. Technical Documents
    - a) Operation and Maintenance Manuals
    - b) Design documents including the contractor's design data, drawings and specifications.
    - c) Tools and test equipment list
    - d) Spare parts list
    - e) Lubricant list

#### 4.1.2. Procedures

- a) Mechanical testing procedure
- b) Electrical testing procedure
- c) Instrumentation testing procedure
- d) Detailed Pre commissioning and commissioning procedure
- e) Detailed Performance Test procedure

#### 4.1.3. **General and Coordination Documents**

- a) Detailed organisation charts for pre commissioning and commissioning showing lines of authorities and responsibility and functions of all key personnel.
- b) The job description of the members of the team.
- c) The scheduled dates of assignment of each member to pre commissioning and commissioning Organisation.
- d) A detailed schedule showing the time sequence which the contractor anticipates to follow for the various steps in completion of erection, pre commissioning and commissioning of each unit and equipment.
- e) The regulations for safety, hygiene and discipline.
- f) The practical organisation of the relationship (meetings, reports, etc.) between the contractor and the Employer at the phases of pre commissioning and commissioning.
- g) Emergency communication route.

#### 4.2. Manpower

- 4.2.1. Required manpower shall be provided as agreed between the contractor and the Employer in a manpower mobilisation plan which shall include the number and qualifications of the operator and maintenance personnel to be furnished by the Employer for the plant.

### 5. **Completion of Installation / Erection**

- 5.1. The completion of plant under erection by the contractor shall be deemed to occur, if all the units of the plant are structurally and mechanically complete and will include among other such responsibilities the following:
  - 5.1.1. Plant in the scope of the contract has been erected, installed and grouted as per specifications.
  - 5.1.2. Installation checks are completed and approved by the EIC.
  - 5.1.3. The erected plants are totally ready for commissioning checks.
- 5.2. At the stage of completion of erection, the contractor shall ensure that all the physical, aesthetic and workmanship aspects are totally complete and the Plant is fit and sound to undergo tests on completion and subsequent pre commissioning checks.

- 5.3. Upon achieving the completion as described above the contractor shall notify the EIC by a written notice intimating completion of erection and notify the EIC for inspection. The EIC shall proceed with the inspection of such units within 14 days of such a notice.
- 5.3.1. The EIC shall certify completion when there are no defaults in the works or
- 5.3.2. The EIC shall inform the contractor list of deficiencies for rectification hereinafter referred as Punch list and the contractor shall complete the rectification work within a jointly agreed period before pre commissioning activities and obtain the EIC's acceptance or approval of the same before proceeding with the same.
- 5.3.3. The EIC may inform the contractor that the works are accepted with the 'Punch' list (items which do not hamper operability, safety or maintainability) and allow the Contractors to proceed with the pre commissioning checks when the contractor undertakes to complete such outstanding works within an agreed time during defects liability period. Taking over shall be based on rectification of all deficiencies as advised by Punch lists.
- 5.4. The erection period indicated by the contractor would be deemed to cover all the activities up to completion as stipulated in previous paragraphs, notice of completion by the contractor, inspection by the EIC for completion and contractor rectification of all deficiencies as noticed by the deficiency / Punch list, and acceptance by the EIC of such rectification's prior to tests on completion.
- 5.5. Minor defects, which in the opinion of EIC which do not hamper operability and maintainability will not be taken into account for deciding mechanical completion. Such defects shall be rectified concurrent to commissioning checks before tests on completion. However, the EIC's decision in this regard is final.
- 5.6. The commissioning period as notified by the contractor shall be deemed to occur beyond the date of completion and shall include all periods of pre commissioning, trials and tests on completion.
- 5.7. It is in the contractor's interest to offer the sections / units / systems progressively under identified milestones within overall erection period, duly completed for rectification of any deficiencies pointed out by the Engineer and to achieve mechanical completion before undertaking the tests on completion within the specified erection period. The EIC also reserves the right to withhold the cost as-estimated to be equivalent to the rectification of deficiencies pointed out to the Contractor until such a time such deficiencies are rectified to the satisfaction of the EIC.

## **6. Pre-Commissioning**

- 6.1. After the completion of erection, pre commissioning activities listed below shall be carried out to make the plant ready for commissioning. All instruments, materials and provisions necessary for conducting site tests shall be provided by the contractor at his own cost.
- 6.2. Upon completion of erection of each piece of equipment, facility or discrete part of the plant, mechanical checks and tests shall be carried out according to the contractor's check list. The mechanical checks and tests shall be to establish that,
  - 6.2.1. The Plant is erected in accordance with the contractor's construction drawings, pipe work drawings, instrument diagrams, etc. issued for the plant.
  - 6.2.2. The materials are installed and mechanically function in accordance with the contract and
  - 6.2.3. Applicable codes as listed in the contract are followed for materials and workmanship.
- 6.3. Items such as painting, thermal insulation and final clean-up which do not materially affect the operation or safety of the Plant will be excluded. All these items shall be listed and completed after pre commissioning or commissioning at the discretion of the contractor but before acceptance.
- 6.4. The contractor shall prepare and maintain at site test forms and records which shall include:
  - 6.4.1. Description of type of test or check
  - 6.4.2. Date and times of test or check
  - 6.4.3. Identification of equipment and facilities
  - 6.4.4. Test pressure, test data and results, including remarks, if any
  - 6.4.5. Signature of the contractor's personnel attesting to data recorded, if any, checks, tests and records thereof shall be carried out by the contractors' construction forces.
- 6.5. Wherever the Employer's witness or attesting of the check or test is required, the Employer's personnel shall attend such check and test. For this purpose, the contractor shall keep the Employer informed of a day to day test plan schedule. The test plan schedule may be revised from time to time to reflect the actual progress of the work and test.
- 6.6. Any items found incomplete or requiring repair or adjustment shall be marked as such on the test records and then reported by the contractor to the Employer and the contractor's personnel in charge of the relevant construction area.
- 6.7. Checking procedures shall be repeated until all the items on the check list are cleared.
- 6.8. A complete set of test records shall be handed over to the Employer on completion.
- 6.9. The tests on the different mechanical and electrical equipment shall include but not limited to,
  - 6.9.1. Pumps, Pipe work and Valves

- a) 1.5 times the shut off pressure or twice the working pressure whichever is higher to test the soundness of the joints. Provision of the necessary pumps, gauges, blank flanges, tapping etc. for carrying out these tests shall be included in the contract.
- b) Leakage tests shall be carried out on all erected pipe work, pumps and valves immediately after erection and where possible before being built in.
- c) Operating tests shall be conducted on valves.
- d) The pump set shall be tested for performance. The vibration and noise levels shall be checked to be within the specified.
- e) The pump shall be tested through the operating range as per BS 5316 Part I Class C / ISO 2548 with all working (excluding stand by) pumps at a time for all the pumps. **However, no negative tolerance shall be permitted on the tested pump efficiency.**

#### 6.9.2. Pump motors

Condition of winding insulation be tested and insulation values shall be restored to required level by suitable heating arrangements locally.

#### 6.9.3. Cranes

The crane and lifting tackle shall be tested to 125 % of the safe working load. The contractor shall arrange the test load. Deflection and speed tests shall also be conducted.

#### 6.10. Instrumentation

The tests on the instrumentation equipment shall include but not be limited to:

- a) All cables shall be tested for polarity, continuity and insulation resistance. The common mode dc voltage at each signal input terminal shall be measured and recorded.
- b) The pre commissioning tests on the various main categories of plant shall be as listed below:
- c) The resistance of each electronic loop shall be measured.
- d) Electronic equipment shall have been energised for at least 24 hours before testing begins.
- e) The zero setting of each display instrument including any local indicator on or associated with a transmitter shall be checked.
- f) The correct calibration of each item in each control or monitoring loop shall be checked by the introduction of appropriate signal at each source, at five cardinal points of the range for increasing and decreasing signals.

#### 6.10.2. The following tests methods shall be used,

- a) Pressure operated devices – dead weight testers or portable calibrators



- b) Level operated devices – actual level variation or simulation thereof. Instrument zero reading shall be checked against a bench mark:
- c) For controlling devices, the contractor shall demonstrate the correct operation of the loop including the regulating devices. Each automatic controller shall be set to the appropriate estimated values of the terms which shall be optimised during the plant start-up. Each control valve shall be checked during the plant start-up. Each control valve shall be checked by operation of the manual control on the associated controller and the correct stroking verified. Valve petitioners, electro pneumatic converters and gauges shall be checked during these tests.
- d) All systems shall be checked for “fail safe” operation.
- e) Initiating devices not covered by the foregoing e.g. plant stop / start controls shall be checked in conjunction with the testing of the associated switchgear and machine.

6.10.3. The contractor shall also demonstrate the data transfer as per data transfer schedule between pumping stations.

## **7. Commissioning**

- 7.1. After the completion of pre commissioning activities the final checks and preparations necessary for start-up of the plant shall be carried out. The contractor shall submit to the Employer a written notice of mechanical completion which shall include:
  - 7.1.1. Identity of a part of the plant considered mechanically complete,
  - 7.1.2. A copy of all relevant completed test reports,
  - 7.1.3. The date on which the completion of the tests was achieved,
  - 7.1.4. Check list and
  - 7.1.5. A request for issuance of a mechanical completion certificate in respect of that part.
- 7.2. Within fourteen (14) days from the date of receipt of the contractor's written notice, the Employer shall:
  - 7.2.1. In the case of acceptance, issue a mechanical completion certificate.
  - 7.2.2. In the case of objection, submit a rejection statement setting forth remaining items to be completed or defects or deficiencies to be corrected before mechanical completion status can be accepted. When the Employer rejects the contractor's notice the contractor shall take any necessary action to complete or correct the items marked and give the Employer a second notice of mechanical completion.

7.3. After the issuance by the Employer of a mechanical completion certificate, commissioning activities listed below shall be carried out to enable the start-up and operation of the plant. Procedures are described as below:

7.3.1. Commissioning Procedure shall be carried out in a methodical sequence as follows

- a) Warming up
- b) Start up
- c) Initial running
- d) Operability adjustment
- e) Stable operation
- f) Final adjustment

7.3.2. At all stages of commissioning sequence, the plant shall be operated at optimum plant conditions. To ensure this, the contractor may make minor adjustment to the conditions indicated in the operation and maintenance manual as necessary.

7.3.3. The contractor shall check the operating conditions of the plant by constantly monitoring operating data.

7.3.4. The contractor shall specify for each discrete part of the plant the operational data to be recorded and the manner in which the data is to be taken.

7.3.5. All the operating data shall be recorded by the Employer on the forms to be mutually agreed. A copy of the operating log and analytical data from initial operation through to the completion of performance test shall be made available by the Employer to the contractor for evaluation.

## **INSTALLATION, TESTING & COMMISSIONING: ELECTRICAL INSTRUMENTATION SYSTEM & EQUIPMENT**

### **Equipment Installation, Testing & Commissioning**

#### **Installation of Equipment**

##### **General**

- a) In accordance with the specific installation instructions, as shown in contractor's drawings or as directed by the EIC's representative the contractor shall unload, erect, install, wire, test and place into commercial use of all electrical equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square, and properly aligned and oriented.
- b) The contractor shall furnish all supervision, labour, tools, equipment, rigging materials and incidental materials such as bolts, wedges, anchors, concrete inserts etc. required to completely install, test and adjust the equipment.
- c) Drawings, instructions and recommendations shall be correctly followed in handling, settling, testing and commissioning of all equipment and care shall be exercised in handling to avoid distortion to stationary structures, the marring of finish or damaging of delicate instruments or other electrical parts.
- d) The contractor shall erect and commission the equipment as per the instructions of the EIC representative and shall extend all cooperation to him.
- e) In case of any doubt / misunderstanding as to correct interpretation of drawings or instructions, necessary clarification shall be obtained from the EIC's representative. The contractor shall be held responsible for any damage to the equipment consequent to not following instructions correctly.
- f) The contractor shall move all equipment into the respective buildings through regular doors or floor openings provided specifically for the equipment. The contractor shall make his own arrangement for lifting of equipment.
- g) Where assemblies are supplied in more than one section, the contractor shall make all necessary mechanical and electrical connections between sections including the connections between bus bars / wires. The contractor shall also carry out the adjustments / alignments necessary for proper operation of the circuit breakers. All insulators and bushings shall be protected against damage during installation. Insulators or bushings chipped, cracked or damaged due to negligence or carelessness shall be replaced by the contractor at his own expenses.

- h) The contractor shall take utmost care in handling instruments, relays and other delicate mechanisms. Wherever the instruments or relays are supplied separately, they shall be mounted only after the associated control panels have been erected and aligned. The blocking material / mechanism employed for the safe transit of the instruments and relays shall be removed after ensuring that the panels have been completely installed and no further movement of the same would be necessary. Any damage to relays and instruments shall be immediately reported to the EIC's representative.
- i) Inspection, storage, installation, testing and commissioning of transformers shall be in accordance with the latest Indian Standards Code of Practice IS: 10028. All commissioning tests as applicable, vide Appendix B of IS: 10028 (Part II) shall be carried out.
- j) Switchgear control panels shall be installed in accordance with the latest Indian Standard Code of Practice 10118. The switchgear panels shall be installed on finished surface or concrete or steel sills. The contractor shall be required to install and align any channel sills which form part of the foundations. Tape or compound shall be applied where called for. The base of outdoor type units shall be sealed in an approved manner to prevent ingress of moisture.
- k) After installation of all power and control wiring, the contractor shall perform operating tests on all switchgear and panels to verify the proper operation of switchgear / panels and the correctness of the interconnections between various items of equipment. This shall be done by applying normal ac or dc voltage to the circuits and operating the equipment. Megger tests for insulation, polarity checks on the instrument transformers, operation tests on equipment, and installation tests shall be carried out by the contractor who shall also make all necessary for proper functioning of the equipment.
- l) Installation and testing of the battery and battery chargers shall be done in strict compliance with the applicable standards. Each cell shall be inspected for breakage and condition of cover seals as soon as received at site. The battery shall be set up on racks as soon as possible after receipt, utilising lifting devices. The cells shall not be lifted by the terminals. Contact surface of the battery terminals and inter cell connectors shall be cleaned, coated with protective grease and assembled. Each connection shall be properly tightened. Each cell shall be tested with a hydrometer and thermometer and the results logged. A freshening charge, if required, shall be added. When handed over to the Employer, the battery shall be fully charged and the electrolyte shall be at the full level and of the specified specific gravity.
- m) Equipment furnished with finished coats of paint shall be touched up by the contractor if their surface is spoiled or marred while handling.

- o) Foundation work and grouting in of fixing bolts or channels for all transformers, switchgear, motor control panels will be carried out by the contractor.

### **Distribution Transformers**

Inspection, storage, installation, testing and commissioning of transformers shall be in accordance with the latest Indian Standards Code of Practice IS: 10028. All commissioning tests as applicable, vide Appendix B of IS: 10028 (Part II) shall be carried out. Fire Wall of 4 Hrs. fire rating shall be provided between two transformers.

### **HV/ LV Switchgear & Control Panels**

Switchgear control panels shall be installed in accordance with the latest Indian Standard Code of Practice 10118. The switchgear panels shall be installed on finished surface or concrete or steel sills. The Contractor shall be required to install and align any channel sills which form part of the foundations. Tape or compound shall be applied where called for. The base of outdoor type units shall be sealed in an approved manner to prevent ingress of moisture.

Following minimum clearances shall be observed while finalizing the HV/ LV panel layouts,

1. Minimum clearance of 1.0 meter shall be maintained from the rear of the panel to the nearest wall /structure.
2. Minimum clearance of 2.0 meter between panels facing opposite to each other.
3. Side clearance for LV panels shall be either  $\leq 200\text{mm}$  or  $\geq 800\text{ mm}$ .
4. For HV metal enclosed, indoor panels, Minimum 1 meter clearance from all sides & 1.5 meter in the front.

Emergency Exit doors shall be provided for electrical room, complying with the requirements of NBC 2005 latest edition.

After installation of all power and control wiring, the Contractor shall perform operating tests on all switchgear and panels to verify the proper operation of switchgearpanels and the correctness of the interconnections between various items of equipment. This shall be done by applying normal A C or D C voltage to the circuits and operating the equipment. Megger tests for insulation, polarity checks on the instrument transformers, operation tests on equipment, and installation tests shall be carried out by the Contractor who shall also make all necessary arrangements for proper functioning of the equipment.

### **Installation and Maintenance of Flow Meters**

#### **General**

This section covers the technical requirements for installation of electromagnetic flow meters and their operation and maintenance. The installation of these meters shall be done in the existing / new water supply system. A proper care should be taken at the time of installation to minimise the disturbance in the supply. From O & M point of view a proper protection and easy access to the meters should be ensured at the time of installation of these meters.

#### **Installation Philosophy**

The installation of EMF meters shall be preferably done in line, except in those cases where, due to site condition, in line installation is not feasible, the meters shall be installed on by pass line. All the installation above 150 mm size should be done with dismantling joint.

To ensure, during measurement the meters must remain completely filled with water, care should be taken to avoid locations where chances of partial flow are high, such as pipes laid on slopes. The meter should not be installed close to the strong electromagnetic fields such as close to power transformer.

The electrode axis of the meter should be in horizontal plane for horizontal pipe runs. Care should be taken to avoid installations of meters on the downstream of the control valves, 90<sup>0</sup> or 45<sup>0</sup> elbows or partially opened valves etc. to avoid cavitation / partial flow conditions.

A minimum of 5 x D, straight pipe up stream and a run of 3 x D pipe diameter downstream or as per the recommendations of the manufacture, whichever is on the higher side must be ensured for all the installation site to avoid turbulent flow profile at the meter location. The flow direction of the water should correspond to the direction shown by the arrow on the sensor.

### **Specials and Fittings**

It is proposed to install the meters on the existing / new common discharge header of pipe material such as Mild steel (MS) etc. All the meters shall be installed using MS fittings only.

It is desirable and advantageous to prepare the assembly of meter and pipe fittings in advance which shall be inserted at pre-selected location in the system to minimise disturbance of water supply and also to ensure high degree of workmanship and fast installation.

All the flange fittings shall be installed with a proper rubber gasket for water tight joints.

### **Electrical Installation**

The signal converter shall be installed remotely and mounted on the panel board / wall of the pumping stations or any other suitable location directed by the engineer in charge. 5 ampere single phase AC connection shall be made available, for power supply to the signal converter and the sensor. All other necessary fixers including wiring with proper cable conduit, safety fuses and other items necessary for the installation of EMF shall be provided by the bidder to the satisfaction of the engineer in charge and no extra payment shall be made on this account.

GI pipes shall be used as a conduit for connecting cables between signal converter and the sensor. First few feet of the conduit must be run in flexible conduit near sensor terminal box and at the signal converter. The signal converter shall be fitted with face sealing cable glands. Only ½” NPT glands and double compression adapters may be used.

Only the specified signal cable recommended by the manufactures shall be fitted. The conduit entry shall be sealed to prevent moisture entering the terminal box via the conduit.

Proper grounding of flow meter with the help of grounding rings shall be ensured for proper electrical contact between flowing liquid and the ground.

### **Protection of Meter**

The flow meters if buried underground shall be with proper protection of terminal box and signal cable. The bidder shall ensure protection of meter from damages due to overburden by providing pre cast cover slabs. The space between vertical walls shall be filled with coarse sand prior to placing the cover slab.

There is a possibility that at some site, installations shall be protected by constructing RCC chamber around the meter with pre cast cover slab and locking arrangement. In case, where meter can be installed inside pump house extra protection viz. RCC chamber shall not be required.

### **Laying of Meter Assembly**

Cutting of pipes shall be necessary for laying and fixing of meter assembly if it is to be installed on the existing underground buried pipes, if any. For this purpose, a trench of sufficient width, depth and length shall be excavated for the underground pipelines. The existing pipe shall be cut and dismantled as per the requirement without damaging the extra length of the pipes. In case the extra length of pipe has been damaged by the bidder the cost of same shall be recovered from the bidder, equivalent to rates of current SOR.

Prior to lowering the meter assembly in the trench, the bottom of the trench shall be rammed and a sand bedding of 150 mm shall be prepared. The meter assembly shall fully rest on the firm and flat bed. After the installation, the trench shall be filled with excavated soil in layer with proper compaction to the entire satisfaction of the engineer in charge. The laying of extra pipe and fixing of meter assembly shall be done as per the relevant code of practice for laying and fixing of joints for respective pipe material.

### **Testing and Commissioning**

On completion of the installation of the meter, bidder should field test (field verification) the EMF using validation tool for the following minimum verification routine to demonstrate the health of meter,

1. Auto logging of instrument data and setting (Diameter, field power and converter outputs)
2. Measurement of power / frequency
3. Check on impedance of coil



4. Check on converter linearity by simulation
5. Check on current outputs

The field-tested meters shall be commissioned at the earliest without the loss of time. The bidder should submit a field validation certificate after completing the field testing stated above and duly signed by the engineer in charge to the concerned authority for asset transfer. The date of receipt of validation cum commissioning certificate shall be treated for commencement of warranty period.

### **Installation Work for Earthing and Lightning Protection System**

- a) The Contractor shall install copper /steel conductors, braids, etc. required for the system and individual equipment earthing. All work such as cutting, bending, supporting, painting / coating, drilling, brazing /soldering / welding, clamping, bolting and connecting onto structures, equipment frames, terminals, rails or other devices shall be in the contractor's scope of work. All incidental hardware and consumables such as fixing cleats / clamps, anchor fasteners, lugs, bolts, nuts, washers, bituminous compound, welding rods, anti-corrosive paint as required for the complete work shall be deemed to be included by the contractor as part of the installation work.
- b) The quantities, sizes, material of earthing conductors and electrodes to be installed as per requirement. Routes of the conductors and locations of electrodes shall be as shown on the project drawings.
- c) The work of embedment of earthing conductor in RCC floors / walls along with provision of earth plate inserts / pads / earth risers shall be done by the civil contractor when the floors are cast or during construction of walls. However, when required to do so in those areas where flooring will be done after the Contractor is at site, the Contractor shall coordinate with civil contractor and shall install the earthing conductors before the commencement of the concrete work. In such cases the contractor's scope of installation shall include laying the conductors in position with 50 mm concrete cover, making welded connections to inserts / pads / risers above the floor near the equipment. The embedded conductors shall be connected to reinforcing rods wherever necessary.
- d) If the tap connections (earthing leads) from the floor embedded main earthing grid to the equipment are more than 500 mm long then the same shall be embedded in floor by the Contractor where required, together with associated civil work such as excavation / chipping,

concreting and surfacing, if not already done by the civil contractor. The concrete cover over the conductor shall not be less than 50 mm.

- e) Installation of earth conductors in outdoor areas, buried in ground, shall include excavation of earth up to 600 mm deep 450 mm wide, laying of conductors at 600 mm depth, brazing / welding as required, of main grid conductor joints as well as risers of length 500 mm above ground at required locations and then backfilling material to be placed over buried conductor shall be free from stones and other harmful mixtures. Back fill shall be placed in layers of 150 mm, uniformly spread along the ditch, and tampered utilising pneumatic tampers or other approved means. If the excavated soil is found unsuitable for backfilling, the contractor shall arrange for suitable material from outside.
- f) Installation of earth connection leads to equipment and risers on steel structures / walls shall include laying the conductors, welding / cleating at specified intervals, welding / brazing to the main earth grids risers, bolting at equipment terminals and coating welded / brazed joints by bituminous paint. Galvanized conductors shall be touched up with zinc rich paint where holes are drilled at site for bolting to equipment / structure.
- g) Electrodes shall be installed (a) directly in earth or (b) in constructed earth pits, and connected to main buried earth grid, The scope of work shall include excavation, construction of the earth pits including all materials required for construction of earth pits, placing the rod and fixing test links on those pipe / rod / electrodes in test pits and connecting to main earth conductors.
- h) Installation of lightning conductors on the roofs of buildings shall include laying, anchoring, fastening and cleating of horizontal conductors, grouting of vertical rods wherever necessary, laying fastening / cleating / welding of the down comers on the walls/columns of the building and connection to the test links to be provided above ground level.
- i) Installation of the test links shall include mounting of the same at specified height on wall/column by suitable brackets and connections of the test link to the earth electrode.
- j) Whenever main earthing conductor crosses cable trenches, they shall be buried below the trench floor.
- k) Suitable earth risers shall be provided above finished floor / ground level. If the equipment is not available at time of laying of the main earth conductors. The minimum length of such riser inside the building shall be 200 mm and outdoors shall be 500 mm above ground level. The risers to be provided will be marked in project drawings.
- l) Earth leads and risers between equipment earthing terminals and the earthing grid shall follow as direct and short a path as possible.

- m) An earthing mat shall be provided under each operating handle of the isolator and operating mechanism of HV breakers. Operating handle of the isolator and supporting structure shall be bonded together by a flexible connection and connected to the earthing grid.
- n) A separate earth electrode bed shall be provided adjacent to structure supporting lightning arrestors. Each connection shall be as short and as straight as practicable. For arrestors mounted near transformers, earth conductors shall be located clear off the tank and coolers.
- o) Wherever earthing conductors pass through walls, galvanized iron sleeves shall be provided for the passage of earthing conductor. The pipe ends shall be sealed by the contractor by suitable water proof compound.

### **Earthing Connections**

- a) All connections in the main earth conductors buried in earth / concrete and connection between main earthing conductor and earth leads shall be of welded type.
- b) Connection between earth leads and earthing terminal provided on the equipment shall be bolted type.
- c) All bimetallic connections shall be treated with suitable compound to prevent moisture ingress.
- d) Metallic conduits and pipes shall be connected to the earthing system.
- e) Lightning protection system down conductors shall not be connected to other earthing conductors above ground level. Also, no intermediate earthing connection shall be made to lightning arrester and transformer earthing leads which shall be directly connected to pipe electrode.

### **Earth Electrodes**

1. Electrodes shall as far as practicable be embedded below permanent moisture level.
2. Test pits with concrete covers shall be provided for periodic testing of earth resistance. Installation of pipe electrodes in test pits shall be suitable for watering. The necessary materials required for installation of test pits shall be supplied and installed by contractor. The installation work shall also include civil work such as excavation and connection to main earth grid.
3. Earth pits shall be treated with salt and charcoal if average resistivity of soil is more than 20ohm metre.
4. Soil, salt and charcoal placed around the electrode shall be finely graded, free from stones and other harmful mixtures. Back fill shall be placed in layers of 250 mm thick uniformly spread and compacted. If excavated soil is found unsuitable for backfilling, the contractor shall arrange for a suitable soil from outside.

**Lightning Protection System**

- a) The lightning protection air termination rods and/or horizontal air termination conductors shall be fixed in such a way that they remain in their installed position even during severe weather conditions. The necessary accessories such as cleats, clamps, welding materials, bolts, nuts, shall be supplied by contractor.
- b) Air termination systems shall be connected to earthing system by down conductors as shown in project drawings. The down conductors shall follow a direct path to earth. There shall not be any sharp bends, turns and kinks in the down conductors.
- c) All joints in the down conductors shall be of welded type. All metallic structure within 2 metres of down conductors shall be bonded to lightning protection system.
- d) Every down conductor shall be provided with a 'test link' at about 1000 mm above ground level housed in a suitable GI enclosure made of adequate thickness steel sheet and hot dip galvanised. The test joint shall be directly connected to the earthing system electrode.
- e) The lightning protection system shall not be in direct contact with underground metallic service ducts, cables, cable conduits and metal enclosures of electrical equipment. However, all metal projections, railings, vents, tanks, etc. above the roof shall be bonded together to form a part of roof grid.

**INSTALLATION OF CABLE RACKS AND CABLE TRAYS****General**

- 1. Lines and grade for trays may be measured from building steel and finished floor elevations. Change in line or grade, or the addition of offsets by means of cutting standard tray sections and inserting additional tray fittings to match with the existing arrangement shall be considered as a normal part of the work.
- 2. Where embedded steel inserts in concrete floors/ walls for welding the supports for cable racks/ trays are not available, Contractor shall provide suitable anchor fasteners at no extra cost.
- 3. Cable shall be clamped to the cable trays at every 750 mm distance.
- 4. Flexible metallic conduits shall be used for termination of connection to equipment such as motors, limit switches and other apparatus.

**Cable Trays**

All the cable tray shall be hot dipped galvanized with minimum galvanization thickness as

per mentioned in this specification.

1. Cable tray shall be of perforated sheet steel with formed flanges and of minimum thickness not less than 1.25 mm for trays up to 100 mm width, not less than 1.5 mm for trays from 100 mm to 150 mm width and not less than 2.0 mm for trays from 150 mm to 300 mm width.
2. All the cable trays above 300 mm width shall be of ladder type with minimum thickness of 2.5 mm.
3. Cable tray for use in areas where chlorine gas may be present shall be constructed from U-PVC or GRP. Cable tray supports shall be of a compatible finish with the associated cable tray.
4. All cable trays tees, intersection units, bends, turns and sets shall be prefabricated (made by the manufacturer) and shall be of a matching design to the main section of cable tray.
5. Tray shall only be joined by couplers supplied by the manufacturers. The joint shall be secured in accordance with the manufacturer's instructions.
6. Cable tray supports supplied by a manufacturer or made up on Site shall have adequate strength to maintain rigid support to the fully laden cable tray along its entire length and shall ensure that the deflection of any one section does not exceed 15 mm at mid span.
7. Wherever possible, cable trays shall be installed in full lengths without cutting. Should it be necessary to cut or drill a length of tray, the bared ends or damaged section of the tray shall immediately be given a coat of zinc rich cold galvanized paint. All site manufactured accessories, supports and metal fittings required to ensure correct installation of the cable trays shall be similarly treated.
8. All cables shall be firmly secured to the tray using purpose made saddles, as approved by the Purchaser's Representative, together with proprietary nylon fasteners and/or cable cleats. Following installation of cables, the tray shall remain rigidly supported and the deflection of any section shall not exceed 15 mm at mid span. All brackets and tray work shall be suitable for withstanding a temporary weigh of 125 Kg.
9. Cable trays shall not be cut to allow the passage of cables through the surfaces of the tray
10. The sizing of the cable tray shall provide a minimum of 20% spare capacity.
11. The tray shall be run at least 300 mm clear of plumbing and mechanical services.
12. Bends in the installation shall take account of the minimum bending radii of cables to be installed.

13. All the cable trays shall be supplied with cable tray supports (of adequate size) at no more than 1.2 Meter interval.
14. Other cable tray details & cabling system shall be as per typical drawings attached with the specifications.

**Cable Trunking – Metal**

1. Cable trunking shall be manufactured from mild steel of not less than 1.25 mm and shall be hot dipped galvanized. The Contractor shall ensure that the size of the trunking is adequate for the number of cables to be installed together with 50% spare capacity and shall in any case be 50 mm x 50 mm minimum size.
2. Segregation of cables shall be carried out if required using continuous sheet steel barriers with the bottom edge welded to the trunking.
3. The trunking shall have two return flanges for rigidity. Where necessary, additional strengthening straps shall be fitted internally. The cover shall overlap the trunking and be made of the same gauge. Fixing screws for covers shall be recessed and be of the self-retaining 'quick fix' type. All bends, tees and intersections shall be of the gusset type and shall, wherever possible, be purpose made by the manufacturer and of a matching design to the main trunking.
4. Cables shall be retained in the trunking when the cover is removed by means of straps. Internal connecting sleeves shall be fitted across joints in the trunking and earth continuity ensured by bonding each section of trunking to a continuous earth wire.
5. Non-flammable fire barriers shall be inserted where the trunking passes through walls or floors. Conduit connections to trunking shall be made by flanged couplings and male bushes.
6. Trunking shall be supported at intervals not greater than 2 meters horizontally or 2.5 meter vertically.
7. Crossings over expansion joints shall be made in flexible conduit.
8. Should it be necessary to cut or drill a section of trunking or a trunking fitting the bared ends shall immediately be given a coat of zinc rich cold galvanizing paint.
9. Cable and conduit/ trunking runs shall be determined by the Contractor and agreed by the EIC's Representative before any work is started. The run shall be at least 300 mm clear of plumbing and mechanical services.

Conduit/ trunking systems erected outside a building shall be weatherproof.

## **CABLE INSTALLATION**

### **General**

1. Cable installation shall be in accordance with IS 1255: 2001- latest edition.
2. Cables shall be installed in such a way that the minimum bending radii are not reduced when installed or during installation. Cables shall not be installed in ambient temperatures below that recommended by the cable manufacturer.
3. Cables grouped together shall have insulation capable of withstanding the highest voltage present in the group.
4. Cables of different categories shall be installed so as to maintain satisfactory clearances for safety and in order to reduce the possibility of electrical interference. The following Table details the distances in mm that shall be maintained between the different categories of cable.

Table of Separation Distances in mm between different Categories of Cable

<b>Cable Category</b>	<b>HV Power</b>	<b>LV Power</b>	<b>C&amp;I/ Protection</b>	<b>Tele-communication</b>
HV Power	N/A	300	600	600
LV Power	300	N/A	300	300
C&I/ Protection	600	300	N/A	200
Tele-communication	600	300	200	N/A

5. These separations are minimum and special circumstances such as the presence of high current flows, or harmonic content may necessitate larger separation distances.
6. A distance of minimum 300mm shall be maintained between the cables to be laid on trays/ conduits carrying low voltage AC and DC signals and a distance of minimum 600 mm shall be maintained between cables carrying HV and L V signals.
7. In order to make economic use of the cable support system, cables shall be arranged in groups of 50 mm maximum overall diameter. These groups shall be securely tied to the cable support system at intervals not exceeding 900 mm for horizontal runs and 300 mm intervals on vertical runs.
8. In order to make the most economic use of cable tray and duct capacity, multicore cabling shall be utilized in order to connect instrumentation groups by using suitably located sub-distribution junction boxes. The junction boxes shall be suitable for the area in which they

are to be installed and for the type of circuit. They shall be readily accessible for maintenance and clearly labelled junction boxes shall be constructed of die cast Aluminium and provide degree of protection IP 65.

9. Instrumentation cables shall be continuous without any joints. Separate cables shall be used for digital and analogue signals at all times. Digital and analogue signals shall be segregated within junction boxes.
10. Cables shall be laid in a manner such that any electrical interference between cables shall not have a detrimental effect on the life and operation of Plant.
11. Where practical a separate cable support system shall be provided for power and non-power cables. Where this is not practical a separation as per indicated in above table shall be maintained between power and non-power cables when run on the same support system.
12. Heavy duty galvanized iron cable tray and ladder racking shall be used for cable support systems. FRP/ GRP cable support systems shall be used in areas used for the storage and handling of chlorine. These systems shall be used to route cables around walls and within cable trenches. Cables shall be securely fixed to the support systems. Bundling of cables shall be permitted where allowance for this practice has been made in sizing the cables.

#### **Laying of Cables**

1. Each instrumentation and power supply cable shall be terminated to individual panel/ terminal box.
2. Identification of each cable shall be by proper ferrules at each junction as per cable schedule to be prepared by Contractor.
3. Cables shall be laid in accordance with layout drawings and cable schedule which shall be prepared by Contractor and submitted for approval.
4. All cable routes shall be carefully measured and cables cut to the required lengths, leaving sufficient amount for the final connection of the cable to the terminals on either end.
5. Various cable lengths cut from the cable reels shall be carefully selected to prevent undue wastage of cables.
6. A loop of 1.0 meter shall be left near each field instrument before terminating the cable.
7. Cables shall be complete uncut lengths from one termination to the other.
8. Separate cables shall be used for digital and analogue signals.
9. All cables shall be identified close to their termination point by cable numbers as per cable interconnection schedules.
10. Identification tags shall be securely fastened to the cables at both the ends.



11. Cable shall be rigidly supported on structural steel and masonry, using individually cast or malleable iron galvanized clips, multiple cable supports or cable trays.
12. The Contractor shall take the actual measurement of the cables and the associated accessories such as cable trays, conduits etc. required at site, prior to the placement of order on the cables.

#### **Cables Laid Direct in Ground**

1. Buried cable up to 1.1 K V shall have a laid at a minimum depth of 750 mm measured from FGL to the top of the highest cable. On crossing roadways the cable shall be run through a PVC-U duct of minimum diameter 100 mm with a minimum of 1000 mm cover and encased on all sides by 150 mm of concrete.
2. Cables of greater than 1.1 K V shall be buried at a minimum depth of 1 meter.
3. The bottom of the cable trench shall be freed of sharp stones and such like and 75 mm of sieved sand laid below the cable. After cable laying 75 mm of sieved sand shall be laid above the cable. For HV cables sand bedding shall be of 150 mm & cables shall be covered with half round Hume pipes of twice the diameter of cable.
4. Interlocking cable protective covers, minimum 1 m long x 300 mm wide, marked 'Danger-Electric Cable' in English and the vernacular shall be laid on top of the sieved sand. Covers shall extend the whole length of the cable trench and shall overlap cables by a minimum of 50 mm.
5. Warning tape shall be laid a minimum of 200 mm above the protective covers.
6. Cables are to be installed without tees or through joints unless otherwise approved by the Purchaser's Representative. Single core cables shall be run in trefoil formation.

#### **Cables Laid in Underground Ducts**

1. Underground ducts shall be constructed of impact resistant PVC-U and laid at a minimum depth of 750 mm, ducts shall be surrounded by at least 75 mm of sieved sand except at road crossings where it shall be 1.0 meters deep and encased on all sides by 150 mm of concrete.
2. The Contractor shall ensure that sufficient draw-in points have been provided and that adequate room has been allowed for installation of cables. Drawstrings shall be provided in all ducts to enable additional cables to be installed when required.
3. Where cables pass in or out of any duct entries into or within buildings such entries, together with any spare ducts shall be sealed against the ingress of moisture by means of duct stoppers and bituminous compounds or by any other method approved by the

GWSSB's Representative. The stopper shall have a fire resistance of at least 30 minutes. Single core cables in trefoil formation shall pass through the same duct and shall not be separated. However, for two different trefoil formations, they shall be laid in separate ducts.

**Cables installed in Conduit**

1. Conduits shall be galvanized heavy gauge solid drawn or welded screwed steel type and be in accordance with IS: 9537, Part 2 or BS: 4568. Accessories shall either be malleable cast iron screwed type or pressed steel and galvanized.
2. A space factor of 40% shall not be exceeded, but in any case, conduit of less than 20 mm diameter shall not be permitted. The tubing shall be perfectly smooth inside and out and free from flaws and imperfections of any kind. Both ends of every length of tubing shall be properly reamed with all sharp edges removed before erection.
3. Where a number of conduits converge, malleable cast iron or heavy gauge sheet steel adaptable boxes shall be employed in order to avoid crossings. Conduits shall be connected by means of male brass bushes and couplings.
4. Where conduits are greater than 25 mm, straight through joint boxes shall be of the trough type. Where conduit and/ or fittings are attached to equipment casings, the material or case of the casing shall be tapped for a depth of not less than 10 mm or male bushes and flanged couplings shall be used.
5. Heavy hexagonal lock nuts shall be used at all positions where running joints are required and care shall be taken to ensure that they seat firmly and evenly on to the mating faces of coupling or other adjacent accessories. All junction boxes, draw-in boxes, and inspection fittings, shall be so placed that the cables can be inspected and, if necessary, withdrawn and re-wired throughout the life of the installation.
6. Generally, not more than two bends or offsets or one coupling will be permitted without a suitable inspection accessory. Fish wires shall not be left in conduits after erection. The whole of the installation shall be arranged for a loop-in type of system with joints being carried out at switches, isolators, etc. Intermediate joints in the cable will only be allowed by arrangement with the GWSSB.
7. Ends of conduits which are liable to be left open for any length of time during building operations shall be plugged to prevent the ingress of dirt, cement, etc. and covers, either temporary or permanent, shall be fitted on all boxes.

8. Generally, conduits shall not cross expansion joints of buildings, but where they cannot be installed in any other manner then a flexible conduit shall be used across the expansion joint. A total 150 mm movement shall be allowed.

#### **Surface Installation**

1. Surface conduits shall be secured and fixed by means of distance spacing saddles or approved purpose made clips at every 500mm, which allow the conduits to be taken directly into accessories without sets or bends. Conduits shall be run in a square and symmetrical manner. An efficient means shall be adopted to provide for the drainage of condensation and the runs shall be properly ventilated. All surface conduit runs shall be marked out for approval by the EIC's Representative before the installation is carried out. Where large multiple parallel conduit runs would occur, use may be made of galvanized cable trunking. Conduits installed on structural steelwork shall be secured at spacing not exceeding those for surface conduit by girder clips, otherwise fixing shall be as for surface conduits on walls, drilled and tapped to the metalwork. Power driven fixings shall only be used with the express permission of the Purchaser's Representative. Any drilling or access which is required through any structural member of the building shall be agreed with the Engineer-in-Charge before carrying out the work.
2. Exposed threads and places where galvanizing has been damaged shall be cleaned and then painted with two coats of an approved metallic zinc-based paint. This treatment shall be applied as the work proceeds.

#### **Concealed Installation**

1. Concealed conduits shall be securely fixed to prevent movement before laying of screeds, floating of plaster, casting of columns or other building operations necessary after the conduit installation. Crumpets or similar fixings shall be used for attaching the conduit to blockwork, etc. Building nails will not be accepted.
2. At least 15 mm cover shall be allowed for finishes over the conduit. Where this cover cannot be maintained then expanded metal shall be fitted with the conduit. Conduit cast into reinforced concrete floors shall be fixed to the steel reinforcing with binding wire and the conduit boxes filled with expanded polystyrene or enclosed in a plastic bag to prevent the ingress of concrete when poured. Where possible, the conduit boxes shall be fixed to shuttering to give a flush finish.
3. Conduit installed in voids, false ceilings, and other concealed routes shall be installed as specified for the surface conduits. Wiring shall be carried out after the false ceiling or

permanent ducts have been completed. Conduit installed in floors shall be sealed against ingress of moisture.

4. The conduit installation shall be inspected by the EIC's Representative before the building operation conceals the work.

#### **Cable Installed in Flexible Conduit**

1. Flexible conduit shall be of the waterproof galvanized type or PVC wire-wound type with cadmium plated mild steel couplings. Lengths of flexible conduits shall be sufficient to permit withdrawal, adjustment or movement of the equipment to which it is attached and shall have a minimum length of 300 mm. Flexible conduit shall not be used as a means of providing earth continuity. A single earth conductor of adequate size shall be installed external to the conduit complete with earth terminations.
2. Where conversion from rigid conduit to flexible metallic conduit is to be made, the rigid conduit shall terminate in a through type box and the flexible conduit shall extend from this box to the equipment, the earth continuity cable shall be secured to the box and to the piece of equipment by properly designed earthing screws. The use of lid facing screws, etc., will not be permitted. Adapters shall incorporate a grub screw or a gland to prevent the flexible conduit becoming loose.

#### **Cable Clipped Direct**

1. All cable hangers, clips, cleats and saddles shall be of an approved type and appropriate to the type and size of cable installed. Their spacing shall be such as to ensure a neat appearance and prevent sagging of the cables at all times during their installed life.

#### **Cable Installed in Internal Floor Trench**

1. In shallow trenches (maximum depth 500 mm)
2. In shallow trenches used for electrical services only, cables may be laid in a neat and orderly manner on the floor of the trench. One layer only shall be allowed. Additional cables shall be installed on the walls of the trench in an acceptable manner & such a way that, in no case the distance between two different types of cable shall not be less than the separation distance tabulated above.
3. Where the trench is shared by other services, cables shall be installed on the walls of the trench in an acceptable manner & such a way that, minimum separation distance of 300mm shall be maintained.
4. All other trenches including walk through service ducts

5. Cable trenches & cable installation shall be in accordance with the attached typical cabling system drawings.
6. Where other services are present the cables shall be segregated from them by separation distances as mentioned above and wherever possible kept above 'cold' wet services. Cables should not be run if at all possible, above or in close proximity to 'hot' services.
7. The cabling shall be installed in such a manner as to allow access to the other services for normal maintenance without disturbance of the electrical installation

### **Cable Terminations and Joints**

#### **1. Power Cable Terminations**

1. Power cables shall be terminated in suitable boxes arranged for bolting to switchgear, motor starters and motors.
2. Cores shall have either crimped lugs or sleeves to match either post terminals or bolted clamp terminals.
3. Each cable entry into a terminating box shall be made through a suitable gland, which shall have provision for securing the armour where applicable. Where single core glands are required these shall be of the non-magnetic type and the associated box bottom plate, where the core passes through, shall not have a continuous magnetic path.
4. Adequate provision shall be made to bond the cable armouring to the box and/or switchgear casing of a suitable size to withstand the prospective short circuit fault current of the system, glands shall be fitted with earth bonding tags where intimate screwed contact between gland and cable box is not possible.
5. Where cable glands are exposed to the weather these shall be protected by heat shrink plastic sleeve or purpose moulded sleeves covering the gland continuously from overall sheath to the gland neck.
6. Where terminations of multicore type have to be made on to items of Plant which have to be dismantled for maintenance, these shall be made off through glands into an adaptable box containing terminals and flexible single cores taken into the equipment via flexible waterproof plastic covered conduit, and a separate earth core linking the box to the equipment.
7. Where single core cables are glanded to or pass through cabling plates the gland plate or cabling plate shall be constructed of non-magnetic material.

**8. Power Cable Joints**

1. Through joints shall only be allowed with the approval of the EIC. Where such joints are necessary in thermoplastic and elastomeric cables, the cables shall be jointed with epoxy or acrylic resin cold setting compound, which has been premeasured and pre-packed ready for use. The boxes shall preferably be of split, moulded plastic type with filling vents for compound. Bonding straps shall be fitted with armour clamps across the joint and inspected by the EIC's Representative prior to filling the box with compound. Wrapped pressure type joints will not be accepted.

**2. Multi-core or Control Cable Terminations**

1. A sufficient number of terminals shall be provided to terminate all cable cores. For control and auxiliary wiring an additional 20% of this number shall be provided as spares.
2. Not more than one core of internal or external wiring shall be connected on any one terminal. Where duplication of terminal blocks is necessary, purpose-made solid links shall be incorporated in the design of the terminal blocks.
3. Terminals which remain energized when the main equipment is isolated shall be suitably screened and labelled.
4. Terminal blocks for different voltages or circuit type shall be segregated into groups and distinctively labelled.

**Cable Fixings**

1. Ties and strapping shall be suitable for securing cable and cable groups to cable tray or ladder. They shall be resistant to chemical and marine corrosion. Plastic coated metal ties used in order to obtain corrosion resistance shall not be acceptable. Nylon ties shall be resistant to the effects of ultra-violet light and shall be self-extinguishing.
2. Large single cables shall be secured with cable clamps or cable cleats.

**Cable Identification**

At each end of each cable, in a uniform and visible position a label shall be fixed on the cable in accordance with the cable schedule. Labels shall be made of PVC and shall be indelibly marked to the approval of the EIC. The label shall be retained using proprietary nylon strips passing through two fixing holes at either end of the label. If the cable gland is not normally visible, then the label shall be fixed inside the panel by means of screws.

**Marking Locations of Underground Cables**

1. The location of all underground cables shall be engraved on brass or other non-corrodible plates to be fixed to the exterior surface of all walls of buildings 300 mm above ground level and directly above the point where cables pass through the wall.
2. Cable route markers as per the attached drawing shall be installed at an interval not more than 30 meter & at bending/ road crossings the interval shall be at every 10meter.
3. The minimum depth for laying of underground cable route markers shall be as per indicated in the typical drawings attached with this tender.

**Additional Requirements for Cable Installations**

1. The Contractor shall install, test and commission the cables specified in the specification. Cables shall be laid directly buried in earth, on cable racks, in built up trenches, on cable trays and supports, in conduits and ducts or bare on walls, ceiling etc. as per drawings, which are to be prepared by Contractor & approved by EIC. Contractor's scope of work includes unloading, laying, fixing, jointing, bending, and termination of the cables & all related accessories. The Contractor shall also supply the necessary materials and equipment required for jointing and termination or the cables.
2. All apparatus, connections and cable work shall be designed and arranged to minimize risk of fire and any damage which might be caused in the event of fire. Wherever cables pass through floor or wall openings or other partitions, suitable bushes of an approved type shall be supplied and put into position by the Contractor.
3. Standard cable grips and reels shall be utilized for cable pulling. If unduly difficult pulling occurs, the Contractor shall check the pull required and suspend pulling until further procedure has been approved by the Engineer-in-charge. The maximum pull tension shall not exceed the recommended value for the cable measured by the tension dynamometer. In general, any lubricant that does not injure the overall covering and does not set up undesirable conditions of electrostatic stress or electrostatic charge may be used to assist in the pulling of insulated cables in conduits and ducts.
4. After pulling the cable, the Contractor shall record cable identification with date pulled neatly with waterproof ink in linen tags. Identification tags shall be attached securely to each end of each cable with non-corrosive wire. The said wire must be non-ferrous material on single conductor power cable. Tags shall further be attached at 10meter intervals on long runs of cables on cable trays and in pull boxes. Cable and joint markers and RCC warning covers shall be provided wherever required.

5. Sharp bending and kinking of cables shall be avoided. The bending radius for various types of cables shall not be less than those specified below:
  1. 11 KV, XLPE insulated, multicore : 15 times the overall dia. of the cable armoured cables
  2. 1.1 KV, XLPE insulated, multicore : 12 times the overall dia. of the cable armoured cables
  3. (If shorter radius appears necessary, no bend shall be made until clearance and instructions have been received from the Engineer in charge)
4. Power, control and instrumentation cables shall be laid in separate cable racks/ trays.
5. Where groups of HV, LV and control cables are to be laid along the same route, suitable barriers to segregate them physically shall be provided.
6. Where cables cross roads and water, oil, gas or sewage pipes, the cables shall be laid in reinforced spun concrete or steel pipes. For road crossings the pipe for the cables shall be buried at no less than one-meter depth.
7. Cables laid in ground shall be laid on a 75 mm riddled earth bed. The cables shall then be covered on top and at their sides with riddled earth of depth of about 150 mm. This is then gently filled up to a depth of about 100 mm above the top of uppermost cable to provide bedding for the protective cable covers which are placed centrally over the cables. The protective cable covers for LV cables may be of earthenware and for HV cables of reinforced concrete. The RCC covers shall have one hole at each end, to tie them to each other with GI wires to prevent displacement. The trench is then backfilled with the excavated soil and well rammed in successive layer of not more than 300 mm in depth, with the trenches being watered to improve consolidation wherever necessary. To allow for subsidence, it is advisable to allow a crown of earth not less than 75 mm in the centre and tapering towards the sides of the trench.
8. In each cable run some extra length shall be kept at a suitable point to enable one or two straight through joints to be made, should the cable develop a fault at a later date.
9. Cables on cable racks, on cable trays and conduits shall be formed to avoid bearing against edges of trays, racks, conduits or their supports upon entering or leaving trays, racks or conduits. Cables shall be racked or laid directory into cantilevered cable trays where practicable, but in some cases, it may be necessary that cables are pulled or threaded into trays. To facilitate visual tracing, cables in trays shall be laid only in single layers and



- unnecessary crossing of cables shall be avoided. Cables on trays shall finally be clamped in an approved manner.
10. Cable splices will not be permitted except where permitted by the GWSSB. Splices shall be made by Contractor for each type of wire or cable in accordance with the instructions issued by cable manufacturers' and the Engineer-in-charge. Before splicing, insulated cables shall have conductor insulation stepped and bound or pencilled for recommended distance back from splices to provide a long leakage path. After splicing, insulation equal to that on the spliced conductors shall be applied at each splice.
  11. Jointing of cables shall be in accordance with relevant Indian Standards Codes of Practice. Materials and tools required for cable jointing work, including cold setting bituminous compound shall be supplied by the Contractor. Cables shall be firmly clamped on either side of a straight through joint at a distance of not more than 300 mm away from the joints. Identification tags shall be provided at each joint at all cable terminations.
  12. At cable terminal points where the conductor and cable insulation will be terminated, terminations shall be made in a neat, workmanlike and approved manner by men specialized in this class of work.
  13. Control cable termination shall be made in accordance with wiring diagrams, using colour codes established by the GWSSB for the various control circuit, by code marked wiring diagram.
  14. When control cables are to be fanned out and cabled together with cord, the Contractor shall make connections to terminal blocks, and test the equipment for proper operation before cables are corded together. If there is any question as to the proper connection, the Contractor shall make a temporary connection with sufficient length of cable so that the cable can be switched to another terminal without splicing. After correct connections are established through operating the equipment, cables shall be cut to their correct lengths, connected to terminals in the specified manner, and corded together where necessary to hold them in place in a workmanlike manner.
  15. Cable seals shall be examined to ascertain if they are intact and that cable ends are not damaged. If the seals are found to be broken the cable ends shall not be jointed until after due examination and testing by the EIC. Before joining is commenced, insulation resistance of both sections of cables to be jointed shall be checked by megger.
  16. After installation and alignment of motors, the Contractor shall complete the conduit installation, including a section of flexible conduit between motor terminal box and trench/

tray. The Contractor shall install and connect the power, control and heater supply cables as per equipment manufacturer's drawings.

17. Metal sheath and armour of the cable shall be bonded to the earthing system of the station. The size of conductor for bonding shall be appropriate with the system fault current

### Lighting System Installation

This covers the requirements of installation of the following

a)	Lighting fixtures complete with lamps and accessories
b)	Main Lighting distribution board
c)	Lighting panels
d)	Receptacles and lighting control switches
e)	Point wiring
f)	HPSV lighting system
g)	Multi core cables for street and boundary lighting
h)	Maintaining equipment/materials during storage and being responsible for the equipment/material until they are handed over to GWSSB.
i)	Installation, testing and commissioning shall be carried out in accordance with the drawings and as stipulated in this specification.

### Applicable Standards

a)	Electrical wiring installations (system voltage exceeding 650 V)	IS:732
b)	Code for practice for interior illumination (Part-1)	IS:3646/BS:8206
c)	Code of practice for street lighting installation	IS:1944
d)	Code of practice for industrial lighting	IS:6666
e)	Code of practice for fire safety of building	IS:1646
f)	Boxes for enclosure of electrical accessories	IS:5133 (Part-1)
g)	Guide for safety procedures and practices in electrical work	IS:5216
h)	Ceiling roses	IS:371

### Lighting Fixtures

- a) The installation of lighting fixtures shall be based on the mounting arrangement shown in the drawings. The unit rates quoted for installation shall include all materials required to

mount the fixtures. Hooks in RC slabs for suspension of high bay fixtures shall be provided wherever not already provided. Cost of supply and installation of such hooks shall be included in the cost of installation of lighting fixtures. Unit rate for installation of lighting fixtures shall include cost of installation of control gear box wherever applicable.

- b) Installation of receptacles and switches shall be carried out suitably. Switch shall be mounted in flush with the front cover plate. Cost of supply and installation of necessary hardware shall be included in the unit rates quoted for installation of receptacles / switches.
- c) Lighting distribution boards shall be installed at the suitable location. Installation rates quoted for installation of lighting distribution boards shall include supply and installation of base channels, foundation bolts etc.
- d) Outdoor lighting distribution boards shall be installed on a concrete plinth. The top of plinth shall be 1000 mm (minimum) above the grade level. Cost of construction of concrete plinth shall be included in the unit rates quoted for installation of outdoor lighting distribution board. No cement and steel will be supplied by GWSSB. Installation cost of lighting distribution board shall include cost of installation of earthing conductor from LDB to the nearest earthing grid.

### **Point Wiring**

Wiring of lighting fixtures shall be on point wiring basis. Two types of point wiring have been envisaged viz. primary point wiring and secondary point wiring. Bidder shall quote primary point and secondary point wiring rates for each building/area specified, on the basis of lighting layout drawings prepared by the contractor.

Point wiring also covers the wiring of the associated control switches of lighting fixtures/control switches of receptacle units.

### **Primary Point Wiring**

Primary point wiring covers the wiring between circuits of the lighting panel to the junction box of the first lighting fixture / receptacle unit and between junction boxes of the subsequent lighting fixture connected to that circuit of the lighting panel. In some cases where there are junction boxes, the primary point covers the wiring between junction box and the first lighting fixture/receptacle unit in that circuit.

### **Secondary Point Wiring**

Secondary point wiring covers the wiring of the remaining lighting fixtures/ receptacle unit other than that covered under primary point of that circuit in the lighting panel.

Secondary point wiring also covers the wiring of the associated control switches of lighting fixtures / control switches and control switches of receptacle units.

### **Point Wiring for HPSV / LED Lighting**

#### **Primary Point Wiring**

Primary point wiring covers the wiring between the lighting distribution board and the junction box of the first lighting pole or flood light tower and between the junction boxes of the subsequent lighting poles or flood light towers connected to a circuit in the lighting distribution board.

#### **Secondary Point Wiring**

Secondary point wiring covers the wiring between the junction box and the lighting fixture on the pole in case of street light and between junction box mounted near the base of the tower and all subsequent junction boxes mounted on that tower and also between junction box and the flood light fixture. The above refers to the remaining fixtures covered under the circuit referred under primary point wiring. Secondary point also covers the wiring of the associated control fuses, switches, looping of terminals, etc. as required.

### **Supply and Installation of Conduit Point Wiring**

- a) The point wiring shall include supply of necessary materials for the conduit wiring such as galvanised rigid steel conduit, galvanised MS fixing saddles with spacer plates, nylon / fibre fixing plugs, galvanised MS fixing screws, 12 SWG galvanised steel earthing wire, PVC insulated copper or aluminium conductor wires, control switches and pulling, termination of the earthing / PVC insulated wires as required, installation of control switches, drilling holes in brick walls / RCC roof slabs for taking the wiring conduits and refinishing and any other works / material necessary for making point wiring complete in all respects.
- b) Wires used for conduit point wiring of lighting fixtures / ceiling fans, 5 A receptacles and receptacles above 15 A shall be 1100 V grade, PVC insulated, single core, stranded copper conductor wires of sizes not less than 1.5 sq. mm and 2.5 sq. mm respectively. Wires shall conform to IS: 694 and shall bear the ISI mark.
- c) Bidder shall take into consideration necessary galvanised MS fixing clamps when the wiring conduits are to be supported from steel roof truss / structural members.

### **Supply and Installation of Cable Point Wiring**

- a) The point wiring shall include supply of necessary materials for the cable wiring such as 1100 V grade multi core, stranded aluminium conductor, PVC insulated, armoured cables of sizes 4 sq. mm and 6 sq. mm for wiring of lighting and receptacles in buildings and outdoor areas, where cable wiring is specified, conforming to IS: 1554, galvanised MS fixing saddles with spacing plates, junction boxes, nylon / fibre fixing plug galvanised MS fixing screws, control switches and installation / termination of cables including supply of cable glands as required, installation of control switches, junction boxes, drilling holes in brick walls / RCC roof and grouting necessary conduit sleeves for taking the cables and any other work materials necessary for making the point wiring complete in all respects.
- b) Bidder shall take into consideration necessary galvanized MS fixing clamps when the wiring cables are to be cleated along steel roof trusses / structural members.
- c) Bidder shall take into consideration any specific material finish, other than galvanising, such as corrosion resistant, epoxy painting or chlorinated rubber painting of all the installation accessories as called for in the relevant lighting layout drawings.

#### **Supply & Installation of Point Wiring for Street and Flood Lighting**

Work includes supply and installation of cables required between LDB and junction box mounted on street lighting pole / flood lighting tower and also between junction box mounted on flood light tower to metal enclosed control gear box located near flood light fixture, supply and installation of all the termination accessories such as crimping type cable lugs and double compression cable glands at each junction box and fixture, termination, testing and commissioning of cables. Contractor's scope of work also includes excavation, preparation of riddled soil bedding, supply and installation of protective covers over the cable, backfilling, ramming, supply and installation of route markers, supply and installation of HDPE pipes for road crossing etc. supply and installation of necessary cleating arrangement for cabling on flood light tower, supply of labour, supervision, welding equipment, all tools and tackles and testing equipment as required. Contractor shall plan and cut the cables in such a way that there is no wastage and no cable jointing is required in any run. However, should any joint become necessary the same shall be provided by the contractor and a joint marker shall also be provided without any extra cost. Earthing of street light pole / flood light tower, lighting fixtures, etc. are included under point wiring.

**Point wiring rates shall also include / hold good for the following**

Supply and installation of lighting control switches and switch boxes complete with fixing accessories.

Drilling holes in brick / RCC wall and roof for taking cable or conduit, sealing and refinishing with cement plaster.

Testing, commissioning and handing over the lighting system in commercial working condition.

Marginal shifting of any fixture / accessory from the location indicated in the lighting Lay-out drawings.

### **Outdoor Lighting (Street and Flood Lighting)**

1. The following shall be deemed to be included as part of the installation work for outdoor lighting point wiring.
2. Installation of multi core / single core cables between LDB and junction box mounted on street light pole/flood lighting tower, from junction box to metal enclosed control gear box.
3. Supply and installation of crimping type cable lugs, double compression type cable glands at each junction box and fixture, termination, testing and commissioning of cables.
4. Contractor's scope shall also include excavation and preparation for buried cables. Supply and installation of route markers, supply and installation of HDPE pipes for road crossing shall also be included in the scope of installation of point wiring.
5. Supply and installation of necessary cleating arrangement for cabling on flood light poles.
6. Contractor shall provide necessary foundation for erecting street light pole / flood light tower and install the same. Contractor shall prepare foundation drawings with necessary details to EIC for approval.
7. Contractor shall plan and cut the cables in such a way that there is no wastage and no cable jointing is required in any run. However, should any joint become necessary, the same shall be provided by the contractor and joint marker shall also be provided without any extra cost.
8. Earthing of street light pole/flood light tower, lighting fixtures, control gear boxes, junction boxes, etc. are also included in the scope of installation of point wiring. Contractor shall earth street light pole / flood light poles and junction box with 25 x 3 mm GI strip / flat tap off from the 25 x 3 mm MS flat earthing grid along the street lighting included in scope. The contractor shall interconnect earthing grid to plant main earthing grid at first and last pole of each feeder circuit and at one intermediate pole.

9. Installation of lighting brackets for switchyard area Outdoor Lighting Work includes supply and installation of HPSV light brackets etc. including associated junction boxes with fuses, links and terminals for junction boxes and junction boxes near each flood light fixtures.
10. Installation of Lighting Distribution Board, Lighting Panels (AC), 240 V, AC Single Phase Distribution Boards
11. Installation of above items shall include necessary foundation channels, bolts / nuts etc. for grouting lighting distribution boards, iron brackets / grouting brackets, bolts / nuts for wall / column mounted panels and associated civil works.

### Work Requirement

Details of work requirements are covered in lighting installation notes and details and typical drawings which form the part of specification. Any changes if necessary due to site conditions / requirements shall be carried out after obtaining approval of EIC. The changes carried out shall be marked clearly in the layout drawings by contractor and 'AS BUILT DRAWING' shall be prepared by the 'contractor' and this shall be forwarded to EIC.

### Wiring

Wiring shall be carried out strictly as per project drawings and technical specification. All exposed conduit wiring shall have provision for easy inspection. Exposed wiring when run along wall shall be as near the ceiling as possible. Where cable wiring is specified cable shall be cleated on to the wall as close to the ceiling as possible. In all types of wiring due consideration shall be given for neatness and appearance.

Wherever DC emergency lighting is provided, emergency lighting wires shall run in a separate conduit. Colour of the wires used shall be as follows; white for positive, black for negative.

Wherever lighting system has three phase distribution, separate conduits shall be used for different phases. For easy identification of phases and neutral wire the following colour wires shall be used.

i	R - Phase	Red
ii	Y - Phase	Yellow
iii	B - Phase	Blue
iv	Neutrall	Black

1. There shall be a circuit breaker or a linked switch on each live conductor of supply mains at the point of entry. The wiring throughout the installation shall be such that there is no break in neutral wire in the form of switch or fuse unit.
2. Conductors not arranged for connection to the same system or supply different phases of the same supply, shall be kept apart throughout their entire run.
3. Receptacles and lighting fittings in general shall be fed from different circuits. Five amps receptacles for toilet or small rooms can be fed from the lighting circuit with proper isolating arrangement.
4. Each final sub circuit from a lighting panel shall be controlled by a single pole switch connected to the live conductor.
5. For long conduit wiring runs, inspection / pull boxes shall be provided at intervals not exceeding 10 m. Such facilities shall also be provided at conduit bends.

**General Practices**

1. All receptacles and switches to be installed in offices and control rooms shall be flush mounted within the wall and those in other areas shall be wall or column mounted.
2. Ceiling roses shall not embody fuse terminals as an integral part. For voltages exceeding 250 volts a ceiling rose or any similar attachment shall not be used.
3. A socket outlet shall not embody fuse terminals as integral part of it. The switch controlling the socket outlet shall be on the live side of the line.
4. All exposed metal parts of the plug, when the plug is in complete engagement with the socket outlet, shall be in effective electrical connection with the earthing pin.

**Earthing**

1. Conduits and fittings shall be earthed by 12 SWG GI wires run along the length of the conduit and secured by means of suitable clamps efficiently fastened to conduit tip. To achieve perfect electrical continuity, the conduits shall be bonded effectively on either end of a coupling and other joints.
2. Conduits shall be earthed at the ends adjacent to switch boards at which they originate or otherwise at the earth clip, clamp or gland, in effective electrical contact with the conduit.
3. For outdoor lighting poles the earthing conductor shall be terminated up to the junction box on the pole and 12 SWG G I wire shall be taken up to the pole fitting.



## **INSTRUMENTATION, CONTROL & AUTOMATION SYSTEM**

### **General**

1. Instrumentation, Control & Automation installation shall be in accordance with manufacturer's recommendation, approved drawings and best engineering practices. A Centralized Control Room (CCR) shall be provided to house PLC-SCADA based control equipment.
2. The test equipment, meters, instruments etc. used for testing shall be calibrated at recognized test laboratory at regular intervals and valid certificates shall be made available to the Purchaser at the time of testing. The calibrating instruments used as standards shall be traceable to international standards. Calibration certificates for test instruments shall be produced from a recognized laboratory for the Purchaser's consent in advance of testing and if necessary, the instruments shall be recalibrated or substituted before the commencement of the test.

### **Commissioning/ Site Acceptance Test**

1. At site, the system shall be properly installed taking care of manufacturer's recommendation, after which Site Acceptance Tests (SAT) shall be carried out taking into the actual field instruments/equipment in the loops.
2. The Site Acceptance Test shall be held at site after the system has been installed as per the finalized SAT procedures. The tests shall be witnessed by GWSSB.
3. The minimum tests to be carried out shall be as indicated in table below.
4. A log of all failed/ mal-operating components/ modules in a sub-system shall be maintained by Contractor, with description of the affected components/ modules, cause of failure, effect of failure on the sub-system and number of hours of operation before it failed. This will start from the date of powering 'ON' of the system for cold commissioning.

### **PRE-COMMISSIONING TESTS ON ELECTRICAL SYSTEM EQUIPMENT TO BE CARRIED OUT AFTER ERECTION**

#### **List of Electrical System Equipment**

- |    |  |
|----|--|
| 01 | Switchyard bus, shielding and grounding.     |
| 02 | Lightning arrester                           |
| 03 | Isolator                                     |
| 04 | Insulator                                    |
| 05 | Power Distribution Transformer               |
| 06 | HV Switchgear Panels                         |
| 07 | L V Switchgear panels, motor control centre. |

- 08 H V / LV Cable
- 09 Control panels for miscellaneous equipment
  - 1. Earthing system
  - 2. Safety Procedure and Practice

### **TECHNICAL SPECIFICATIONS FOR PRE-COMMISSION TESTS**

#### **Switchyard Bus, Shielding and Grounding**

- 1. Insulation resistance test between each phase and earth and between phases. All transformer terminals, CT-PT connections and lightning arresters disconnected using 5000 V motorised megger.
- 2. Thermograph, if arranged by customer.

This is done after switchyard is charges and loaded. Scan all bus sections, insulators, droppers and joints with an AGA Thermo vision Camera and find out hot spot if any.

Defects noticed in the hot spot locations are to be rectified on priority basis.

#### **Lightning Arrester**

- 1. IR Values
- 2. Thermograph, if arranged by customer

#### **Isolator**

- 1. IR Values
- 2. Contact resistance measurement by milli volt drop test method
- 3. Manual Closing and Opening
- 4. Drive motor operation for closing and opening in Local and Remote position
- 5. Mechanical interlock between isolator and earth switch
- 6. Electrical interlock between isolator, earth-switch and circuit breaker

**Insulator**

1. IR Values of insulator
2. Thermograph - similar to item 1. If arranged by customer

**Circuit Breaker (3.3 KV)**

1. Mechanical charging - closing - tripping of breaker
2. Electrical charging - closing - tripping of breaker
3. Tripping of breaker through protective relays and trip circuit healthiness
4. Mechanical interlocks of breaker
5. Closing and opening time measurement of each pole
6. Contact resistance of measurement of each pole
7. IR Values
8. Operation of breaker auxiliary switches
9. Electrical closing at 85% of rated control voltage
10. Electrical tripping at 70% of rated control voltage
11. Space heater and illumination circuits of cubicle
12. Anti-pumping device operation
13. Control circuit and operational tests in local - remote position
14. Check on spare contacts for customer use

**Power Distribution Transformer**

1. Insulation resistance test HV side, LV side and HV – LV side.
2. Magnetising current test at rated ta.
3. Winding resistance test at rated ta.

4. Voltage Ratio & Tap continuity test at all tap.
5. Vector group test at rated ta.
6. Magnetic Balance Test at rated ta.
7. Buchholz Relay Test
8. Neutral CT Test
9. Winding Temperature Indicator / Oil Temperature Indicator Test
10. Polarisation Index Test (For LV windings 3.3 KV and above)
11. Cooling System.
12. Local / Remote operations of OLTC
13. No load test and performance observation

**HV Switchgear Panels**

1. Local / Remote operations in test as well as service position including all electrical interlocks
2. Control circuit and operational tests
3. Tripping through relays and trip circuit health
4. Anti-pumping device operation
5. Auto - Manual bus-transfer scheme (ABT Scheme)
6. Protection system operation stability and sensitivity by primary injection testing method including testing of metering circuits
7. IR values of power and control circuits
8. HV Test – DC High voltage on switchboard
9. Panel indication, annunciation, and space heater circuits
10. Spare contact for customer use

**Breaker**

1. Mechanical charging - closing - tripping of breaker
2. Electrical charging - closing - tripping of breaker
3. Mechanical and opening time measurement of each pole
5. Contact resistance measurement of each pole
6. IR values
7. Operation of breaker auxiliary switches
8. Electrical closing at 85% of rated control voltage
9. Electrical tripping at 70% of rated control voltage
10. High voltage test on VCB Circuit breaker.

**Current Transformer**

1. IR Value between Primary and Earth, Secondary and Earth and Primary - Secondary
2. Polarity Test.
3. Ratio and circuit test
4. Knee point voltage, exciting current and secondary resistance in case of class - PS - CT - Magnetisation characteristic

**Potential Transformer**

1. IR Value between Primary and Earth, Secondary and Primary - secondary
2. Polarity Test
3. Ratio & Circuit Test
4. Secondary winding resistance

**L V Switchgear Panels: PMCC**

1. IR Values of power and control circuits
2. Mechanical charging - closing - tripping of breaker
3. Electrical charging - closing - tripping of breaker
4. Trip circuit healthiness and tripping through relays
5. Remote closing / Tripping / Interlocks circuits
6. Indication / Annunciation / Panel space heater circuit / Space contacts for customer use.
7. Secondary injection testing of protective relays
8. Auto manual bus-transfer (ABT) scheme testing
9. CT testing for polarity, ratio, IR values and magnetisation for class PS characteristics
10. PT testing for polarity, ratio, IR values
11. IR Values of breaker
12. Testing of modules for Either DOL or Star / Delta starting or any other starting method as per the schematic drawings applicable.

**H V Bus Duct (NA)**

1. IR Values before Hipot
2. Hipot Test
3. IR Values after Hipot
4. Measurement of contact resistance

**H V Cable**

1. IR Values before Hipot
2. Hipot Test - Measurement of leakage current
3. IR Values after Hipot

**Earthing Resistance**

1. Earthing resistance of each electrode
2. Earthing resistance of grid.

## 12 **Safety Procedure and Practice**

Following safety procedure and practice should be provided by electrical contractor in switchgear room / substation as per latest edition of IS: 5216.

### a) Rubber Matting

- i) In front of 11 KV / 3.3 K V switchgear panels, 3.3KV capacitor panel, FCMA soft start panel.
- ii) In front of 415 V PMCC, APFC & PDB etc. panels in switchgear room.
- iii) Shock treatment charts
- iv) One chart near 11 KV / 3.3 K V switchgear room
- v) One chart near 415 V switchgear room

### b) Caution / Danger Board

- |      |                                |   |        |
|------|--------------------------------|---|--------|
| i)   | 11 KV switchyard               | : | 2 Nos. |
| ii)  | 11/3.3KV switchgear            | : | 2 Nos. |
| iii) | 3.3 KV capacitor bank panel    | : | 2 Nos. |
| iv)  | 415 V MCC panel                | : | 2 Nos. |
| v)   | 415 V APFC Panel               | : | 2 No.  |
| vi)  | Transformer near H V cable box | : | 2 Nos. |
| vii) | All power Distribution board   | : | 1 No.  |

### c) Fire Safety

The requirement of hand appliance in switchgear room, electrical equipment room shall be provided as per Clause 4.0 of Fire Protection Manual by Regional Tariff Committee, 10th edition 1988.

### d) Contractor's License

The Contractor shall possess the necessary License / Authorisation from the Licensing Board of the locality / State for carrying out the installation work.

The persons deputed by the contractor's firm should also hold valid permits issued / **recognised** by the Licensing Board of the locality / State in which the work is to be done.

The electrical installation work shall be carried out by licensed electricians only and approved by appropriate authorities. It is the responsibility of Contractor to get approval of complete system from the appropriate authority.

**Specials**

Power system analysis, short circuit calculations, relay coordination using renowned software, relay settings for over current, earth fault and unit protection of motors etc. shall be submitted at the time of testing.

1. Equipment / instruments which shall be used for testing should be calibrated as per ISO – 9000.

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**APPROVED VENDOR LISTS**



**(Mechanical, Electrical, Instrumentation & Civil Items)**

**The approved lists of vendors for Mechanical / Electrical / Instrumentation / Civil equipment and accessories to be supplied under this contract / bid is available on GWSSB's official website at <http://www.gwssb.gujarat.gov.in>.**

For certain sub items & sub components additional vendors have been mentioned in section of detailed technical specifications and respective data sheets given in Volumes.

The lists of approved vendors as prevailing on the date of submission of the BID will hold true. However subsequent addition / deletion in above vendors' lists by the competent authority of GWSSB shall also be applicable at the time of approval of QAPs. However, decision of the competent authority of GWSSB shall be final & binding in this regard.

**TECHNICAL DATASHEETS (SAMPLE)**

## MECHANICAL EQUIPMENT

**DATA SHEET FOR VERTICAL TURBINE PUMP****Name of RWSS: Palanpur RWSS****Name of Pumping Station: Ambaghata H/W**

Sr. No.	Particulars	Departmental Requirement	Bidders' Data
<b>1.0</b>	<b>General</b>		
1.1	Make	As Per Vendor List	
1.2	Model		
1.3	Type	VERTICAL TURBINE	
1.4	No of stages	* Maximum numbers to be suggested by the department depending on duty parameters 5 stage	
<b>2.0</b>	<b>Duty Parameters &amp; Performance</b>		
2.1	Capacity/ Discharge in LPS / M3/ Hour corresponding to 50 Hz frequency.	650 M3/Hr.	
2.2	Head in meters corresponding to 50 Hz frequency.	135 MTR	
2.3	Water kW	284.49	
2.4	Guaranteed Bowl efficiency at duty point in %	83.5%	
2.5	Guaranteed Pump efficiency at duty point in %	83%	
2.6	Shut off head in meters	* To be given by the department (Minimum 115 % of rated head)	
2.7	Speed corresponding to 50 Hz frequency in RPM	* To be given by the department (1000/1480 / 1500)	
2.8	Pump input at duty point In kW	As per manufacturers standard	

<b>3.0</b>	<b>FEATURES OF CONSTRUCTION</b>		
3.1	Type of Impeller	Mixed flow enclosed	
3.2	Discharge size in mm	As per manufacturers standard	
3.3	Bearings	Ball / Roller / Thrust bearing	
3.4	Sealing	Mechanical seal	
3.5	Direction of rotation	As per manufacturers standard	
3.6	Line Shaft	* 350 mm dia / 6 nos of 1.5 meter and 1 nos of 1 meter (Two store building on sump with pump outlet on first floor and motor on second floor)	
3.7	Line shaft bearings	Thordon	
<b>4.0</b>	<b>LIQUID DATA</b>		
4.1	Liquid handled	Clear water	
4.2	Specific gravity	* To be given by the department	
4.3	Temperature	Ambient	

<b>5.0</b>	<b>MATERIAL OF CONSTRUCTION</b>		
5.1	Pump Casing	Cast Steel WCB	
5.2	Impeller	CF8M	
5.3	Shaft	SS AISI 410	
5.4	Shaft Sleeve	SS AISI 410	
5.5	Gland packing	Mechanical seal	
5.6	Line shaft	SS AISI 410	
5.7	Line shaft bearings	Thordon	
5.8	Motor mounting housing	CI IS 210 FG 260	
<b>6.0</b>	<b>ACCESSORIES AND SERVICES OFFERED</b>		
6.1	Housing for motor	Required	
6.2	Foundation bolts	Required	

6.3	Companion flanges	Required	
6.4	Maintenance tools	Required	
<b>7.0</b>	<b>TESTING</b>		
7.1	Hydrostatic test	Factory test certificate to be produced	
7.2	Performance test as per IS specifications	To be witnessed jointly by TPI & department	
7.3	Static and dynamic balancing test	Factory test certificate to be produced	
7.4	Visual inspection check	To be carried out jointly by TPI & department	
<b>Note- Maximum Number of stages shall be Five but final decision regarding stages will be taken by EIC and will be bound to contractor.</b>			

<b>SLUICE VALVE (FOR PUMP HOUSE)</b>			
<b>Name of Pumping Station/ Pumping Section: Ambaghata</b>			
<b>Sr. No.</b>	<b>Particulars</b>	<b>Departmental Requirement</b>	<b>Bidders' Data</b>
<b>1.0</b>	<b>GENERAL</b>		
1.1	Type	Both Ends Flanged/ Non-Rising Spindle Type	
1.2	Make	As per Vendor List	
1.3	Rating	<b>PN2.5</b>	
1.4	Manufacturing Standard	IS: 14846 – 2000 (For Valve)&IS:1538–1976 (For Flanges Drilling Standard)	
1.5	Sizes and Quantity	As per Tender Specifications	
1.6	Mode of Operation	1) Manual Through Hand Wheel Upto 400mm Dia. Size 2) Manual through Spur Gear Box Above 400mm Dia. Size	
1.7	Weight of Complete Valve	Bidder to Specify	
1.8	Dimensions of Complete Valve (LxBxH in mm)	Bidder to Specify	
<b>2.0</b>	<b>MATERIALS OF CONSTRUCTION</b>		
2.1	Body, Bonnet, Wedge, Stuffing Box & Gland	Ductile Iron IS:1865 Grade 400/15/Cast Steel ASTM A 216 Gr. WCB	
2.2	Non-Rising Stem	Stainless Steel AISI-410	
2.3	Renewable Body Seat/Wedge Face Ring	High Tensile Bronze Grade IS:318LTBII//Stainless Steel 304 / ASTM A 217	

<b>DUAL PLATE CHECK VALVES (FOR PUMP HOUSE)</b>			
<b>Name of Pumping Section / Pumping Section: ALL</b>			
<b>Sr. No.</b>	<b>Particulars</b>	<b>Departmental Requirement</b>	<b>Bidders' Data</b>
<b>1.0</b>	<b>GENERAL</b>		
1.1	Type	Both Ends Flanged Dual Plate Type (Non-Slam, Spring Action)	
1.2	Make	As per Vendor List	
1.3	Rating	<b>PN 2.5</b>	
1.4	Manufacturing Standard	API594/API598(Design & Testing) & IS:1538 –1976(For Flanges Drilling Standard)	
1.5	Sizes and Quantity	As per Tender Specifications	
1.6	Weight of Complete Valve	Bidder to Specify	
1.7	Dimensions of Complete Valve (L x B x H in mm)	Bidder to Specify	
<b>2.0</b>	<b>MATERIALS OF CONSTRUCTION</b>		
2.1	Body	Ductile Iron IS: 1865 Grade400/15/Cast Steel ASTM A 216 Gr. WCB	
2.2	Plate & Plate Seat (Disc/ Plate & Seat)	Cast Steel IS 2062 Gr. BA 216 GR WCB with 13% Cr. Steel overlay (On seating surface only)	
2.3	Stop, Hinge Pin & Washer	Stainless Steel AISI316	
2.4	Seat Ring(Body)	SS AISI-316 with Weld Overlay on Seating Surface in conjunction with EPDM	
2.5	Bearings (Body & Plate Lug)	Bronze IS:318LTB-II/ PTFE	
2.6	Spring	Stainless Steel AISI316	
2.7	Hardware	Carbon Steel IS1367 CL 4.6/4	
2.8	End Cover	Mild Steel	

<b>3.0</b>	<b>HYDROSTATIC TEST</b>		
3.1	Body	As per API598	
3.2	Seat	As per API598	
<p><b>This is sample data sheet and agency has to submit data sheet, GA drawings for dual plate</b></p> <p><b>Check valves all pumping stations covered in this tender separately duly certified by the original manufacturer.</b></p>			

<b>EXPANSION BELLOWS(FOR PUMP HOUSE)</b>			
<b>Name of Pumping Station/ Pumping Section: ALL</b>			
<b>Sr. No.</b>	<b>Particulars</b>	<b>Departmental Requirement</b>	<b>Bidders' Data</b>
1	Make	As per GWSSB Vendor Policy	
2	Type	Corrugated Design Single Metallic	
3	Quantity	As per Tender Specifications	
4	Manufacturing Standards	EJMA	
5	Design Pressure	<b>As per BOQ</b>	
6	Axial Extension	Minimum 05 mm	
7	Axial Compression	Minimum 15 mm	
8	Materials of Construction		
	Bellows / Collar /Internal Sleeve	Stainless Steel 240 GR 304	
	Limit Rods	CSIS: 1367, CL4.6	
	Nut &Lock Nut	CSIS: 1367, CL4.0	
	Lugs / Flanges / Weld Ends	IS: 2062 Gr.B	
9	Design Life	Minimum 7000 Cycles	
10	Hydrostatic Test Pressure	Minimum 20 Kg / Cm <sup>2</sup> (Hold Time: 15 Min.)	
<p><b>This is sample data sheet and agency has to submit data sheet, GA drawings for expansion below for all pumping stations covered in this tender separately duly certified by the original manufacturer.</b></p>			

**ELECTRICAL EQUIPMENT**

<b>LV MOTOR FOR VT type PUMP</b>			
<b>Name of Pumping Station: Ambaghata</b>			
<b>Sr. No.</b>	<b>Particulars</b>	<b>Departmental Requirement</b>	<b>Bidders to Specify</b>
<b>1.0</b>	<b>GENERAL</b>		
1.1	Make	Bidder to Specify	
1.2	Application	Pump Motor	
1.3	Applicable Standard	IS: 12615	
1.4	Motor Energy Efficiency Class	IE3 Class as per IS: 12615	
<b>2.0</b>	<b>TYPE</b>		
2.1	Type of Motor	Totally Enclosed Fan cooled Squirrel	
2.2	Rated Voltage	415 Volts	
2.3	Number of Phases and Frequency	3 Phase, 50 Hz	
2.4	Permissible Voltage Variation	± 10%	
2.5	Permissible Frequency Variation	± 5 %	
2.6	Combined Voltage & Frequency Variation	± 10%	
2.7	Type of Duty/ Designation	Continuous / S1	
2.8	Method of Starting	<b>As per E-M technical Specifications</b> Micro Processor Based Soft Starter <b>(Depending on rating of motors)</b>	
2.9	Class of Insulation & Temperature Rise by thermometer	"F" (Temperature Rise Restricted to Class B)	
2.10	Ambient Reference Temperature	45 <sup>0</sup>	
2.11	Type of Cooling	TEFC	
2.12	Degree of Protection	IP 55	



2.13	Nominal Speed Corresponding to 50 Hz frequency	1000 / 1500 RPM	
3.0	RATING/PERFORMANCE		
3.1	Ratings in kW	315 kW	
3.2	Motor Frame Size	Bidder to Specify	
3.3	Efficiency of Motor		
	1) at Full Load	IS 12615 IE 3 Minimum	
	2) at Duty Point	Bidder to Specify	
	3) At ¾Load		
	4)At ½Load		
3.4	Power Factor		
	1) at Full Load		
	2) At ¾Load		
	3) At ½Load		
	4) At Starting		
3.5	Starting Torque% of Full Load Torque	Sufficient starting torque to Start the pump with delivery valve closed and when other pumps are running (Bidder to Specify@100%V&110% V)	
3.6	Pull Out Torque% of Full Load Torque	Sufficient to bring the motor To normal speed in minimum time	
3.7	Full Load current	Bidder to Specify	
3.8	No Load current	Bidder to Specify	
3.9	Starting Current @ 110% Voltage & Full Load (Soft Starting Current Amperes)	Not More Than 3 Times (Bidder to Specify)	
3.10	Starting Current @ Rated Voltage & Full Load (Soft Starting Current Amperes)	Not More Than 3 Times (Bidder to Specify)	

3.11	Type of Bearings	Ball/ Roller/ Thrust (Bidder To Specify Make, Type, Lubrication & Life Span in Hours of Operation)	
3.12	Winding Connection	Delta (Bidder to Specify)	
3.13	Space Heater	Numbers, Watts & Voltage (Bidder to Specify) <b>Applicable Only for Motors Greater Than 45 KW Rating</b>	
3.14	Winding Temperature Indicator	Type & Numbers (Bidder to Specify) <b>Applicable Only for Motors Greater Than 75 KW Rating</b>	
3.15	Bearing Temperature Indicator	Type & Numbers (Bidder to Specify) <b>Applicable Only for Motors Greater Than 75 KW Rating</b>	
3.16	Motor Terminal Box	Type, Fault Current, Size of Cable & Size of Lugs (Bidder to Specify)	
3.17	Grounding Terminals	On Motor Body & On Terminal Box (Bidder to Specify)	
3.18	Shaft Orientation	<b>Horizontal Solid Shaft for HSCF</b>	
3.19	Supply System Fault Level with Stand Capacity	50 KA	
3.20	Moment of Inertia $GD^2$	Bidder to Specify	
3.21	Total Weight in Kg	Bidder to Specify	
3.22	Noise Level	Bidder to Specify	
3.23	Vibration Level	Bidder to Specify	
4.0	<b>TESTING</b>		
4.1	Performance Test as per IS & Tender Specifications	<b>1) Acceptance Tests</b> of All Motors covered in this tender to be witnessed jointly by TPI & GWSSB	
4.2	Visual Inspection Check	To be carried out jointly by TPI & GWSSB	
4.3	Materials Test Certificates	Required for Review & Acceptance	
<b>Certified characteristic curves for motor: load v/s power factor, load v/s efficiency, load v/s speed, load v/s current) are to be submitted duly certified by the motor manufacturer at the time of submission of QAP for approval.</b>			

**This is a sample datasheet. Additionally, the agency must submit the datasheet and general-arrangement (GA) drawings for TEFC induction motors covering all pumping sections/stations in this tender. Each submission must be separately certified by the original manufacturer.**

<b>L V415 V PMCC Panels</b>				
<b>Name of Pumping Station/ Pumping Sections: ALL</b>				
<b>Sr. No.</b>	<b>Particulars</b>	<b>Unit</b>	<b>Departmental Requirement</b>	<b>Bidders' Data</b>
<b>1</b>	<b>SITE CONDITIONS</b>			
1.1	Maximum Ambient Temperature	°C	50 <sup>0</sup>	
1.2	Minimum Ambient Temperature	°C	06 <sup>0</sup>	
1.3	Applicable Standard		IS: 8623 & IS: 13947 & as per Tender Specifications	
<b>2</b>	<b>OPERATING CONDITIONS</b>			
2.1	Voltage	V	415	
2.2	Maximum Voltage	V	415 +10%	
2.3	Frequency	Hz	50 ± 3 %	
2.4	System & No. Of phase		4 Wire / Three Phase	
2.5	System Fault Level		20 MVA	
2.6	1 Minute Power Frequency Withstand Voltage			
	A) Power Circuits	V (RMS)	2500	
	B) Control Circuits	V	1500	
	C) Auxiliary Circuits Connected to Secondary of CTs	V	1500	
2.7	Control Supply for			
	Protective Relays	V AC	220 V AC	
	Indicating Lamps	V AC	220 V AC	
	Panel Illumination Lamp	V AC	220 V AC	
	Contactor Coils	V AC	220 / 415 V AC	

2.8	System Earthing		Effectively Solidly earthed	
<b>3</b>	<b>GENERAL &amp; OTHER CONSTRUCTIONAL DETAILS</b>			
3.1	Make		As Per Vendor List	
3.2	Type		Compartmentalized, Fixed & Floor Mounting Type	
3.3	Degree of Protection		IP 52 (For Indoor Application)	
3.4	Thickness of Sheet Steel for Frame, Frame Enclosure, Doors, Covers, Partitions	mm	CRCA Sheet 2.0 / Partition: 1.6 / Load Bearing Member: 2.0 Gland Plate: 3 mm	
3.5	Overall Weight of Complete Panel	Kg	Bidder to Specify	
3.6	Overall Dimensions: Length x Depth x Height	mm	As per Tender Specifications & Actual Requirement (Bidder to Specify)	
3.7	Dimensions of Largest Shipping Section: Length x Depth x Height	mm	Bidder to Specify	
3.8	Colour Shade		RAL 7032 / Light Grey Semi Glossy Shade 6310 of IS: 5 (Bidder to Specify)	
3.9	Cable Entry		Bottom	
3.10	Recommended Clearances: As Per IS Standards			
	Front	mm	Bidder to Specify	
	Rear	mm	Bidder to Specify	
	Above	mm	Bidder to Specify	
3.11	Clearance in Air of Main Bus Bars: As Per IS Standards			
	Phase to Phase	mm	25.4 mm	
	Phase to Earth	mm	20 mm	
3.12	Main Bus Bar Details			
	Continuous Current Rating at Design Temperature (50°C)		<b>As per E-M technical specifications</b> (Max Current Density 0.75 Amperes per square mm)	

	MATERIAL		Electrolyte Grade E91E <b>Aluminium</b> Fully Insulated Encapsulation by Heat Shrinkable Coloured PVC Sleeves &Tapes	
	SIZE		Bidder to Specify	
	LOCATION		Bidder to Specify	
3.13	Maximum Temperature of Bus Bars, Droppers & Contact sat Continuous Current Rating Under Site Ambient Temperature	$^{\circ}\text{C}$	90 $^{\circ}$ C for non-Silver plated joints &105 $^{\circ}$ C for silver plated joints	
3.14	Short Circuit Current Withstand for Bus Bars &Droppers (i)Short Time 1 Second	KA (rms)	50 KA CPRI Test Certificate (Bidder to Specify)	
3.15	Vertical Bus Bar Details (If Required)		Bidder to Specify	
	Current Rating/ Size		Bidder to Specify	
3.16	Earth Bus Size/ Material	Square mm	Copper/Aluminium as per E-M Tender Specifications and Actual Requirement (Bidder to Specify)	
3.17	1 Second Short Circuit Withstand Capacity	KA	50 KA CPRI Test Certificate	
3.18	Peak Dynamic Withstand Capacity	KA	105KACPRI Test Certificate	
<b>4</b>	Pump Selector Switch			
	<b>For Pumping Section</b>	No.	<b>2 working configurations</b>	
<b>5</b>	Outgoing Main Motor &Other Feeders			
	<b>For Pumping Station/Pumping Section</b>	No.	<b>As per E-M technical specifications</b>	
<b>6</b>	<del>AIRCIRCUIT BREAKER</del> NOT APPLICABLE			
<b>7</b>	<b>Moulded Case Circuit Breakers</b>			
7.1	Make &Type(s)		<b>As per BOQ</b>	
7.2	Rated Voltage & Frequency		415 V, 50 Hz	

7.3	Norma Current Under Site Conditions		As per Tender Specifications	
7.4	Symmetrical Interrupting Current		As per Tender Specifications	
7.5	Operating mechanism		Quic Make/ Quick Brake	
7.6	Shunt Trip		As Required	
7.7	Relays / Releases		As per Tender Specifications (Bidder to Specify)	
7.8	Any Other Details		Additional MCCBs To be provided 02 Nos. for APFC & 02 Nos. for No Load Compensating Capacitor Banks	
<b>8</b>	<b>Contactors</b>			
8.1	Make		Bidder to Specify	
8.2	Type		Air-Break	
8.3	Rated Voltage		Bidder to Specify	
8.4	Rated Current (AC 3 duty)		Bidder to Specify	
8.5	Thermal Rating		Bidder to Specify	
8.6	Making Capacity		Bidder to Specify	
8.7	Breaking Capacity		Bidder to Specify	
8.8	Switching Frequency	Operations /Hour	Bidder to Specify	
8.9	Life(Mechanical)	Operations (@ rated volt)	As per tender specifications	
8.10	Life(Electrical)	Electrical operations	As per tender specifications	
8.11	Coil Consumption pick up	VA at P F	Bidder to Specify	
8.12	Coil Consumption hold on	VA	Bidder to Specify	
8.13	Closing Time	Seconds	Bidder to Specify	
8.14	Opening Time	Seconds	Bidder to Specify	
8.15	No. Of Aux. Contacts		To be provided as required	
<b>9</b>	<b>Thermal Over load Relays</b>			

9.1	Make		Bidder to Specify	
9.2	Setting Range		As per Tender Specifications	
9.3	Type of Operation(Direct/CT operated)		As per Tender Specifications	
<b>10</b>	<b>Current Transformers</b>			
10.1	Make & Type		Cast Resin	
10.2	Ratio		As per Actual Requirement Primary/ Secondary (Bidder to Specify)	
10.3	Burden		15 VA	
10.4	Accuracy Class		Class 1.0	
<b>11</b>	<b>Multi-Function Digital Meter</b>		96 x 96 mm size, With RS485, One Each for Incoming & One Each for All Outgoing Motor Feeders with required CT and Wirings and as per E- M Tender Specifications	
<b>12</b>	<b>Time Totalizer (Pump Running Hour Meter)</b>		Digital and One for Each Motor Feeder	
<b>13</b>	<b>Ammeter with Selector Switch 03 CTs</b>		96x96 mm Digital, One for Each Outgoing Motor Feeder of class 1.0 accuracy as per E- M Tender Specifications with 6A rotary selector switch	
<b>14</b>	<b>Volt meter with Selector Switch</b>		96x96mm Digital, One for Each incomer of class 1.0 accuracy as per E- M Tender Specifications with 6A rotary selector switch	

15	Indicating Meter		Moving Iron type 240 <sup>0</sup> Degree scale for AM&VM,AM dial range to suit CT Primary current &VM dial range to suit P.T.primary voltage Size 96X 96 mm Digital type, Accuracy class 1.0	
16	Push Button		Momentarytype02 NO & 02 NC contacts of 10A at 240 V AC	
17	Control Fuse		HRC cartridge type With base &carrier (Bidder to Specify)	
18	Control Wiring		Stranded Copper Conductor,PVC Insulated, 660 / 1100 V grade of 2.5 mm <sup>2</sup> for CT circuit and 1.5mm <sup>2</sup> for control circuit marked with ferrule numbers @ both ends.	
19	Indicating Lamp		Minimum 22.5 mm LED type with Series Resistance	
20	Control Terminals		10 A, 1100 V Grade, Clip on type with DIN rail mounting	
21	CT Terminals		To be provided with Short link & earthing facility	
22	Capacitor for Compensation	No Load	02 Sets of Required KVAR Fixed APP type Capacitor Bank (Approx.5% of KVA rating of transformer) with MCB of Required Amps & Power Wiring ( <b>only in case where transformers are required</b> )	



22.1	Type		APP	
22.2	Applicable Standards		IS 2834	
22.3	Capacitor Loss at Rated Voltage (for Individual Capacitor)		0.2 watts KVAR per	
22.4	Capacitor Losses at Rated Voltage (for Complete Bank)		0.5 Watts KVAR per	
22.5	Rated Voltage		415 Volts	
22.6	Over Current Capacity of Individual Capacitor		130%	
22.7	Over Voltage Capacity of Individual Capacitor		110%	
22.8	Type of Impregnant		Vacuum	
22.9	Type of Insulation		Oil NPCB	
22.10	Average Life		Bidder to Specify	
23	<b>Outgoing Feeders for Auxiliaries</b> (WTP, Drain Pump, EOT Crane/ MCPB, Indoor & Outdoor Lighting with Time Switch, Flow Meter, Actuator & Four Spare)		As per BOQ	
24	<b>OTHER DETAILS</b>			
<p>This is a sample data sheet, and the agency has to submit the data sheet in this format, along with GA drawings, BOM/BOQ, and SLDs for PMCC panels for all pumping sections/pumping stations covered in this tender, separately and duly prepared &amp; certified by the panel builders/integrators. Where there is no provision for an APFC panel, fixed capacitor banks must be provided as per actual load and requirements for all pumping stations.</p>				

<b>L V415V APFC Panels</b>				
<b>Name of Pumping Station: ALL</b>				
<b>Sr. No.</b>	<b>Description</b>	<b>Unit</b>	<b>Particulars</b>	<b>Bidder to Specify</b>
<b>GENERAL, OPERATING CONDITIONS &amp; CONSTRUCTIONAL FEATURES</b>				
<b>1</b>	Make		As Per Approved Vendor List	
<b>2</b>	Ambient Temperature		50°C	

3	Voltage	V	415	
4	Maximum Voltage	V	415 +10%	
5	Frequency	Hz	50 ± 5 %	
6	Applicable Standards		IS16636-2017 & As Per E-M Tender Specifications	
7	Overall Dimensions of Panel (Length x Depth x Height)	mm	Bidder to Specify	
8	Quantity & Rated Capacity	Set	<b>As per BOQ</b>	
9	System Earthing		Effectively Solidly Grounded	
10	Degree of Protection		IP 42 (For Indoor Application)	
11	Thickness of Sheet Steel for Frame, Frame Enclosure, Doors, Covers, Partitions	mm	CRCA Sheet 2.0 / Partition: 1.6 / Load Bearing Member: 2.0 Gland Plate: 3 mm	
12	Colour Shade		Interior: Glossy White	
			Exterior: Light Grey Semi Glossy, Shade 631 of IS: 5	
13	Earth Bus Size/ Material	Sq. mm	Aluminium as per E-M Technical Specifications/ Actual Requirement (Bidder to Specify)	
14	1 Second Short Circuit Withstand Capacity	KA	50 KA CPRI Test Certificate	
15	Capacitor Losses For Complete Bank For Individual Unit	Watts	0.5 W/ KVAR	
		Watts	0.2 W/ KVAR	
16	Unit Capacitors			
16.1	Rated Voltage	V	415 V	
16.2	Standard Rated Output Per Individual Capacitor Unit at 415V	KVAR	5 / 10 / 15 / 25 / 50 / 100 KVAR	
16.3	Maximum Over Voltage Unit Capacitor is Capable to Withstand Continuously	%	As per IS 13585	
16.4	Type		Double Layer APP	

16.5	Insulation Level	KV (RMS)	2.5	
16.6	Capacitor Bank Connection		Delta	
16.7	Discharge Time		<50Volts within 5 minutes	
16.8	Permissible Overload for 1) Voltage, 2) Current &3) Output KVAR		• 110 % of rated voltage	
16.9	Capacitor Protection (Individual)		MCB of Required Rating with Individual Capacitor	
17	Type of Switching		Automatic switching In esponse to PF through PF Sensing Relay with RS485 port	
17.1	Switching Steps		Minimum 12 (Bidder to Specify)	
18	Rating of Contactor		AC 6b Duty ie Capacitor Duty to Suit Individual Capacitor KVAR Unit	
19	In comer Switch Current Rating		MCCB As per Actual Requirement	

**This is a sample data sheet. The agency is required to submit the data sheet in this format, along with the Bill of Materials (BOM), Bill of Quantities (BOQ), General Arrangement (GA) drawings, etc., for APFC panels of the specified capacity for all pumping sections/pumping stations covered in this tender. All documents must be duly prepared and certified by the panel builders/integrators.**

<b>POWER,CONTROL &amp; INSTRUMENTATION CABLES</b>				
Sr.	Description	Unit	Particulars	Bidder to Specify
1	11kV(E),Stranded Aluminium XLPE insulated,inner& outer extruded PVC sheathed, GI flat/strip armoured heavy duty power cable	LS	As per Tender Specifications of Required Core, Size &Amperage	
1.1	Make		As per Vendor List	
1.2	Applicable Standards		As per IS 7098 Part	
2	1.1 kV Grade, Stranded Aluminium XLPE insulated, inner & outer extruded PVC sheathed, GI flat/strip armoured heavy duty power cable	LS	As per Tender Specifications of Required Core, Size &Amperage	

2.1	Make		As per Vendor List	
2.2	Applicable Standards		As per IS 7098 Part	
<b>3</b>	1.1 KV, Flat PVC sheathed Copper Submersible Cable (for Drain Pump)	LS	As per Tender Specifications of Required Core, Size & Amperage	
3.1	Make		As per Vendor List	
3.2	Applicable Standards		As per IS 694	
<b>4</b>	Cable Accessories			
4.1	Cable Gland		Double Compression Brass type to suit the size of cable & of required MOC	
4.2	Cable Lugs		Crimping type to suit the size of cable & of required MOC	
4.3	Cable Accessories		To be provided as per specifications & requirements	

### EARTHING AND LIGHTNING PROTECTION SYSTEM

Sr.	Description	Unit	Particulars	Bidderto Specify
1	Main Earthing Grid		To suit as per maximum S. C. Rating & design criteria	
2	Conductor leads to Equipment		Minimum 2 distinct Earthing leads for equipment having > 125 V & 1 earthing lead for equipment	
3	Other Items			
3.1	Main Lighting D.B, Control Panels And Sub Lighting Distribution Boards	LS	GI, 25 x 6 mm	
3.2	Hand Rails	LS	GI, 25 x 3 mm	
3.3	Cable Trays	LS	GI, 25 x 3 mm	

3.4	Tanks	LS	GI, 25 x3 mm	
3.5	Street lighting, flood lighting poles and junctions boxes	LS	GI wire, 8 SWG	
3.6	Lighting Fixtures, Single Phase Receptacles, Lighting Conduits	LS	GI wire, 12 SWG	
3.6	Push Button Stations, Limit Switches	LS	GI wire, 12 SWG	
3.7	Cranerail,	LS	GI, 25 x3 mm	
3.8	Metallic Non-Current Carrying Structures	LS	GI, 25 x3 mm	
4	Lightning Conductors	LS		
4.1	Lightning Protection Down Comers for Building	LS	GI, 25 x6 mm	
4.2	Lightning Protection Horizontal	LS	GI, 25 x6 mm	
5	Earth Electrodes			
5.1	Pipe in Pipe Technology(Earth Pit of Minimum bore dia. of 150 mm)	Min. No. 18	Pipe in pipe outer dia. 50mm & inner dia.25	
			Mm with GI pipe 2000 mm long with back filling compound minimum 25 Kg per each job as per relevant IS for two pole structure with transformer with Gate +Fencing, HV&LV MCC-APFC Panels & Motors etc.	
5.2	Maintenance Free UL Listed Earthing System	Min.08 Nos.	Copper bonded rod 17.2 mmdia.with 3000 mm length & minimum copper bonding of 0.25 mm with 95% Carbon based earth enhancement material of 30Kg for each job with pit cover as per relevant IS for LA of two pole structure and transformer neutral with copper strip of 25 x6 mm.	

5.3	Maintenance Free UL Listed Earthing System	01 No.	Copper bonded rod 17.2 mm dia.with 3000 mm length & minimum copper bonding of 0.25 mm with 95% Carbon based earth Enhancement material of 30Kg for each job with pit cover as per relevant IS for Instrumentation Panels with copper strip of 25 x6 mm.	
6	Earthing Resistance to be achieved		As per IEEE Std. 80 -2000	
6.1	Transmission substation	Ohm	≤1	
6.2	Distribution substation	Ohm	≤5	

<b>LIGHTING &amp; RECEPTACLE SYSTEM AND EQUIPMENT</b>				
<b>Sr.</b>	<b>Description</b>	<b>Unit</b>	<b>Particulars</b>	<b>Bidder to Specify</b>
<b>1</b>	<b>AC Voltage</b>			
1.1	3 Phase, 4 wire 50 Hz system			
1.2	Nominal	V	415	
1.3	Maximum	V	460	
<b>2</b>	<b>DC Voltage</b>			
2.1	Rated	V	24 / 110	
2.2	One minute withstand voltage		2000 V AC	
<b>3</b>	<b>System short circuit level</b>			
3.1	At 415 V AC	KA(rms)	10	
3.2	At 110 V DC	KA (DC)	6	
4	Reference Ambient Temperature		50°C	
<b>5</b>	<b>Distribution Board / Panels</b>			
5.1	Make		As per Vendor List	
5.2	Applicable Standards		As per Tender Specifications	
6	Main, floor mounted distribution boards			
6.1	Main LDB(AC)		As per Requirement	
<b>7</b>	<b>Bus Bars</b>		Al / Cu	
7.1	Bus Bar Current Rating	A	As per Requirement	
7.2	Incoming		As per	
7.3	Outgoing		As per requirement (With Minimum 2 spare feeders)	
7.4	Cable Entry		Bottom	
7.5	Earthing terminals		50 x 8 mm GI flat	
<b>8</b>	<b>Emergency Lighting Panel</b>		As per requirement	
8.1	Bus bars		Copper	
8.2	Bus bar current rating	A	As per Requirement	

	Incoming and outgoing feeders		As per requirements (With Minimum 2 spare feeders)	
8.3	Cable entry		Bottom	
8.4	Earthing terminals		50 x6 mm GI flat	
<b>9</b>	<b>Sub DBs, wall/ structure</b>			
<b>10</b>	<b>SLDB for indoor area</b>		As per requirement	
10.1	Bus bars		Copper	
10.2	Bus bar current rating	A	As per requirement	
10.3	Incoming and outgoing feeders		1No.incoming TPN MCB* (Minimum32A) with ELCB As per requirement Outgoing 10/16A MCBSPN And DPELCB per phase with PPI (With Minimum 2 spare feeder circuits; a single circuit consists of SPN MCBs for R,Y,B phase)	
10.4	Cable Entry		Bottom / Top	
<b>11</b>	<b>SLDB for outdoor area</b>		As per requirement	
11.1	Bus bars		Copper	
11.2	Bus bar current rating	A	As per requirement	
11.3	Incoming		1No.For Incoming * A TPN, MCB (Minimum 32A) with ELCB-with timer (0-24 hours)	
11.4	Outgoing		As per actual requirement, Outgoing 10/16A SPN MCB with switch contactors. (With Minimum 2 spare feeder circuits; a single circuit consists of SPN MCBs for R, Y, B phase)	
11.5	Cable entry		Bottom / Top	
<b>12</b>	<b>Paint Finish</b>			
12.1	Colour shade(Interior/ Exterior)		As per industry Standard	



12.2	Epoxy paint required		Yes	
<b>13</b>	<b>Earthing terminals suitable for</b>			
13.1	Size	Mm x mm	25 x3 flat	
13.2	Material		GI	
<b>14</b>	<b>Receptacle Units</b>			
14.1	Make			
14.2	Decorative(complete with flush / surface mounted boxes / cover plates etc.)			
14.2.1	3 pin 1 phase& N with switch	A	5 / 15 A, Indoor	
14.2.2	Industrial(complete with surface mounted, prefabricated CRCA boxes)			
14.2.2a	3 Pin, 230 V AC With ELCB(30 mA)& plug	A	As per required 15 A, Indoor Type	
14.2.2b	5 pin, 3 Phase, 415 V with ELCB(30 mA)&plug	A A	As required 63 A, Outdoor type and 32 A, Indoor type	
<b>15</b>	<b>Lighting Wires</b>			
15.1	Make 1100 V, PVC insulated		As per Vendor list	
15.2	Conductor		Stranded Copper	
15.3	Size (sizes mentioned are Minimum & size to be decided on circuit load & voltage drop criteria)	Core x mm <sup>2</sup>	Lighting 2x1C x1.5 mm <sup>2</sup> Receptacle/ Sockets Decorative 2x 1 C x 1.5 mm <sup>2</sup> Industrial 1Phase– 2x1Cx4 mm <sup>2</sup> 3 Phase – 4Cx6/16 mm <sup>2</sup>	
<b>16</b>	<b>Conduits</b>			
16.1	Make			
16.2	Material		Galvanized Iron (GI)	
16.3	Size	mm	20	
<b>17</b>	<b>Street light poles and flood light poles</b>			
17.1	Make		As per Vendor	
17.2	Street Light Pole			
17.2a	Typical drawing(if any)		-	

17.2b	Total Height	m	8.5 / 10 / 12	
17.2c	Quantity	Nos.	As per	
<b>18</b>	<b>Junction Box with Pole</b>			
18.1	Typical drawing(if any)		-	
18.2	No. Of cable entries	Nos.	Two	
18.3	Cable entry suitable for		4 C x 16 mm <sup>2</sup> Al. Conductor,PVC insulated, armoured cable	
18.4	Earthing terminal suitable for		8 SWG / 25x3 mm GI Flat	
<b>19</b>	<b>Floodlight Light Pole</b>			
19.1	Total Height	Mts.	8.5 / 10 /12 /High Mast	
19.2	No. Of floodlights to be fixed per pole	No.	Minimum One/ as required	
19.3	Painted		Yes	
19.4	Earthing terminal suitable for	Mm x mm	8 SWG / 25x3mm GI Flat	
19.5	Quantity	Nos.	As per requirement	
20	Luminaire (Lighting fixture Complete with prewired control gear terminal block & suitable lamps)	LS	As per E-M Technical specifications and Actual Requirement	
21	Note			
	<p>Supply of conduits, wires/cables, all fixing hardware, terminal connectors, cable Termination kit sand associated accessories for lighting, receptacles, earthing, cabling &amp; wiring works, required civil work sets. Are included in variably in Contractor's scope. Entire works shall be carried out to ensure sufficient level of illumination level as per relevant standards.</p> <p>All ELCBs for lighting circuit shall be with 100 mA sensitivity. All ELCBs for receptacle circuit shall be with 30mA sensitivity.</p>			

DATA SHEETS INSTRUMENTATION SYSTEM

<b>FULL BORE ELECTRO MAGNETIC FLOW METER</b>			
<b>Name of Pumping Station/ Pumping Section: ALL</b>			
<b>Sr. No.</b>	<b>Particulars</b>	<b>Departmental Requirement</b>	<b>Bidder to Specify</b>
1.0	<b>GENERAL</b>		
1.1	Service	Water Flow Measurement & Analysis	
1.2	Line Size	As per BOQ	
1.3	Range Setting	As per actual requirement	
1.4	Liquid Type	Clear Water	
1.5	Type of Solid	Silt Particles	
1.6	Operating Pressure	<b>2.5 Mpa (25 Kg / Cm<sup>2</sup>)</b>	
1.7	Operating Temperature	0 <sup>0</sup> C to 50 <sup>0</sup> C	
1.8	Overall Accuracy of Measurement	± 0.5 % of Full Scale /Measured Value	
1.9	Quantity	As per BOQ	
2.0	<b>FLOW SENSOR</b>		
2.1	Type	Full bore type Electromagnetic (Compatible to GSM / GPRS Connectivity)	
2.2	Measuring Principle	Magnetic Induction	
2.3	Weather Protection Class	IP 68 of IS: 13947 Part (I)	
2.4	Measuring Principle	Magnetic Induction	
2.5	Type	Pulsed DC excitation	
2.6	System	Separate with Cable Output	
2.7	Power Supply	240 V AC, 50 Hz	
2.8	End Connections	Welded Flanges of Carbon Steel	
2.9	Flange Rating &Material	<b>PN 2.5</b> Cast steel as per IS: 1538 / DIN / ANSI	

2.10	Electrodes	Measuring, Reference and Empty Pipe Electrodes with Empty Pipe Detection & Alarm Facility	
2.11	Electrode Material	Stainless Steel 316 / Platinum / Tantalum	
2.12	Meter Tube	Stainless Steel 304	
2.13	Electrode Type	Round Head Electrodes (Bullet Nose)	
2.14	Lining Material	Neoprene / Polyurethane / EPDM	
2.15	Protection Category (Housing Ingress)	IP 68IS: 13947 Part (I)	
2.16	Measuring Accuracy	±0.5% of Measured Value Inclusive of Linearity, Repeatability, Pressure Effect and Hysteresis between 0.5-4m/s Velocity	
2.17	Coil Housing	SS304 with Fully Welded Construction/ Die Cast Aluminium/ Cast Steel with Anticorrosive Epoxy Paint	
2.18	Connection / Junction Box	SS 304	
2.19	Earthing	Grounding Rings in SS316 / Built in Earthing Electrodes in SS 316	
2.20	Fluid Conductivity	>500 Siemens / cm	
2.21	Marking	Direction of Flow with Arrow, Size, Sr. No. & Make	
<b>3.0</b>	<b>FLOW TRANSMITTER</b>		
3.1	Type	Microprocessor Based of Modular Design (Remote/ Integral Mounted)	
3.2	Display Language	English	
3.3	Ambient Temperature	-2°C to + 60°C	
3.4	Display	Minimum 2 line back lit LCD for Indication of Actual Flow Rate/ Instantaneous Flow Rate, Forward, Reverse, Cumulative Flow, Sum Totalizers, Alarm Indicator	

3.5	Outputs	One Current Output(4–20 mA) One Scalable Pulse Output One Status Output	
3.6	Protection Category (For Transmitter Ingress)	IP 67 IS: 13947	
3.7	Enclosure	Die Cast Aluminum with Polyurethane Finish with Glass Window / SS 316	
3.8	Programming	Through key / keypad on front fascia /optical touch key	
3.9	Power Supply	230 V AC, 50 Hz	
3.10	Cable Gland	½" NPT (4 Glands of Double Compression Type)	
3.11	Mounting	Wall Mounted	
3.12	Interface	RS 485, based on EIA R 422 / 485 Standard, or HART	
3.13	Power Failure Mode	Provision of RAM/PROM To Store Parameter entered and Measured Flow Data during power failure	
3.14	Maximum Separation	Upto200 meters between Sensor & transmitter without any signal boosters	
3.15	Terminals	Shock –hazard protected push lock terminals	
3.16	Error Identification	0 / 3.6 / 22 m Amp	
3.17	Interchange ability	Fully Interchangeable with all sizes of flow sensors	
3.18	Safety Classification	General Purpose Certification	
<b>4.0</b>	<b>FLOW INDICATOR ANDINTEGRTOR</b>		
4.1	Type	Microprocessor Based	
4.2	Display	Digital, Seven Segment Back Lit LCD Display	
4.3	Flow Indicator Totalizes	Internal 8 Digit LCD Totalizes	
4.4	Digit Height	14 mm or Higher	
4.5	Number of Digits for		
	Flow Indicator	5 Digits	
	Flow Integrator	8 Digits	
4.6	Zero and Span Adjustment	Required	
4.7	Manual Reset Facility Flow for Integrator	Required (shall be key operated)	

4.8	Engineering Units for		
	Flow Rate Indicator	Bidder to specify in M <sup>3</sup> /Hr	
	Flow Integrator	Bidder to Specify in MI	
5.0	<b>ACCESSORIES</b>		
5.1	Prefabricated Integral Cables for Connecting Sensors and Transmitter	As per Actual Requirement In Single Length (Minimum 20Meters) from Source of Power Supply	
5.2	Constant Voltage Stabilizer	One with each flow meter required to supply stabilized voltage	
<p><b>This is sample data sheet and agency has to submit data sheet, GA drawings for flow meters</b></p> <p><b>For all pumping sections and pumping stations covered in this tender separately duly certified by the original manufacturer.</b></p>			

<b>PRESSURE GAUGE</b>			
<b>Name of Pumping Station &amp; Pumping Section: ALL</b>			
<b>Sr. No.</b>	<b>Particulars</b>	<b>Departmental Requirement</b>	<b>Bidders' Data</b>
<b>1.0</b>	<b>GENERAL</b>		
1.1	Make	Reputed Make	
1.2	Service	Individual Pump Discharge & Common Discharge Header	
1.3	Fluid	Clear water	
1.4	Area of Classification	Non-Hazardous	
<b>2.0</b>	<b>MATERIAL OF CONSTRUCTION</b>		
2.1	Type	Bourdon	
2.2	Sensor and Other Wet Parts M.O.C	SS 316	
2.3	Process Connection	½" NPT(M)	
2.4	Dial Size	150 mm	
2.5	Material of Dial	Aluminium with White Background and Black Numerals	
2.6	Glass	Shatterproof	
2.7	Housing Material	Die Cast Aluminium with Epoxy Coating	
2.8	Accuracy	± 1% of Full Scale or better	
2.9	Over Range Protection	125 % of Maximum Pressure	
2.10	Gauge Protection	IP 65	
2.11	Temperature	50°C Ambient	
2.12	Range	0 to 7 OR 0 to 20 Kg/ Cm <sup>2</sup>	
2.13	Accessories	Snubber, 3 Way Isolation Valve, Impulse Tubing, Fittings, All Other Installation Hardware	
2.14	Diaphragm Seal MOC	SS 316	
2.15	3 Way Isolation Valve MOC	SS 316	
2.16	Impulse Tube Fitting MOC	SS 316	

Note: For data sheet so fall mechanical, electrical, instrumentation equipment & accessories following undertaking is to be given by original equipment manufacturer/panel builder/sub vendor & principal contractor.

**I/We are bound to supply the above item (s) of stated manufacture having rated capacity, material(s) of construction and all other general & specific/ particular requirements mentioned in the concerned technical specifications and datasheet (s).**

**SIGNATURE of CONTRACTOR**

**EXECUTIVE ENGINEER  
P.H.MECHANICAL DIVISON  
PALANPUR**