

Government of West Bengal
Irrigation & Waterways Directorate
Office of the Executive Engineer
Metropolitan Drainage Mechanical Division
Jalasampad Bhawan (4th floor), Salt Lake City, Kolkata-91
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Memo No: 1092/1 (3) /1T-1

Dated: 22/07/2024

Corrigendum notice to Expression of Interest (EOI)/Budgetary Quotation for EOI ref No.:

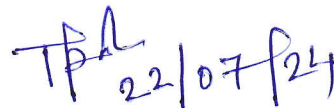
WBIW/EE/MDMD/e-EOI-02/2024-25

For the work of "Supply, installation, testing and commissioning and one year successful operation and maintenance of four (04) Nos. 50 cusec (each) vertical turbine pump sets with allied electrical (HT & LT) and mechanical works complete for the proposed Dumdum Park Pumping Station at the confluence of Cantonment khal and Bagjola khal at PS- Baguiati and Dist- North 24 PGS"

In continuation with the Expression of Interest (EOI)/Budgetary Quotation for EOI ref No.: WBIW/EE/MDMD/e-EOI-02/2024-25 the following correction/rectification are made in the BOQ and specification and corrected/updated BOQ uploaded in the website.

1. Motor rating should be 150 KW instead of 125 KW
2. The rotors shall be electrolytic grade copper bar / aluminium die cast
3. Minimum solid handling size of pumping waste water = 50mm
4. The trash rack/bar screen should be made of SS/AISI 304 and all other gratings/floor gratings and guide channels should be made of hot dip galvanized MS sections
5. And other few minor corrections are made in the BOQ and specifications

The corrected/updated BOQ and specification are attached with this notice


22/07/24

Executive Engineer
Metropolitan Drainage Mechanical Division

SCHEDULE OF WORK (BOQ) (corrected)

Name of the project: **Supply, installation, testing, commissioning and trial run and one year successful operation and maintenance of external water lubricated vertical turbine pump sets of four (04) nos 50 cusec each with electro-mechanical installation complete for the proposed Pumping Station at the outfall of the Cantoment khal, PS- Baguiati and Dist. North 24pgs.**

Sl. No	Description of work as per preliminary assessment	Qty.	Unit	Rate (Rs)	GST @18%	Cess @1%	Rate including GST & Cess (Rs)	Amount (Rs)
1	<p>Supply, delivery, storing at site, installation, testing & commissioning of vertically suspended wetpit installation, axial/mixed flow, non pull out type, continuous rating VT pump complete with bowl assembly, column pipe assembly, discharge tee, base plate, motor stool, thrust bearing assembly etc. and all accessories conforming to the latest revision of IS 1710/IS 5120 and Hydraulic Institute standard USA and shall be designed to be protected against reverse direction of rotation suitable for following duties and conforming to detailed specification and enclosed G.A. drawing including two coats of painting with approved paint . Pump should be suitable for pumping solid bearing liquid such as wastewater, industrial discharge, storm or canal drainage etc.</p> <p>a) Pump capacity - 5100 M³/Hr (each) b) TDH = 5.95 MWC c) Column pipe dia. = 900 mm d) RPM ≤ 600 rpm e) Lubcrication & cooling by external clear water f) Bowl efficiency 85% (Minimum) g) Sump data : sump floor level (-)1.789 M, C/L of delivery pipe (+)4.0 M, pump house floor level- (+)6.711M, sump bay width- 2400mm h) Delivery below floor level. (The enclosed G.A.drawing, actual site condition and all datas are to be verified by the bidder)</p>	4	set					

- | | | | |
|---|--|-------|-----|
| 2 | <p>Supply, delivery, storing at site, installation, testing & commissioning of 150KW, TEFC squirrel cage vertical flange mounting induction motor, F class insulation and temperature rise limited to B class, suitable to operate on 415V, 3ph, 50Hz AC supply with voltage variation of $\pm 10\%$ and frequency variation of $\pm 3\%$, synchronous speed 600 r.p.m (10 pole) suitable for S1 duty, direct coupling with the vertically suspended pump and as per latest version of IS 325, IS 4722, IEC 60034 and other relevant IS specification to meet the power requirement of the pump with 95% efficiency. (Motor rating to be verified by the bidder keeping in sufficient factor of safety as per site condition).
Make-ABB/Jyoti/Marathon /CGL /Siemens/Kirlosker</p> | 4 | set |
| 3 | <p>Supply, delivery, storing at site, installation, testing & commissioning of C.I.D.F delivery pipes with flange and fittings complete with all accessories as per specification including jointing conforming to the latest revision of IS : 1710, IS : 5120, IS: 1537 & IS:1538.
Straight pipe of 900 mm. dia. & 3000 mm. long(approx.) (one piece not exceeding 2.5m)</p> | 7.865 | MT |
| 4 | <p>Supply, delivery, storing at site, installation, testing & commissioning of double acting automatic air relief valve of nominal size 100mm as per IS 14845 with isolating mitre bevel geared sluice valve as per IS 14846 complete of material body & top cover- CI, IS 210 FG 260, internal fittings- bronze IS 318 LTB 2, hardware in contact with water- SS 304 and as per following specification.

Working Pressure Body/seat - 7 / 5 kg/cm²
Design Pressure Body/seat - 18 / 12 kg/cm²
Testing as per IS 14846</p> | 4 | set |
| 5 | <p>Supply, delivery, storing at site, installation, testing & commissioning of 900mm. dia. C.I. Single flange, swing type double hung flap valve with pressure rating as per specific standard (Body, flap Cast iron, IS:210, FG:260, Body & disc set: stainless steel, AISI 304, Hinge pin: Stainless steel AISI 410), flange standard IS 1538, leakage as per IS 13349 class 3 and as per specification -

Rated flow - 5100 M³/Hr, Velocity at rated flow - 2.228 m/sec
Design Pressure - 15 MWC
Testing as per IS 14858</p> | 4 | set |

6	Supply, delivery, storing at site, installation, testing & commissioning of lubrication and cooling water pump horizontal, single/multi-stage, 6m ³ per hour capacity, fitted with 2.2 KW motor, 23 mtr. Head contineous rating centrifugal pump of approved brand complete with squirrel cage induction motor with base plate, coupling etc.along with with all fittings, non-return valve, sluice valves, striner and all accessories for suction from water reservoir and allied equipments all upto delivery as per approved design and drawing.	2	set
7	Supplying, fitting and fixing of cooling & lubricating water G.I. pipe line of TATA make with all necessary accessories, specials viz. socket, bend, tee, union, cross, elbo, nipple, longscrow, reducing socket, reducing tee, short piece etc. fitted with holder bats clamps, including cutting pipes, making threads, fitting, fixing etc. complete in all respect including cost of all necessary fittings as required, jointing materials and two coats of painting with approved paint in any position above ground.		
7.1	80 mm dia. medium quality	80	Mtr
7.2	50 mm dia. medium quality	50	Mtr
7.3	25 mm dia. medium quality	50	Mtr
8	Supply, Installation, testing & commissioning of pressure gauge meter (as per IS 3624) for cooling & lubricating water pipeline completer with all accessories and suitable class of enclosure, including all sundries, fixtures as required as per specification and direction of E.I.C.	10	set
9	Supplying, fitting and fixing Peet's valve fullway gunmetal standard pattern best quality of approved brand bearing I.S.I. marking with fittings (tested to 21 kg per sq. cm.)		
9.1	50 mm dia	4	each
9.2	25 mm dia	8	each
	(SOR PWD Plumbing,2017, Item no- 4, Page- 5)		
10	Supplying P.V.C. water storage tank of approved quality with closed topwith lid (Black) - Multilayer(1000 litre capacity)	2	each
	(SOR PWD Plumbing,2017, Item no- 6, Page- 37)		

11.1	Supply, delivery, storing at site, installation, testing & commissioning of stainless-steel trashrack/ bar screen and other similar structure conforming to relevant IS codes (IS:11388) fabricated with stainless-steel (S.S. to AISI-304) sections such as flat, channels, angles etc including cost of materials, machinery, labour, cutting, aligning, welding, fixing at site as per approved drawing including transportation charges as per direction of E.I.C. (Material: (S.S. /AISI-304)).	15211	kg
11.2	Supply, delivery, storing at site, installation, testing & commissioning of grating/floor gratings/guide channel and other similar structures conforming to relevant IS codes (IS:11388, IS:800, IS:2062) fabricated with hot dip galvanized MS structural steel sections such as MS flat, channels, angles etc. including cost of materials, machinery, labour, cutting, aligning, welding and fixing at site as per approved drawing including transportation charges as per direction of E.I.C. (Material: hot dip galvanized MS sections and SAIL / TATA steel make).	2500	kg
12	EOT crane for lifting lowering of VT pump set Design, supply, delivery, storing at site, installation, testing & commissioning of 15 M.T. capacity x 7 meters span approx. x 7.5 mtrs. lift double girder construction pendant controlled EOT overhead travelling crane having all motions electrical and to be operated by pendant push button unit from floor. The crane shall be of M-5 (Class II) duty, indoor operation as per IS: 807, IS: 3177 or equivalent at its latest revision. This work also includes manufacture supply & fixing of long travel steel gantry girder(16.5 mtrx2 approx) with square rail for travel length of 16.5 mtr approx and designed for column pitch distance of 3 mtr and DSL arrangement for feeding power to the crane along longitudinal travel comprising of 4 line PVC shrouded type GI conductor with supporting brackets and a set of current collector. The crane should be marked with safe working load (SWL). The whole work must be completed in all respect as per direction of E.I.C.	1	set

13 **Electrically operated straight monorail crane (2nos) with supporting MS structure for trashrack/screen lifting lowering.** Design, supply, delivery, storing at site, installation, testing & commissioning of **5 M.T. capacity straight monorail (2 Nos.)** placed at a distance of 900 mm approx. suitable for travel length of 15 mtrs. Both the monorails shall be supported on 6 nos. independent goal post structure. Both hoist and longitudinal travel shall be electrical and to be operated by **2 Nos. 5 M.T. capacity electrical chain hoist with motorised trolley. 1 No. hoist shall run on each monorail.** The height of lift shall be 7 mtrs. for both the hoist. The top of goal post structure shall be covered by suitable sheet metal to protect the hoist from direct sun and rain and also provide side sheeting and gable end sheeting upto 8 ft. from top of goal post structure. The crane shall be suitable for outdoor operation of M-5 (Class II) duty, as per IS: 807, IS: 3177 or equivalent at its latest revision. This work also includes design, manufacture supply & fixing of **2 sets of DSL arrangement** i.e. power feeding arrangement to the hoist along the longitudinal travel comprising of 4 line PVC shrouded type GI conductor with supporting brackets and a set of current collector for each hoist. One set of DSL with current collector shall be required for each hoist and 2 Nos. isolating switch of suitable rating at two ends for connecting the DSL cable. The crane should be marked with safe working load (SWL). The whole work must be completed in all respect as per direction of E.I.C.

1 set

14 Sinking of 200 mm. dia. (8") well x 180 m depth (approx) with 30 M strainer.

Labour for drilling perfectly vertical bore hole of specified dia. For a specified depth below ground level in alluvial soil strata by mud rotary rig drilling as required to suit the site condition as per direction of E.I.C. Including use of own rigs and its accessories, tools & plants and consumables etc. for lowering of finished bore suitable for lowering of 200 mm. dia. GI/PVC pipes for housing, fitted with socket and with or without well screen as per necessity for the soft, medium, hard and boulder formation (GI/PVC casing pipes of required by the contractor to protect collapse of over burden portion) including lowering and withdrawing of casing pipe after drilling 200 mm. to 450 mm. dia. in over burden portion.

2 set

Supply of all pipes material and labour and T & P for lowerin the GI/PVC pipes with or without slotted pipes as per the necessity from ground level and fitted and fixed up in perfectly vertical position, including cutting and threading of pipe and slotted pipwe and fixing all joints, materials etc. complete and keeping the top of the casing pipe threaded including plugging tube wells to prevent entry of foreign materials from the obove excluding the cost of fittings and materials.

Cleaning and developing the production well using their own compressor continuously worked till clear and adequate discharge is obtained from the tube well including supply and use of all necessary equipments and labour as per direction of E.I.C.

Supply all labours, T & P for packing the bore with washed gravel (Size P - 6) around the pipes in good quality including cost of gravel etc. complete as per direction of E.I.C.

Supplying all materials, labour and T & P and grouting with cement slurry for sanitary sealing around the GI casing pipe up to 3 mtrs. Below ground level including cost of cement all complete as per direction of E.I.C.

- | | | | |
|----|---|---|-----|
| 15 | Supply, delivery, installation (Bore hole installation) and testing at site of 11 m ³ per hour capacity, 50 m head, continuous rating vertical submersible pump conforming to IS : 8034- 2002 and coupled with 3.7kw, 3 phase, 415 volt, induction motor conforming to IS 9283 - 1995 of approved brand along with NRV and required quantity of 1 x 3 x 4 sq. mm. PVC submersible cable along with required length of G.I./PVC pipe with necessary fittings for connecting pump delivery from under ground well to the reservoir. Supply and delivery fittings including sundries, fixtures as required as per direction of E.I.C. | 2 | set |
| 16 | Carrying out CFD analysis of the sump as per design and drawing, based on details of pump being offered at reputed educational institute/ laboratory with prior approval of E.I.C. and to provide suitable arrangement of flow guides, buffers, splitters as required at the sump to achieve smooth pump operation free from vortex, pre rotation, swirl etc. | 1 | job |

Electrical components

- | | | | |
|----|---|---|-----|
| 17 | SITC of 12 KV, 800 Amps 3 (Three) Panel with 12 KV, 800 Amps 25/26.3 KA VCB switchgear along with Panel top mounted P.T. as per enclosed specification. 1 No Incomer feeder, 2 Nos Outgoing feeder { Make as per approved Make list] This Item Comprise 17.1 to 17.7 | 1 | set |
|----|---|---|-----|

17.1 RATING: 800A, BUSBAR 800A COPPER (25KA for 3sec) - 1no

17.2 A: MOVING PORTION:

A1: 11KV, 800A, 25KA for 3sec VCB - 1no

A2: VCB Enclosure + 800A Copper connections - 1no

A3: 800A High Voltage Grade Heat Shrinkable sleeved Copper Bus Bars -1 unit

17.3 B: CT AND PT DETAILS:

B1: 2 Core CT: CTR:100/1A+1A - 1no & CTR: 50/1A+1A-02 Nos
CORE 1: For metering, class-1.0, 10Va
CORE 2: For Protection, Class-5P10, 10VA
B2: 3 Nos 1Phase PTR:11KV/v3/110V/v3, CL, 1 & 3p, 50VA (Per Core) Drawout type/
Fixed Type - 1no

17.4 C: BREAKER PANEL INDICATION LAMPS:

C1: BREAKER On/OFF/Trip circuit Heathy/ Spring charge indication/ Breaker test position/ Breaker service position/ Auto Trip/ DC Available.- 8 nos
C2: R-Ph./ Y-Ph./ B-Ph. -3nos

17.5 D: SWITCHES/ MCB AND OTHER ACCESSORIES:

D1: DC ON/ OFF Switch- 1no
D2: AC ON/ OFF Switch-1no
D3: Auxiliary contactor (2NO + 2NC) - 1no
D4: Heater with heater switch & thermostat -2nos
D5: Cubicle illumination lamp-1
D6: 15A, 230V, 3 pin plug & socket and MCB -1no
D7: Local Remote Switch -1no
D8: T-N-C Switch -1no
D9: Mech. On-OFF push button -1no
D10: TTB -1no
D11: Buzzer- 1no
D12: 4 way Annunciator for I/C & 12 way Annunciator for TRF fdr-1 No

17.6 E: METERS & TRANSDUCERS:

E1: Ammeter with selector switch -1no
E2: Voltmeter with selector switch- 1no
E3: Digital MFM (Model: EM6400, CI-1.0 SCHNEIDER MAKE)- 1no
E4: Digital KWh meter- 1no
E5: 1 set flush mounting digital type trivector meter with accuracy class0.5 with max demand indicator at 30 minute interval

17.7 F: RELAYS

F1: Numerical relay communicable on MODBUS protocol MICOM P 127/ P3U30 & P122/P1F with Power pack Unit- 1no
F2: Mastertrip lockout relay VAJH 13 (86)- 1no
F3: Electromechanical type DC fail relay VAA21 -1no
F4: Electromechanical type Trip circuit Supervision Relay (VAX31)- 1no
PT should be drawout type & Power pack unit must be provided for tripping circuit

Cable entry box both side (Incomer & Outgoing) suitable for 3C X 300 sq. mm XLPE 11KV grade cable.

18 Supply, delivery, storing at site, installation, testing & commissioning of 800 KVA, 11KV /433V, 3 phase, 50HZ Δ/λ, Dyn 11 outdoor ONAN type **transformer** in IP 65 enclosure with copper windings, OFF load tap changing arrangement in HV Side @ 2.5% in 6 Step, Seven Position tap Switch From -10% to +5% , having HT cable end boxes with cable gland plate suitable for terminating 11KV ,3C x 300 sqmm XLPE/ARMD, AL cables for primary side and 1.1KV, 5 x 3-1/2C x 400 sqmm. XLPE/ARMD, AL cables on the secondary side, three channel temperature scanner for continuous monitoring of the windings , with supply of all associated materials and accessories like oil conservator, silica gel breather, Buchluz relay, mounting channels bolts ,nuts washers, screw, clamps, painting, earthing etc. and confirming to IS- 1180 (Level-2) and as per specification as laid down in the contract complete in all respect as required at site including construction of required size CC pedestal.
Make- Schneider/ KEC /CGL/ABB/ Automatic Electro Gear/ Century.

2

Nos

LT PANEL AT PUMP HOUSE

19 Supply, delivery, storing at site, installation, testing & commissioning of 415V (35MVA) TPN floor mounting free standing LTpanel made of min. 2mm thick sheet steel and stiffened by angle iron frame as necessary extensible on either side totally enclosed, dust and vermin proof, self supported, free standing unit with base channel, multi tier, compartmentalised cubicle, front access type construction with details of feeders as given below. LT panel shall be suitable for 500/415VAC 50HZ, 3-phase and neutral system. Panels shall be treated with seven tanks process before painting with two coats of epoxy paint over two coats of epoxy primer/powder coated paint all of approved shade complete with front operated incoming and outgoing switchgears, cablealleys, provision for cable entries from top and bottom, necessary meters, internal wiring with 1.1KV, copper wire (2.5 sq.mm) protection HRC fuse etc terminal blocks, selector switches, inter connection with insulated(1.1KVgrade) colour coded copper conductor cable, gland plates, earth bus of copper, lifting bolts, level inscriptions, earth connections etc and supply of all necessary accessories all complete and mending good the damages as required.
Make- Siemens/L&T/ABB/CGL/Schnider

1

set

Note:All works are to be done in accordance with I.E.rules and regulation and as per direction of Engineer-in-charge.GA drawing for each panel has to be get approved by the engineer-in-charge before manufacturing the same.

(A) Incomer- 2Set each set comprising the following items

(i) 1-Nos 1600A FP, 433V, 50 KA, **Icu=Ics=Icw=100%**, **EDO** Air Circuit Breaker (ACB) with OL, SC, Inst. GF Protection. UV Protection with ACB auto power restoration facility.
Make-

Siemens/L&T/ABB/Schneider

(ii) 1-set (3 Nos in each set) 15VA, 1600/5A, CL-1 for metering CTs

(iii) 1-set cable termination box suitable for 5 nos x 3½ C x 400 sq. mm., 1.1KV, XLPE /A, AL cable

(iv) 1-set 0-1600A AC flush mounting digital ammeter with selector switch.

- (v) 1-set 0-500V flush mounted digital voltmeter with selector switch
- (vi) 1-set ON/OFF/TRIP/TRIP CIRCUIT HEALTHY/ SPRING CHARGE lamps and push buttons
- (vii) 1-set R/Y/B phase indication lamps
- (viii) 1-set TRIP/NEUTRAL/CLOSE selector switch
- (ix) Earth bus-bar and all other accessories complete
- (x) Annunciator unit. 8W
- (xi) 1-set Multi Function Meter

(B) Bus-Bars

2-Set **TP(100%) & N(50%)**, 500/415V, **1600A**, 50Hz, 35 MVA continuous rated **copper bus-bar with insulating sleeves**

(c) Bus- Coupler

(i) 1-Nos 1600A FP, 433V, 50 KA, Icu=Ics=Icw=100%, EDO Air Circuit Breaker (ACB) with OL, SC, Inst. GF Protection.

(D) Outgoing

(i) 5 nos-630A TP 500/415V, AC 50KA breaking capacity MCCB microprocessor based. Fully Automatic Star Delta Starter (FASD) for operation of 125KW pump motor having 3nos. 300A, AC-3 Duty, 415V, TP AC 3 contactors and Star Delta timer 0-30 sec CT operated thermal O/L relay having suitable setting range with single phase preventor MN-12-L, ON/OFF/TRIP lamps, START/STOP push buttons, 0-500/A, CT operated digital ammeter with 500/5A class-1 CTS and selector switch, local/remote selector switch, 8 Channel Temperature Scanner (Masibus/Eq make), completely wired up to the terminals (for 4 nos VT pump & 01 no spare. Motor Space Heater Automatic On/ Off scheme shall be Provided).

(i.a) 05 Nos - Motor Protection Relay, Microprocessor Based with protection for Short Circuit, Overload, Earth fault, Phase Loss, Unbalance, Phase Reversal, Under current, Prolonged Starting, Locked Rotor along with 03 Nos CT 500/5A, CI 1.0, 15 VA

(ib) 05 Set - 65 KVAR reactive output at 440 Volts AC system voltage, Capacitor rated Voltage 525V AC of suitable rating KVAR output, Heavy Duty capacitor bank, Box Type as per Motor KW to improve power factor around 0.95, delta connected double dielectric heavy duty Metalised poly propylene -Heavy duty (MPP-H) Power Factor correction capacitor, 3ph, 50Hz, as per IS:13340 & IEC specification to be connected directly in parallel with the 150 KW motor terminals along with Capacitor Duty Contactor of 50 KVAR Capacity, 7% Detuned Harmonics Filter of 440 VAC Rated, copper wound, 125A 3P MCCB, 36 kA (Icu=Ics=100%), with TM release of OL & SC protection, On-delay timer, LED Indication for Capacitor ON, Start/Stop Push Button, Auto-Manual Selector Switch. The operation of the Capacitor shall be as such: Motor ON - Capacitor ON - Motor OFF -Capacitor OFF)

Note:Capacitor should be able to with stand a 110% of rated voltage and 130% of rated current. Rating of KVAR & switchgear combination shall change as per change in KW rating. Make- EPCOS/L&T/ Schneider)

(ii) 5 nos- 100A TPN 500/415V MCCB with breaking capacity of 50 KA including 0-100A CL-1 digital ammeter with 60/5A class-1 CTs and selector switch and ON/OFF/TRIP indication light complete (1 no for EOT crane, 1 nos for LDB, 1 nos for PDB. 2 nos spare).

(iii) 1 No 63 A TPN MCCB, 50KA including 0-50A Ammeter with 50/5A CL-1, CT And Selector Switch, On, Off Trip Indication, Street Light Timer-1 No, Auto/ Manual Selection Scheme-1 No

(E) Earth bus-bar

Continuous earth bus bar of 50 x 6mm G.I. flat running continuous through out the length of the switch board with earthing terminals.

20 CONSUMER 1-PANEL AIR CIRCUIT BREAKER AT SUB-STATION

2

Set

Supply,delivery, storing at site,erection testing & commissioning of indoor, floor mounted metal clad totally enclosed horizontal cubicle fully compartmentalized,extensible on either side motor operated spring charged, electrically/manually operated fully draw-out type 433V Air Circuit Breaker(ACB) Board having rupturing capacity of 35MVA at 433V conforming to specification etc and detail shown in single line diagram and as described below Including supplying necessary mounting channels and all other mounting accessories complete.LT panel shall be suitable for 433V AC 50HZ,3 phase and neutral system. Make- Siemens/L&T/ABB/Schnider

Note:All works are to be done in accordance with I.E.rules and regulation and as per direction of Engineer-in-charge.GA drawing for each panel has to be get approved by the engineer-in-charge before manufacturing the same.

(A) Incomer/ Outgoing

(i) 1- No 1600A FP, 433V, 50 KA, Icu=Ics=Icw=100%, EDO Air Circuit Breaker (ACB) with OL, SC, Inst. GF Protection. UV Protection with ACB auto power restoration circuit.

- (ii) 1-set (3 Nos in each set) CT with CTR 1600/5A, 15VA, CL-1 for metering
- (iii) 1 No 1200/5A, 15 VA Class 1 CT for APFC Relay
- (iv) 1-set cable termination box suitable for 5 nos x 3½ -C x 300 sqmm. 1.1KV, XLPE /A, AL cable
- (v) 1-set 0-1600A AC flush mounting digital ammeter with selector switch.
- (vi) 1-set 0-500V flush mounted digital voltmeter with selector switch
- (vii) 1-set ON/OFF/TRIP/TRIP CIRCUIT HEALTHY/SPRING CHARGE lamps and push buttons
- (viii) 1-set R/Y/B phase indication lamps
- (ix) 1-set TRIP/NEUTRAL/CLOSE selector switch
- (x) Earth bus-bar and all other accessories complete
- (xi) 1-set Multi Function Meter with MD (RTC)
- (xii) Busbar: 1600A TP (100%) & N (50%) Electrolytic Grade Copper Busbar .

ACB panel shall also consist of 150 KVAR (25 KVAR Fized & 125 KVAR Auto) APFC Panel, each comprising of: 01

No 315A 36 kA, 3P Thermal Magnetic Type MCCB for OL & SC Protection (Icu=Ics=100%) with Rotary Handle & Spreader Link. 01 No 0-300A 3-Ph Digital Ammeter, CI 1 with 03 Nos 300/5A, 5VA CT, CI 1.0, Tape wound. 01 No 12 Stage APFC Relay, Aux Contactor, Control MCB, Auto/ Manual Selector Switch, Copper Busbar 300A Rated, 01 No 25 KVAR Capacitor (FIXED), 05 Nos 15 KVAR Capacitor (AUTO), 03 Nos 10 KVAR Capacitor (AUTO), 04 Nos 5 KVAR Capacitor (AUTO). (Capacitor rated Voltage 525V AC of rating suitable rating so as to get 150 KVAR output at 440 VAC) Heavy Duty Box Type capacitor bank, 63A/ 40A/ 25A/ 16A - 3P 25 kA MCCB with Thermal magnetic Release, 7% detuned copper wound harmonics filter, 440 VAC suitable for 15 KVAR/ 10 KVAR/ 5 KVAR, Capacitor Duty Contactor suitable for 15 KVAR/ 10 KVAR/ 5 KVAR, ON LED Indication, Start/Stop Push Button, Exhaust Fans with timer & MCB protection.

Cooling/lubrication pump & submersible pump starter.

- | | | | |
|----|--|---|-----|
| 21 | Supply and fitting fixing of wall mounted cubicle panel board fabricated with 2mm MS CRC sheet complete with powder coated paint, copper busbar with all accessories. 1 Nos-100A 4P 500/415V AC 50KA breaking capacity MCCB microprocessor based OL & SC Protection with all other accessories complete including 415V, 2nos DOL starter for operation of 02 nos 2.2KW cooling/lubrication pump motor and 1no Submersible Pump controller Starter fully automatic star-delta starter (L&T make) for 01no submersible pump having 1 no contactor 32A, thermal O/L relay having setting range 4-6.3A with, single phase preventor, ON/OFF/TRIP lamps, START/STOP push buttons, 0-10A, ammeter, local/remote selector switch, completely wired up to the terminals (2 nos. 2.2 KW lubrication/cooling pump motor and 1no submersible pump motor of suitable size) | 1 | set |
|----|--|---|-----|

22	Supply, Installation , testing & commissioning of battery charger with DCDB of 110 volt DC, considering of 55 nos dry maintenance free batteries of 100 AH capacity , complete with metal racks & all other accessories housed in a common floor mounted enclosed & properly Ventilated sheet steel Cubicle (IP-42) including preparation of Pedastal, Position of charger & batteries including necessary inter connection as supply, painting, earthing all complete as per specification. Battery Model: UBST 100 Evide	1	set
CONTROL CABLE			
23	Supplying and laying of following sizes of 1.1KV grade XLPE insulated armored / unarmoured Copper cable in excavated trenches, erected cable tray, pipes and masonry trench through under ground etc. as and where required as follows:		
	a) 7C X 2.5 Sqmm XLPE/A Cu Cable.	70	RM
	b) 16C X 2.5 Sqmm XLPE/A Cu Cable.	600	RM
	c) 3C X 2.5 Sqmm XLPE copper	720	RM
Cable Tray			
24	Supplying and installing following size of perforated Hot Dipped Galvanised Iron cable tray (Galvanisation thickness not less than 50 microns) with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with G.I. suspenders including G.I. bolts & nuts, etc. as required.		
24.1	375 mm x 2.0 mm x 50 mm	60	RM
24.2	300 mm x 1.6 mm x 50 mm	40	RM
24.3	150 mm x 1.6 mm x 50 mm	40	RM
25	Supplying and fixing of 5.0 kg capacity fire extinguishers (Dry chemical type) to be fitted in wall with suitable bracket including cutting, chipping and mending good the damages.	6	Each
26	Supplying and fixing 9 lts. Capacity MS fire bucket coloured red.	6	Each
27	Supplying and fixing of shock treatment chart duly framed with glass on wall with necessary screws.	2	Each
28	Supplying and fixing of 250 mm x 250 mm x 2 mm thick danger boards with screws.	8	Each
29	Supplying and delivery high high voltage tested electrical rubber mat size (1mte x 2 mtr) and thickness 25 mm at site.	8	Each

30	Supplying and fixing of First Aid Box with all items as required by rule on MS Bracket including mending good the damages.	2	Set
31	Supply & laying & Termination of overall shielded Instrumentation Cable for RTD, BTD sensor to temperature scanner connection 30C (Triad) 0.75 Sqmm	50 50	Mtr Mtr
32	Supplying fitting fixing fabrication of MS ladder tray, hanger, masonry trench cover fabricated with MS angle, chanel, flats etc with painting for cable and electrical accessories.	1250	kg
33	Supply of an advance non-electronics lightning protection system ESE Air Terminal as per standard NFC 17- 102:2011at Level IV . It shall work on Advanced Early Steamer Emission (ESE)principle and generation of streamer is through corona effect. It shall be made of Stainless steel central capture head of 316L.The system should be so designed to be capable of protecting against direct lightning point as well as conducting/ diverting it to earth completely after tracing the lightning in advance. An ESEATshall be tested & certified from International /national recognised Test Lab with impulse wave test of 100kA of 10/350 microseconds. And also include necessary accessories.	1	Set
34	Supply of GI Mast of length 5Mtr with base plate with guy wire cable tie with all connecting accessories (with Radius of protection of 107 meter).	1	Nos
35	supply of 50 sq. mm insulated copper cable for high lightning current discharge	50	RM
36	supply of Holder for holding 50 sq 1.5 mm insulated copper cable (For RCC)	50	Nos
37	Supply of Stainless steel Test link suitable for connecting 70 sqmm PVC insulated cable to 25x6mm GI strip with enclosure	2	Nos
38	Supply of Electromechanical lightning strike counter for counting the number of lightning strikes without any power supply. The counter should be mounted on the down conductor. The lightning counter should be IP68 rated closure suitable for external application	1	Nos
39	Supply of Maintenance free copper bonded earth rod of diameter 17.2 mm, 10 feet length, made of high tensile low carbon steel rod, molecularly bonded with copper on outer surface (minimum copper bonding thickness-250 microns). complying standard IEEE80, IS 3043:2018,UL 467 with 30 Kg ROHS approved Earth enhancing compound with earth rod clamp and pit cover.	4	Nos

40	Supply, Installation, Testing ,Commissioning of hot dip galvanized 12 Mtr High Mast pole (Make Calcutta pole/Utkarsh or eqv approved by EIC) including feeder pilar, SS wire rope, winch, motor, compensating disc etc i.e all necessary accessories suitable to install of 6 nos 150Watt high-efficiency IP 66 LED luminaries in symmetrical arrangement with pressure die-cast aluminium housing and toughened glass (Make - Orient Model LFSMP-150-C or eqv approved by EIC) to complete the job with required CC foundation as per direction of EIC.	1	Job
41	Operation and running routine maintenance of pumps and allied electro-mechanical system and cleaning of trash rack/ barscreen/ gratings at inlet to the pump bays after commissioning of the pumps for 12(twelve) months and replacement of spares(if required) during the 1st year of warranty period.	12	Per/Month
42	Supply and delivery of following spares for one no 50cusec pump set		
42.1	Top, intermediate, bottom/impeller shaft complete set	1	set
42.2	Shaft sleeve complete set	1	set
42.3	Muff coupling complete set	1	set
42.4	Cut less rubber bush complete set	1	set
42.5	Ratchet pin & keys complete set	1	set

1.0 TECHNICAL SPECIFICATION OF THE WORK

Supply, installation, testing and commissioning and one year successful operation and maintenance of four (04)nos 50 cusec(each) vertical turbine pump sets with allied electrical (HT & LT) and mechanical works complete for the proposed Dumdum park pumping station at the confluence of Cantonment khal and Bagjola khal at PS-Baguiati and Dist- North 24 PGS

1.1 Codes and Standards:

The design, manufacture and performance of the pumps specified herein shall comply with the requirements of the applicable codes and standards, including but not limited to the following:

SI No	Standard	Title
01	IS: 1710	Vertical Turbine Mixed and Axial Flow for clear cold water
02	IS 10981	Class of acceptance test for centrifugal mixed flow and axial pumps - Class B
03	IS 9137	Code for acceptance test for centrifugal, mixed flow and axial pumps - Class C
04	IS 13538	Centrifugal mixed flow and axial pumps - Code for hydraulic performance tests - Precision class
05	IS 5600	Pumps - Sewage and Drainage
06	IS:5120	Technical Requirements for Roto-dynamic Special Purpose pumps
07	ANSI HI 1.3, HI 2.3, HI 2.4, HI 9.8, HI 9.6.1, HI 9.6.3, HI 9.6.4, HI 9.6.5, HI 14.6	ANSI Hydraulic Institute Standards for pumps
08	ISO 1940	Mechanical Vibration- Balance quality requirement of Rigid Rotors
09	BS EN ISO 9906:2000	Rotodynamic pumps — Hydraulic performance acceptance tests Grades 1 & 2

Where the above standards are in conflict with the stipulation of tender specifications, tender specification supersedes them.

1.2 General:

The pump shall be of vertically suspended, single stage, single flow, wet pit type complete with bowl assembly, column pipe assembly, discharge head assembly and base plate with all accessories as applicable, driven by single speed vertically mounted solid shaft flange mounted motor. Pump should be suitable for pumping solid bearing liquid such as wastewater, industrial discharge, storm or canal drainage etc. The outline specifications are given in the following table.

No. of pumps	4
Type of pump	Vertical Turbine, Axial/Mixed flow
Capacity of each pump (Duty point)	1.42 Cumec / 5100 M ³ /Hr
TDH (Duty point)	5.95 M
RPM of Pump	≤ 600
Bowl Efficiency (minimum)	85%
Lubrication & cooling	external clear water
Solid handling capacity of the pump	50 MM
Sump Data:	
Sump floor level	(-)1.789 M
C/L of delivery pipe -	(+) 4.0 M
Pump house floor level-	(+) 6.711M
Sump bay width-	2400mm
Delivery	below pump house floor level
Canal data	
Bed level of Cantonment Khal	(+) 0.00 M
HFL of Cantonment Khal	(+) 1.905M
Bed level of Bagjola Khal	(-) 0.40 M
FDL of Bagjola Khal	(+) 2.29 M

The total dynamic head referred above is inclusive of all losses in the pipeline. TDH for each pump shall be calculated and verified with the above result by the bidder and included in the design head of bowl assembly. The Bidder shall submit design of V.T. pump and its accessories for approval to placement of supply order.

The pump shall have stable performance characteristics throughout the whole range of its operation i.e. from zero flow to run out condition. The pump of particular category shall be identical and shall be suitable for continuous operation.

1.3 Characteristic Curve:

System head curve for the pumping system is furnished along with the tender. The bidder shall furnish characteristic curves of each pump. The bidder shall furnish with the tender the characteristic curve so prepared and superimposed on system head curve for single or multi pump operations.

The pump shall have stable characteristic over the entire range of working head of operation.

The pump characteristics shall be of stable nature and such that the efficiency is fairly steady for the water level variations as mentioned in the foregoing clauses. The maximum efficiency point will be nearer to the duty point and fairly constant for larger range on either side. The pumps should run smoothly from lowest head to shut off point without Cavitations and vibration (within HIS limitations for vibrations.) The variation in the efficiencies for any point of operation on the entire operating range should be minimum.

1.4 Design Requirements

The pump shall be capable of developing the required total head at rated capacity for continuous operation. The head discharge curve shall be continuously rising towards the shut off with highest shut off point. Impeller shall preferably be non- overloading type. Pump shall run smooth without undue noise and vibration.

1.5 Pump Duties

1.5.1 Duty Point discharge

The pump shall have to give a discharge at normal water level conditions at duty point head mentioned in B.O.Q and shall give corresponding higher discharge for the lesser heads.

1.5.3 Duty point efficiencies

The pumps shall have maximum efficiencies at duty point. The tenderer should evaluate the above efficiency and specify the same in their offers along with calculations. The efficiency curves for the entire range of operation should invariably be submitted along with the offer.

1.5.4 Power Margin

The pumps shall be capable of operating in the range as mentioned above without being overloaded at any point and keeping a margin of at least 5% of power in the motor of pump over entire operating

range. The pump should be capable of starting against fully closed flap valve without being overloaded at any point up to valve fully open.

1.5.5 NPSH requirements

The pump will be operated over a range of capacities and not at a fixed duty point and driven by a constant speed motor. It is most important that the pump can function properly over the full operating range of the system curve. For this NPSH margin of minimum 1 meter is required to avoid any damage to the pumps and $NPSH_R$ shall not exceed the $NPSH_A$ at any point of operation in the range. For calculation purpose following data may be used.

- (i) Atmospheric Pressure: 10 MWC
- (ii) Vapor pressure of water: 0.3 MWC

1.5.6 Class of Operation

The pumps shall be suitable for non- stop continuous 24 hours operations without interruptions.

1.5.7 Sump Model Testing

It is obligatory on the part of the contractor to carry out sump model tests at C.W.P.R.S., Pune or Indian Institute of Science, Bangalore, or any such reputed laboratory with prior approval of the Engineer, at his own cost and at the earliest after issue of the work order. The contractor must fully satisfy himself about the suitability of the proposed design and layout of the sump, to ensure vortex free and Cavitation free operations of the pumps. Two representatives of the Department. will be deputed for inspection of this test, if so desired by the Department. **The contractor will have to bear the expenses towards their traveling, boarding and lodging, etc.** for attending the above test. Minor modifications to the sumps as are acceptable to Department and as are possible considering the then stage of civil works, will be carried out at the cost of Department, and as per contractors proposal in writing. Test results in triplicate of the contractors sump model testing, should immediately be sent to the Engineer in charge, along with proposals by the contractor of any; for his consideration. If the changes proposed by the contractor in the design of the civil works construction; it is obligatory on the part of the contractor, to modify the design of his equipment to the extent possible, which would suit the sump finalized by the Department and to ensure hydraulically smooth operation. Such modification in the design of the equipment is deemed to be covered under the agreement rate for the item.

1.6 Features of Construction:

Bowl Assembly:

Pump bowl shall be of **Cast Iron (IS210, Grade FG260)** and shall be flanged type with machine mating of faces. The castings shall be free of blow holes, sand holes, and other detrimental defects. The bowls shall be capable of withstanding a hydrostatic pressure equal to twice the pressure at rated capacity or 1.5 times shut-off head, whichever is greater. Bowls may be equipped with replaceable seal rings on the suction side of enclosed impellers.

Impeller:

Impeller shall be open type, cast in one piece and balanced both statically and dynamically and shall be fastened securely to the impeller shaft with keys, taper bushings, or lock nuts. They shall be adjustable vertically by means of a nut in the driver or an adjustable coupling between the pump and the driver. The interior surfaces and passages shall be smooth finished, to obtain the highest efficiency and shall be designed to ensure smooth operation free from any cavitations or vibration. As raw water is being pumped, balancing holes / devices will not be accepted for balancing the hydraulic thrust. Impeller shall be of material: **Duplex stainless steel 1A (ASTMA 890 Gr.CD4MCu)**, TS, min. 690MPa; YS, min.485MPa; elongation 16%.

Wearing Ring:

Wearing ring shall be renewable type. These shall be held in place by screwing against rotation, press fit or locked with pins, flanged or screwed. Wearing ring shall be of same material as impeller. However, hardness of wearing ring shall be less by at least 50 BHN than the impeller.

Column pipe assembly:

The column pipe material shall be of **Cast Iron (IS210, Grade FG260)**, heavy duty, flanged type, each pipe shall be of 1.50 Mtr length or less. The Column pipe dia (ID) shall be of 900 mm (for 50 cusec) and thickness shall be of such to take required pressure and all types of load acting on it. The end of column pipe should be machined with correct tolerance level to secure the bearing retainers when assembled to ensure proper alignment.

Impeller Shaft:

The impeller shaft shall be of precision ground **Stainless Steel 316 (ASTMA 276 type 316 or IS1570 (part V) Gr. X04Cr17Ni12Mo2)** and finished to the close tolerances. The impeller shaft will not be overhung at the bottom and will be rotating in bearing support at its bottom or as approved by EIC.

The critical speed of the shaft, which shall be at least 20 % above or below the operating speed. The shaft shall be properly balanced so as not to cause any vibration during operation.

Line shafts:

The line shaft shall be of **Stainless Steel 316 (ASTMA 276 type 316 or IS1570 (part-V) Gr. X04Cr17Ni12Mo2)** solid type precision ground and will be designed to take all types of load such as torsion, tensile, dynamic, etc. Shaft size and bearing spacing are determined by horsepower and thrust requirements and have muffed coupling arrangement. To ensure accurate alignment of the shafts, they shall be straight within 0.13 mm total indicator reading for a 3-m section; the butting faces shall be machined square to the axis of the shaft. The line shaft shall be coupled with steel couplings. The shaft shall be provided with a noncorrosive wearing surface/shaft sleeve of stainless steel at the location of each guide bearing.

Composite design of the line shaft material and its dia. and bearing center shall ensure that the entire rotating assembly is brought from stands still to full speed without any vibration and shaft deflection and to ensure that first critical speed is not within 80 % to 120 % of full speed.

Line shafts bearings:

The line shaft rubber bearings shall be designed for vertical turbine pump service, to be lubricated by the pressurized clear water. They shall be mounted in bearing retainers that shall be held in position in the column couplings by means of the ends of the column pipes. The bearings shall be spaced at intervals of not more than 3 mtr. Outer shell of bearings cast or extruded **brass or SS tubes. Rubber compound** is of **neoprene, nitrile or composite** type. Internally and externally turned and ground surface. Minimum bearing area must be 50% of rubber surface. Maximum bearing load < 0.0246 kg/Sq. mm of inside area. Inside groove shape 'V' or 'U' in circular with sharp edges rounded off.

Shaft Enclosing Tube:

Shaft Enclosing Tube is used to protect the line shaft and bearings from the fluid being pumped. The line shaft protection tubes should be of heavy duty seamless stainless steel tubes and shall withstand all mechanical and hydraulic forces exerted on it with an allowance for corrosion and erosion.

Ratchets:

Water-lubricated vertical turbine pumps shall be provided with a non reverse mechanism in the motor to protect the line shaft and the motor from reverse rotation when the power is interrupted and the water empties from the discharge column.

Discharge Head and Motor Stool:

The discharge head motor stool shall be of full diameter flanged all ends. Flanged surface and tee in smooth 90 degree bend so as to have minimum loss of head in it. The pump discharge head shall be designed to withstand all static load, dynamic load, hydraulic thrust, torsional load imposed by the Pump & motor to limit vibration and shall be of robust construction to support entire load of pump assembly, water column and motor etc.

The pump discharge head motor stool shall have thrust bearing with cooling arrangement and contained in cast iron stuffing box in which the top shaft will be sealed. Self aligning thrust bearing designed to accommodate entire weight of rotating pads any hydraulic thrust and shall be suitable for reverse rotation up to at least 150 % normal forward speed. Thrust bearing shall be designed for minimum 1,00,000 hours life. The bearing shall be of oil lubricated type with proper cooling arrangement and shall be provide with oil level gauges and suitably positioned temperature probes.

The power shall be transmitted from motor to vertical shafting through a flexible coupling. Both halves of the couplings shall be machined all over and securely keyed to their respective shafts. The keys shall be of Stainless steel. The arrangement of two halves shall be suitable to check alignment and parallelism.

Motor stool shall be provided for mounting the electrical Motor. The Motor stool shall accommodate the pump thrust bearing and pump motor coupling. The Motor stool shall be of robust construction and of fabricated from mild steel and adequately sized with openings to work of the flexible couplings.

Miscellaneous:

The pump shall be provided with non reversible ratchet or similar mechanism to prevent from rotation in Reverse direction. Pressure gauge to each pump and manifold pipe shall be provided. Pressure gauges shall be of 150 mm dia and pr. range 0-10 kg/cm² and with least count of 0.05. Each pressure gauge shall be filled with restrictor nozzle of brass and with G.I. pipe and 'U' tube. All pressure gauges shall be installed in pump house on the all headers and wall with necessary G.I. pipe connections. The pressure gauges shall be installed at suitable height so that the reading can be taken accurately.

Sole Plate:

The M.S. sole plate arrangement shall be provided under the discharge head for precise horizontal and vertical alignment. Thickness of sole plate shall not be less than 50 mm. It shall be independent of base plate integral with the discharge head. The contract surfaces of the sole plate as mentioned below shall be machined for precise leveling and shall ensure vibration free operation of the pump.

All joints between machined contact surfaces shall be with nut bolts / tapped studs / bolts. All contact surfaces shall be blue matched to ensure proper contact to the extent of 60% of contact area after necessary site finished if required. The opening in the sole plate / frame shall be of adequate size to pass the bell mouth, bowl assembly etc. very easily. M.S. base frame shall be anchored in the floor ensuring complete rigidity. Entire structural fabricated and foundation arrangement shall be designed and submitted for approval. M.S. plates shall be grouted on pump supporting R.C.C. slab / beams provided in civil structure. Fixing of level shall be the responsibility of pumping machinery contractor with all related works.

1.7 Vibrations and Noise

Pumps shall run smooth without undue noise and vibration. The velocity of vibration shall be within the 4.5 mm/sec. Combined noise level of pump motor system when all pumps are running simultaneously shall be limited to 85 dBA at a distance of 1.86 m.

All the pumping units shall be supplied with machined pads to allow the fitting of portable vibration monitoring transducers. One portable vibration monitoring equipment capable of measuring and recording velocity and vibration shall be supplied for each pumping plant.

1.8 Testing and Inspection of VT pumps

All the VT pumps specified in B.O.Q shall be inspected and tested at the manufacturing works as below in presence of the Engineer's representatives as per clauses of tender documents to ascertain the performance of the pumps and to compare them with guaranteed duty point.

The duration of the test shall be sufficient to obtain consistent results, having regard to the degree of accuracy to be achieved. Accurate measurement of head and discharge are chief hydraulic parameters for any field acceptance tests.

Test Report and Documents for VT pumps

Contractor shall furnish to the Engineer following documents before dispatch of the material.

- (1) Test reports for chemical analysis of materials of construction for major components like impellers, pump shaft, line shafts, bowl assembly, column pipe etc.
- (2) Pump performance test reports with sample calculations and actual pump performance curves and pumps performance test acceptance reports.
- (3) Other test and inspection reports as above.
- (4) Final constructional drawings of the pump.
- (5) Operation, maintenance and spare parts manual for pumps.

The contractor shall arrange a) Factory testing and third party inspection, b) Field performance testing of all the pumps as mentioned below.

A) Factory Test

All the pumps shall be subject to factory test in presence of Engineer-in-Charge or his representative.

Scope of the factory test and inspection is as under:

- i) Review of raw materials test certificates of various components of the pump and quality control procedure.
- ii) Hydrostatic Test

Following accessories shall be tested at hydrostatic pressure equal to twice the duty head or 1.50 times shut off head of bowl assembly whichever is higher as per IS 5120.

- a) Bowl assembly.
- b) Discharge head.
- c) Column pipes.
- iii) Performance Test at manufacturer's works

The test shall generally be carried out as per IS 9137 accepted test for pump Class C or IS 10987 accepted test for pump Class B. The test shall be carried out at full speed and full load. The test shall be carried out only by the job motor which will be supplied under this contract. The test at reduced speed and reduced load will not be acceptable.

The performance test shall cover below mentioned 10 points.

- a) Duty head point
- b) 4 points above duty head
- c) 4 points below duty head
- d) Shut off head point
- e) Power consumption and pump efficiency at all 10 points.
- iv) **Cavitation Test** or NPSH test also to be conducted at manufacturers works to verify that the NPSH required by the pump is less than the available NPSH by a specified margin to ascertain that the pump is free of cavitation over the range of operating region.
- v) Strip inspection

One number of pumps set, after completion of its performance test and as selected at random by the Hydraulic Engineer or his representative will be offered for strip

inspection and dimensional checking. The contractor/manufacturer shall submit all required dimensional drawings for strip inspection. Minimum points as under shall be checked.

- a) Condition of all components, particularly bushes, bearings and wearing rings to examine undue rubbing, wear etc.
- b) Hardness of cutless rubber bearing.
- c) Dynamic balancing of a) Impellers b) Flexible coupling. Maximum unbalance shall be as per relevant IS codes.
- d) Clearance and tolerances between
 - i) Wearing rings
 - ii) Impeller shaft and bearings
 - iii) Impeller shaft and key
 - iv) Shaft and flexible coupling
 - v) Key and key way on shaft
 - vi) Finishing of water passage in impeller and diffuser
 - vii) Material test certificates of various pump components shall be furnished by the contract / manufacturer.

A) Field Performance Test

The field test generally is carried out as per IS. The Volumetric measurements of discharge would on the basis of drop of levels in the sump from which water is pumped or rise in water level in ESR/GSR water to be pumped. The effective shall be measured with pressure gauges, fitted to delivery pipe at suitable elevation before delivery pipe line. The gauge shall be fitted at 1 MTR distance from discharge nozzle. The readings may be taken with at least two gauges. The electric input will be measured with the help of two watt hour meters.

The field test shall be taken with the entire head range in such a manner that it would cover at least five points on head, discharge curve (one at duty point and two each equally spreading above and below the duty head). This field test shall be carried out after one month from the date of pumps is put in operations. The field test shall be witnessed by the Engineer- In-charge or his representative and Chief Engineer. The test shall be carried out as per IS 9137 code of acceptance test of pump Class C, in general and as stated below in particular.

The purpose of the field performance test is not to ensure whether pump performance as regards parameters i.e. Head (H), Discharge (Q) and power etc. within acceptance limit as per IS 9137. The

purpose is to ensure that the pump performance is generally acceptable or otherwise. Final acceptance shall be as per following criteria.

- i) Verification of guarantee of H and Q specified in Clause 9.4.1 of IS 9137 shall be based on following liberalize tolerances.

$$X_H = 0.04$$

$$X_Q = 0.07$$

Tolerance Limits as per IS 9137

$\pm 3.5\%$ for Discharge, Head and Power Input

$\pm 2.0\%$ for Speed of rotation

$\pm 5.0\%$ for Pump efficiency

+ 4.5% for Overall efficiency

- ii) As regards P-Q characteristic for acceptance it shall be checked whether motor is not getting overloaded within the specified head range.
- iii) Volumetric measurement shall be taken. In addition calibrated flow meter to be provided by the contractor.
- iv) Pump head shall be measured with calibrated pressure gauge of accuracy 1 % or better. At least 3 pressure gauges shall be got calibrated from two different institutions with prior approval of the Engineer-In-Charge. The calibration shall be point to point and not mere for percentage error.
- v) The input power to electrical motor shall be measured with class 0.50 accuracy power meter with suitable CTs and test lid and PTs provided in panel. The watt meters, CTs and PTs shall be got calibrated point to point and not mere for percentage error.
- vi) Pump speed shall be measured by at least 2 Nos. non contact techo-meters with digital display calibrated from two different institutions approved by Engineer-In-Charge.

1.9 C.I.D.F. DELIVERY PIPES

C.I.D.F delivery pipes with flange and fittings complete with all accessories as per speciation including jointing conforming to the latest revision of IS : 1710, IS : 5120, IS: 1537 & IS:1538.

1.10 AIR RELIEF VALVE

Double acting automatic air relief valve of nominal size 100mm as per IS 14845 with isolating mitre bevel geared sluice valve as per IS 14846 complete for vertical turbine pump set shall be provided and installed on the delivery pipe coming out from each vertical turbine pump. The valves shall be provided at locations shown in the drawing.

Working Pressure Body/seat - 7 / 5 kg/cm²

Design Pressure Body/seat - 18 / 12 kg/cm²

Testing as per IS 14846

Material of Construction

Material body & top cover- CI, IS 210 FG 260,

Internal fittings- bronze IS 318 LTB 2,

Hardware in contact with water- SS 304

1.11 FLAP VALVE

Each pump will be provided with one non- return valve / flap valve in its delivery pipe end. The flap valve will be of 900mm. dia. C.I. Single flange, swing type double hung flap valve with pressure rating as per specific standard and following specification.

For Rated flow - 5100 M³/Hr,

Velocity at rated flow - 2.228 m/sec

Design Pressure - 15 MWC

Leakage as per IS 13349 class 3

Testing as per IS 14858

Material of Construction

Body, flap Cast iron, IS: 210, FG: 260,

Body & disc set: stainless steel, AISI 304,

Hinge pin: Stainless steel AISI 410,

Flange standard IS 1538,

Painting

All the valves shall be painted with zinc rich epoxy primer plus two coats of epoxy paint. The paint shall be spray applied and dried in a painting booth to avoid ingress of foreign particles especially when the painted surface is not completely dry.

Inspection and Testing

The valve shall be subjected to seat and body test in accordance with relevant IS at the manufacturers works in presence of Engineer or his representative, before delivery. The test certificates shall be furnished in triplicate.

All the major components of each valve shall be physically and chemically tested by approved independent testing authority to confirm the material quality. The manufacturer shall intimate the Client, the relevant Standard to be followed for testing. All components subject to testing shall be identified, and only those which are tested successfully shall be used for the manufacture of final product. All test results shall be submitted for Client's approval.

Hydrostatic Test

The pressure retaining components of all valves shall be tested at the pressure stipulated in the relevant standard followed. The manufacturer should inform the Client regarding the pressure ratings of the valves and all the test certificates to be submitted before dispatch of the materials.

2.0 LUBRICATION WATER PUMP AND COOLING WATER PUMP

Domestic regenerative type, horizontal, single/multi-stage pump complete with motor, base plate, coupling etc. along with all accessories and galvanized iron pipelines at both suction and delivery of suitable size along with all fittings, valves etc. to be provided for both cooling and lubrication purpose of VT pump.

The pump shall run smooth without noise and vibration. The power rating of the pump motor shall not be less than the maximum power required from zero discharge to maximum discharge range.

The pump shall be designed to operate satisfactorily without detrimental surges, vibration, noise or dynamic imbalance over the required head range.

Code and Standard

Pump design shall be as per IS : 6595 and pump performance shall be as per IS : 9137.

Characteristic Curve

The head-capacity curve of the pump shall have a continually rising head characteristic with decreasing capacity over the whole range of total head. The shut off head of the pump shall be at least 135% of the total head.

Design Requirement

The Contractor shall guarantee that adequate required Net Positive Suction Head (NPSH) is available to ensure that pumps can operate without cavitation under the worst operating condition. The required NPSH at duty point and throughout the range shall be at least 1.0 M and 0.5 M less than the available NPSH respectively at the lowest water level in the sump.

Each pump must be capable of running satisfactorily in parallel with other sets in the system without throttling and by itself, without cavitation or overload under all operating conditions within the system resistance indicated.

The unit shall be designed to operate safely at the maximum speed attainable in the reverse direction of rotation due to water returning through the pump at times when the power supply to the motor is interrupted and the discharge valve fails to close. The first critical speed of the pumps set shall be at least 30% above the operating speed.

A stationary coupling guard shall be provided for the coupling conforming to all relevant safety codes and regulations. Guard shall be designed for easy installation and removal, complete with necessary support, accessories and fasteners. The pumping unit shall be provided with a common base plate. The base plate shall be of sufficient size and rigidity to maintain the pump and motor in proper alignment and position.

The driving motor will be suitable for operation at 415 Volts + 10%, 3 phase, 50 Hz, AC supply and will be of squirrel cage induction type, indoor installation with DOL starter.

Material of Construction

Casing	:	CI IS 210 Gr FG 200
Impeller	:	CI IS 210 Gr FG 200 or Bronze Gr.LTB2 IS 318
Shaft	:	SS or Gr 40C8 IS 1570
Shaft Sleeve	:	Bronze Gr.LTB2 IS 318 or SS Gr. X04Cr12, X12Cr12 or X20Cr13 IS6603 / IS 6911
Casing ring	:	CI IS 210 Gr FG 200 or Bronze Gr.LTB2 IS 318
Shaft Seal	:	Mechanical
Base Plate	:	CI/Epoxy Coated MS

Vibration and Noise

Pumps shall run smooth without undue noise and vibration. The velocity of vibration shall be within the 4.5 mm/sec. Noise level shall be limited to 85 dBA at a distance of 1.5m. All rotating parts shall be

statically and dynamically balanced as per ISO standards. All pumps shall be provided with mechanical seals of working life not less than 20000 hours of operation.

Testing

Pumps shall be tested for all routine tests as per latest applicable IS.

3.0 PRESSURE GAUGE

All the pumps shall be provided with dial type pressure gauges of suitable range at delivery flanges complete with SS tubing and control cocks. The gauges shall be of direct mounted Stainless Steel diaphragm sealed type. The dial size of each pressure gauge shall not be less than 150mm. The materials of construction shall be suitable for drainage pumping station installations. Each pressure gauge shall be complete with pressure rubber and of suitable class of enclosure. Accuracy shall be + 1.0% of full scale range or better. Scale range shall be so selected that normal system pressure is approximately 50% of full scale. The pressure gauges shall conform to the latest revision of IS: 3624 / BS: 1780/equivalent. Testing as per IS 3624.

4.0 PEET'S VALVE

Peet's valve fullway gunmetal standard pattern best quality of approved brand bearing I.S.I. marking with fittings and tested to 21 kg per sq. cm.

5.0 TRASHRACK

5.1 GENERAL SCOPE OF WORK

The Scope of the work covers the following items of works:

(a) Supply, delivery, storing at site, installation, testing & commissioning of stainless-steel trashrack/ bar screen/guides and similar structure conforming to relevant IS codes (IS:11388) fabricated with stainless-steel (S.S. to AISI-304) sections such as flat, channels, angles etc including cost of materials, machinery, labour, cutting, aligning, welding, fixing at site as per approved drawing including transportation charges as per direction of E.I.C. (Material: (S.S. /AISI-304)).

(b) The scope of work also covers manufacture, transport, supply and erection of all the guide channel and anchorages including all embedded parts required to be complete the work as a whole. All the concreting works i.e. 1st stage and 2nd stage concreting works are under the scope of this work.

(c) The scope of work also covers proper storing of all components, sub-assemblies, electromechanical parts etc. of the items to be furnished under this tender and keeping them in safe custody till they are taken over by the E.I.C. in the final installed form.

(d) The entrusted agency shall also carry out at his own expense all the preliminary and enabling works and all other incidental works such as establishing a field workshop and stores, furnishing and installing erection aids, cranes if necessary, scaffoldings, ladders, temporary bracings and supports etc. complete as required to facilitate execution of work and shall also carry out at his own expense all other operation covered under the meaning and intent of conditions and specifications in the tender documents. The cost tendered by the Bidder for the above items shall be deemed to be inclusive of all expenses required to be incurred by him for executing the work.

5.2 APPLICABLE B.I.S. CODES :

All materials & methods and procedures for the work of design, manufacture, transport, supply and installation shall conform to latest edition Indian Standard Specification and other publication listed below unless otherwise specified.

IS: 11388 Recommendation for design of trash rack for intakes

IS: 6280 Sewage screens

IS : 456 : Code of Practice for Plain and Reinforced Concrete

IS : 800 : Code of Practice for General Construction in Steel.

IS : 808 : (Part-1I) Dimensions for Hot Rolled Steel Beams M.B. Series.

IS : 808 : (Part-III) Dimensions for Hot Rolled Steel Beams, Channel and Angle Section Channel

IS : 814 All parts Specification for covered Electrodes for Metal Arc Welding of structural steel, Welding Sheets.

IS : 815 Classification and coding of covered Electrodes for Metal Arc Welding of Structural steel.

IS : 816 Code of Practice for Use of Metal Arc Welding for General Construction in Mild Steel.

IS : 817 Code of Practice for Training and testing of Metal Arc Welders.

IS : 961 High Tensile Structural Steel

IS : 1365, IS : 2389 Threaded fasteners

IS : 2595 Code of practice for Radio Graphic Testing.

IS : 2644 High Tensile Steel Castings.

IS : 2709 Guide for selection of Fits.

- IS : 3073 Assessment of surface roughness.
- IS : 3640 Specification for Hexagon fit bolts.
- IS : 3757 Specifications for high strength structural bolts.
- IS : 7205 Safety code for erection of structural steel.
- IS : 7215 Tolerances for fabrication of steel structure.
- IS : 7307 (Part-I) Approval Tests for Welding procedures – Part-I Fusion Welding of steel.
- IS : 7310 (Part-I) Approval Tests for welders working to approved welding procedures – Part-I-Fusion welding of steel.

The above list is only indicative & in no way complete or exhaustive. Any other materials necessary as approved drawings have to be procured and used by the bidder within quoted rates.

5.3 METAL WORK, FABRICATION AND MACHINE WORK:

General Workmanship

All fabrication work under the contract shall be done in accordance with the specifications and works shall be performed and completed in a through workman like manner as per the practice in manufacture and fabrication of materials of the type covered by the specification. The work, shall in all cases, be of the highest quality and carefully performed to the laid down specification. All materials and workmanship furnished by the Bidder be free from injurious defect. He shall replace free of cost, any defect in material or workmanship noticed during erection and shall bear all cost of the modification in the field of any defect for which he is responsible. Workmanship shall conform to the latest standards, laid down in Indian Standard specification.

All members shall be free of twists, bends or other deformations and all surfaces that will be in contact be thoroughly cleaned before assembling. Parts shall be adjusted to line and fit and shall be firmly bolted or otherwise held securely together so that surfaces are in close contact before drilling, reaming or welding is commenced.

If weight limitations and transport clearances do not permit anchorages and miscellaneous embedded parts, they shall be fabricated into sub-assemblies. The Bidder shall submit a drawing showing the sub-assemblies into which he proposes to fabricate the trash rack, anchorages, miscellaneous assemblies and embedded parts and hoists for transporting them to site.

Plates with laminations discovered during cutting, welding or at any other time shall be rejected. Minor surface imperfections can be repaired wherever possible with the prior approval of the E.I.C. Materials

not supplied or workmanship not performed in accordance with the approved drawings and / or with the specifications shall be rejected and replaced.

All parts of the trash racks shall be fabricated in accordance with the specifications and approved drawing. The Bidder shall take special care in fabrication of the parts affecting strength, rigidity.

FITS AND TOLERANCE

Fits used for different components shall be according to the best modern shop practice. Due consideration shall be given to the special nature of function of the parts and to the corresponding accuracy required to secure proper operation. The fits shall be in accordance with the Indian Standard IS : 2709.

MACHINE FINISH

The type of finish, unless otherwise specified shall be that most suitable for the part to which it applies and shall be smooth, average or rough as defined under Indian Standard "Assessment of Surface Roughness (With Amendment No. 1 to 3) IS : 3073. A smooth finish (Three Delta, that is 0.20 to 0.8 micrometers) will be required for all surfaces in sliding / rolling contact, an average or commercial finish (Two Delta, that is 1.6 to 6.3 micrometers) for surfaces in contact where a tight joint is required and a rough finish (Single Delta, that is 12.5 to 25 micrometers) for all other machined surfaces which are not in contact, but which require finished for dimensional accuracy.

FABRICATION OF STRUCTURAL STEEL:

The structural steel work for the equipments covered by the specifications shall conform to the requirements of "Reamed work and shall conform to the following requirements unless otherwise called for in these specifications.

STRAIGHTENING

Before being laid off or worked in any manner, structural materials shall be straight without twist, bends or kinks and if straightening is necessary, it shall be done by methods that will not injure or mark the materials. Heating or hammering shall not be permitted. All steel surfaces to be welded shall be cleared of dirt, rust and mill scale prior to fabrication.

SHEARING, CHIPPING AND GAS CUTTING:

Shearing, chipping and gas cutting shall be done carefully by torch or by arc and all portions of the work which shall be exposed to view shall present a neat appearance. Gas cutting shall be mechanically controlled. Re-entrant cuts and copes in beams and channels shall be filled before cutting. Gas cutting by mechanically controlled torch shall be permitted for mild steel only. Gas cutting of high tensile steel

shall also be permissible provided special care is taken to leave sufficient metal to be removed by machining so that all metals that have been hardened by flame are removed.

PLANNING OR FINISHING EDGES:

Planning or finishing of the sheared or cut edges of plates or rolled shapes shall not be required except otherwise specified for welded edges or as shown on the Bidder's drawings, approved by the E.I.C.

WELDED EDGES:

The edges of plates or shapes to be joined by welding shall be properly formed to suit the selected type of welding. Sheared edges of plates and shapes to be joined by welding shall be machined or chipped to sound metal before welding.

5.4 WELDING

PREPARATION FOR WELDING:

Members to be joined by welding shall be cut accurate to size, and where required shall be rolled or pressed to the proper curvature in accordance with the dimensions shown on the Approved / uploaded drawings. The edges of the member to be joined by welding shall be sheared, flame cut or machined to suit the required type of welding and to allow through penetration. The cut surface shall expose sound metal, free from laminations, surface defects caused by shearing or flame cutting operations and other injurious defect. The surfaces of plates to be welded shall be free from rust, grease and other foreign matter for a distance of at least 50mm, back from the edge of the weld. In assembling and during welding the components parts of built up members shall be held in place with sufficient and proper clamps or other adequate means to keep all parts in proper position.

WELDING TECHNIQUE:

All welding shall be performed by electric arc process using coated electrodes or other means whereby the atmosphere is excluded from the molten metal and where applicable, automatic machines with correct precision control shall be used. After being deposited, the weld shall be cleaned of slag or flux and shall show uniform section, smoothness of weld metal, feature edges without overlap and free from porosity and clinkers. Visual inspection at the edges and ends of welding shall indicate good fusion with the base metal. When weld metal is deposited in successive layers, each layer except the last shall be peened moderately with a tool before the next layer is applied. Particular care shall be taken in aligning and separating the edges of members to be joined by but welding, so that complete penetration and fusion at the bottom of the joint shall be ensured. All pin holes, cracks and other defects shall be repaired by chipping or grading the defects to sound metal and re-welding. Where fillet welds are used, the member shall fit closely and shall be held together during welding. The welding

rods used for manual welding shall be of heavily coated type and shall be suitable for all position welding where required. While welding precaution shall be taken to minimize stresses due to expansion and contraction and distortion due to heat by using the proper sequence in welding i.e., by peening the welds while hot or by other satisfactory methods.

Rectification of distortions by blows after welding shall not be permitted. Welds shall not be proper coated until they have been inspected and approved by the E.I.C. The welding shall conform to Indian Standard "Code of practice for use of Metal Arc welding for general construction in mild steel IS : 816. All skin plate welds shall be continuous and water tight and shall develop the full strength of plate. The electrodes shall conform to the "Indian Standard Specifications for covered Electrodes for Metal Arc welding of structural steel for welding products other than sheets and for welding sheets (Part-I and II) IS : 814.

The Bidder shall prepare shop and field welding procedure including stress relieving and preheat requirements and shall submit this procedure to the E.I.C. for approval. The procedure shall be in accordance with the best modern welding practice and shall be such as to minimize residual stresses and distortion of the finished members of the structure. Approval of any procedure, however, shall not relieve the Bidder of the sole responsibility for producing a finished product meeting all requirements of these specifications.

APPROVAL TEST OF WELDING PROCESS:

Specification of the welding procedure that are proposed to be used shall be established and recorded and a copy of such procedure, specifications together with certified copies of reports of results of tests made in accordance with the procedure specifications shall be furnished by the bidder. The procedure specifications shall conform to the Indian Standard "Approval Tests for welding procedure Part-I Fusion Welding of Steel IS : 7307 (Part-II).

QUALIFICATION OF WELDERS:

All welders assigned to the work shall have passed qualification test for welders. If at any time, work of the welder appears to be questionable, such welder shall be required to pass additional qualification test conforming to Indian Standard "Code of Practice for Training and Testing of metal Arc welders " IS : 817 and Indian Standard "Approval test for welding procedure part-I Fusion welding of steel IS : 7307 (Part-I).

5.5 CLEANING, SURFACE PREPARATION AND PAINTING:

GENERAL

The Bidder shall furnish, prepare and supply all materials for cleaning surface preparation and painting of metal work as hereinafter specified. The cost of furnishing, preparing and supplying all materials which are required for cleaning, surface preparation, painting and coating operations including supply of all labour, tools and equipments shall be included in the agreement rates.

PAINT MATERIALS, PAINTING AND HOT DIP GALVANIZING:

TRASHRACKS:

All the surfaces (except non-ferrous surfaces and machined mating ferrous surface) after properly cleaning as per relevant IS standard, applied with 1 (One) coat of Epoxy Base Primer followed by 2 (Two) coats of COAL TAR EPOXY. The Epoxy Base Primer and coal tar epoxy paint shall generally conform to the particular given in the relevant IS Codes or as directed by the E.I.C. The first coat of the Epoxy Base Primer shall be applied within 4 hours of cleaning. The dry filling thickness (DFT) of each coat of zinc rich primer shall be at least 50 microns. The dry filling thickness (DFT) of each coat of coal tar epoxy paint shall be at least 100 microns.

EMBEDDED PARTS:

The surfaces (except non-ferrous surface and machined mating ferrous surfaces) of all the embedded parts after cleaning as per the relevant IS codes foregoing para shall be coated as under:

- i) All the exterior ferrous surfaces of the embedded parts which are to come in contact with concrete shall be given 2 (Two) coats of cement wash mixed with 5% potassium dichromat. The first coat shall be applied immediately after cleaning and second immediately before pouring concrete.
- ii) The ferrous, unfinished surfaces of the embedded parts (except stainless steel) which will be exposed to water or atmosphere shall be painted with the same paint materials (viz. Epoxy Base Primer and Coaltar epoxy paint) and coated in same manner as specified for the trash rack.

6.0 EOT CRANE:

Double Girder 15 MT capacity semi EOT Crane for lifting lowering of VT pump set:

6.1 SCOPE OF WORK:

- i) **1 No.** : Design, manufacture, supply and installation of 15 M.T. capacity x 7 meters span approx. x 7.5 mtrs. lift double girder construction pendant controlled EOT overhead travelling crane having all motions electrical and to be operated by pendant push button unit from floor.
- ii) **16.5 x2 =33 mtr(approx)** : Design, manufacture and supply of steel gantry girder with square rail suitable for the above crane for a travel length of 16.5 mtr approx and to be designed for column pitch distance of 3 mtr approx. Steel gantry girder shall be supported on column brackets to be provided with suitable base plate and side insert plates during casting. The total length of steel gantry girder shall be 16.5 x2 =33 mtrs(approx). Suitable tie and joint plates shall also be provided as per design requirement.
- iii) Design, manufacture and supply of Down shop lead arrangement for feeding power to the crane along the longitudinal travel comprising of 4 line PVC shrouded type GI conductor with supporting brackets and a set of current collector. The length of DSL shall be 16 mtrs.

6.2 Code and Standards

The crane shall be designed, manufactured, erected and tested in accordance with the following or their latest version of IS Codes.

- i) IS 3177 -1999 – Indian Standard Code of Practice for Electric Overhead Crane.
- ii) IS 807-2006 - Indian Standard Code of Practice for design, manufacture, erection, and testing (Structural portion) of Cranes and Hoist.
- iii) IS 2266 – Specification for steel wire ropes for General Engineering purposes.
- iv) IS 325- Specification For three phase induction motor.
- v) IS 5749 – Specification for forged hooks
- vi) IS 800-2007 – Design of Steel structure

EOT crane data:

Type	: Electrically operated overhead travelling crane
Construction	: Double girder
Capacity	: 15000 kg

Crane span	: 7000 mm approx
Height of lift(total lift)	: 7500 mm
Number of rope falls	: 8 fall, 14 mm dia or as per design
Hoist speed	: 2-2.5 M/Min, 10 HP crane dutys/cage motor or as per design
C.T. speed	: 8-12 M/Min, 1.0 HP crane duty geared break motor or as per design
L.T. speed	: 12-15 M/Min, 2x1.0 HP crane duty geared break motor or as per design
Brakes	: Main hoist shall be provided with 1 No. electro hydraulic thruster brake and CT and LT motion shall be provided with electro magnetic disc brake.
Limit switches	: All motions shall be provided with suitable limit switches. An additional gravity type limit switch shall be provided in hoist motion.
Protective device	: Electrical control components shall have protective devices like air break contactors, MCB and step down transformer.
Power supply	: 415 V +/- 10% 3 phase 50 cycles AC
Control voltage	: 110 V AC.
Class & duty	: The EOT crane shall be suitable for M5 (class II) duty indoor operation conforming to IS:807 & IS:3177 as and where applicable.
Bay length	: 16.5 meters approx
Method of control	: The crane shall be controlled from floor by 8 way pendant push button switch hanging directly from the crane control panel having an operating voltage of 110 V AC.
Buffers	: Hard rubber buffers shall be provided in both CT and LT motion of crane.
Distance from centre of end column to centre of end pump on longitudinal side at both ends.	: 2200 mm (minimum)
Hook approach	: 1250 mm on either sides from rail centre.
Painting	: The crane structure and supporting gantry structure shall be supplied duly painted with one coat of red lead primer and two coats of synthetic golden yellow enamel paint.

6.3 Load Testing:

The crane shall be designed with 25% overload capacity as per IS 807. The load and overload test of the crane shall be carried out at manufacturers works in the presence of EIC or his representative before dispatch. The test and guarantee certificate of the crane shall be submitted along with the supply.

6.4 Rigid Control Safety

- (a) The crane should be rigid, robust, and sturdy construction.
- (b) Crane controls should be conveniently located. The various controls should be suitably interlocked to prevent accidental movement of the crane.
- (c) Suitable limit switches, one each for cross travel and two each for main and auxiliary hoists, should be provided to stop the crane and prevent over travel of various moving parts of the crane.
- (d) Electrical interlocks should be so provided that two operations of traversing and traveling can be performed simultaneously, but while hoisting it is not possible to undertake the traversing or traveling.
- (e) Suitable buffer should be provided to prevent over travel of the crane mechanism in both longitudinal and cross traverse directions.
- (f) Suitable guards or enclosure should be provided on the crane to prevent inadvertent contact with down shop lead, or any other exposed electric conductors and cables.
- (g) Sheaves shall be provided with rigid guards to retain the wire ropes in the grooves. The guard shall fit close to the flange having a clearance not more than one-fourth of the diameter of the wire between the sheave and the inside of the guard. Bottom block sheaves shall be enclosed except for wire rope openings.
- (h) The fully commissioned crane should be rigid and robust to withstand the pump house environment with an ambient temperature ranging up to 50 °C and relative humidity 100 %.

6.5 Maintainability

- (a) All electrical cables should be so laid that they are not liable to damage and can be easily inspected and maintained. The cable should be weather proof.
- (b) All components of cranes of identical capacity and duty shall be interchangeable unless otherwise required.
- (c) Materials used for equipments and structures should be free from cracks, blowholes, laminations, pitting etc.. Except of areas where a superior grade of material is required. Steel Grade 'B' quality shall be used throughout to IS

2062(latest) . The supplier should submit material test certificates for structural steel and mechanical component such as couplings, gears, gearboxes, rope drum, brake drum , shaft, wheels etc.

- (d) A tool box containing all tools required for the maintenance of the crane.
- (e) Fasteners of pedestal blocks, gear boxes, etc. should be easily removable from the top of the platform.
- (f) Standardization and unification shall be carried out to the maximum extent for the various sub assemblies constituting the mechanism of various cranes. Unit shall be designed such that they can be dismantled quickly without disturbing of the installation of the neighboring unit with which they are connected. Units as a whole as a whole, such a wheel assembly gear box, brake, rope drum assembly etc. Shall be replaceable and interchangeable with other identical units.

6.6 Structural Details

- (a) All welded subassemblies of box girder should be stress relieved before final welding of the box girder.
- (b) Position of Weld joints in top plate, side plate and bottom plate of the box girder assembly should specified with respect to the maximum deflection plane (i.e. the plane passing through the centre point of the box Girder.)
- © In the main bridge girder, in addition to the required full length diaphragms, short diaphragms should be inserted wherever require to transmit the trolley wheel load to web plate and to limit the maximum stress in the trolley rail to safe permissible limits. All diaphragms must bear against the top flange. Steel plate used for bridge girder and diaphragms should be as per IS 2062 (latest).
- (d) All fasteners should be hot dip galvanized. All load bearing fasteners should be of high tensile grade. It should be of reputed Make. Manufacture should submit a test report for mechanical testing for the same.
- (e) The Bridge Girder should be connected to the end carriage by large gusset plates. Ground tight fit bolts in reamed holes should be used for bolted connections.
- (f) All Butt welds on structural members of bridge girders subjected to tension should be radio graphically tested. All other welds should be subjected to Magna Flux or dye penetration test.

6.7 Tolerance

The entrusted agency shall ensure that the crane shall be manufactured as per the tolerance specified below:

01	Span over LT Wheel	± 6 mm up to 40 meter
02	Wheel Base	
	LT	± 5 mm
	CT	± 3 mm
03	Difference in diagonal	
	LT	± 5 mm
	CT	± 3 mm
04	Long Travel wheel alignment	± 1 mm
05	Tilt of wheels or balancer axle	± 1 mm/1000 (Horizontal/vertical)
06	Trolley wheel gauge	± 3 mm up to 7500 span ± 5 mm above 7500 mm span
07	Difference in height between trolley rails (H) in relation to the trolley track gauge(S) shall be within the following tolerances :	
	'S" (mm)	"L' (mm)
	Up to 2500	4
	Above 2500 and up to 4500	6
	Above 4500	10
08	Horizontal bend of girder in plan	Span/2000
09	Shift of web plate of main & ens girders from vertical over height 'H' measured near the mid span and close to the main diaphragm	H/200
10	Twist of main Girder	Span/1500
11	Axis of flame Plates from the axis of the beam	H/250
12	Over Buffer length	± 5 mm
	(over buffer dimension on two sides shall be same)	
13	Height of centre of Buffer	± 5 mm

	(From top of track rail)	
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6.8 Testing after erection

- (a) Insulation test and other test mentioned in IS 3177-1999 shall be carried out.
- (b) Deflection test: The deflection test of bridge girder shall be carried out as IS 3177-1999. After the deflection test with safe working load, the crane shall be tested for deflection with 25 % overload and there shall not be any permanent set after the removable of the load.

6.9 Speed Test:

All motion of the crane shall be tested with rated load on all the notches at the time of commissioning of the crane at side and the speeds shall be attained within the tolerance limit.

All motion of the crane shall be tested with 25 % over load in which case the specified speed need not be attained but the crane shall follow itself capable of dealing with the over load without difficulty.

6.10 Brake Test:

The hoist brake shall be capable of breaking the movement with rated as well as overload. However, the breaking path with rated load shall not exceed hoisting speed/120 for class 2 duty cranes.

The long travel and cross travel brakes shall be capable of arresting the motion with in a distance in meters equal to 10 % of speed in meters/min.

The crane shall be completely assembled and tested in the supplier's work for full load and 25 % overload on hoisting and cross traverse motion , in presence of E.I.C. representative in addition to other tests as specified in IS 3177-1999.

6.11 Mechanical Details:

Rope Drum

The rope drum shall be designed to with stand the compressive stresses caused by the rope wound on it and the bending stress due to beam action of the drum.

The drum shall be rolled or centrifugally cast steel as per IS 2328 flanged end, if required not less than 2.5 mm in thickness and not less than 65 mm , beyond the pitch diameter of the drum. Crane shall be designed with nos. of rope having 4 falls.

Rope Sheave

All the sheaves should be of cast/ forged steel. They should be identical, with the exception of the equalize sheaves. The equalizer sheaves should be mounted above the trolley floor and should be easily accessible and removable from the trolley floor level. The equalizer sheaves should be arranged to turn and swivel in order to maintain rope alignment under all circumstances. Sheave groove should be smooth finished for getting increased rope life. The supplier should further ensure that wire ropes are parallel with each other.

Wire Ropes

Hoisting ropes, if of the conventional type, type should be 6 x37 up to 16 mm diameter and 6 x 36 above 16 mm diameter construction and made out of the best plough steel having tensile strength of 180 kg/ sq.mm. Rope should be parallel right hand lay as per IS 2266-1976(latest) . The wire rope shall comply with **clause 8.3 of IS 3177-1999.**

Hook Block

The sheaves shall be full encased in closed fitting guards fabricated out of steel plates . Smooth opening shall be provided in the guards to allow the free movement of rope , and hole shall be provided for drainage of the oil.

(i) Gearing

The gearing for all motion should be of suitable case carburizing low carbon alloy steel and should conform to relevant Indian standards. They shall generally be in accordance with IS 4460-1967(or latest) . All gears and pinions must be made from forged blank only. All gear should be hardened and profile ground for longer life and silent operation. The minimum surface hardness of pinion shall be between 266 to 300 BHN and that for gears shall be between 217 to 255 BHN . The difference in hardness of pinion and Gear must not be less than 20 BHN.

Worm wheels and bevel gears must not be used .At all stages helical Gears should be used except in planetary gear boxes, which can be spur type. Overhung or split gears and pinion should not be used.

(ii) Gear box

All gear boxes shall be of completely enclosed splash lubricated type. All gear boxes shall be of oil tight and sealed with compound or gasket. All gear shaft shall be supported in anti friction bearing mounted in the gear boxes. Gear box shall be cast , wrought and from low/ medium carbon alloy steel and suitably heat treated. The fabricated gear box shall be stress relieved before machining and the method of doing so shall be explained in details in the offer. The internal surface of the gear box shall be painted with oil resistant paint. Gear Box shall be provided with breather vent, easily accessible drain plug, and a suitable oil level indicator, such as dip stick. Adequate radial clearance between the gear box inner surfaces and outside diameter of the gear shall be ensured and the clearance proposed to be provided shall be indicated in the offer. The facial clearance between the inner surface of the gear box and the face of the nearest gear/ pinion shall be at least 10 mm.

(iii) Connection Between Rope Drum and Gear Box

One of the following arrangements shall be adopted for connecting the rope drum with the Gear Box. Flexible joint, incorporating flexible geared coupling housed within the drum. Fully flexible geared coupling between the drum and gear box.

(iv) Track Wheel

All Track wheel shall be double flanged. The Blank shall be made by roll forming, forging and casting from grades of steel appropriate to the forming process. Wheel shall be mounted in a anti friction roller bearing housed in ' L' shaped bearing bracket for easy removable during maintenance.

Wheels from 400 mm diameter and above may consist of hardened, rolled / forged steel tyre of not less than 60 mm thickness .

The wheel should be shrinking fit on the axles, rather than being keyed on.

(v) Coupling

Motor shaft shall be connected to the Gear box input shaft through flexible shock absorbing coupling. Rotating parts shall be suitably covered by 3.15 mm thickness thick sheet steel hinged cover for safety. In case of single motor centre drive for long travel motion , Output shaft of the Gear box shall be connected to the line shaft through half geared coupling .Half geared coupling with floating shaft shall be provided between the wheel and the wheel and the line shaft .

(vi) Bearing

Anti friction bearings shall be used throughout except where required otherwise for technical reasons.

(vii) Buffers

Spring loaded buffer shall be provided in all the four corners of the bridge girder and the end carriages for cross and long travel motion respectively.

(viii) Brakes

For LT & CT motion, the maximum braking torque to arrest long travel and cross traverse motion should not be less than 125 % of full load torque for each brake . The LT & CT motion brakes should provided with Electro Mechanical (EM) fail DC disc type- 01 nos.(for each)

For hoist motion, two brake should be used and the braking torque for each brake should not be less than 125 % of full load torque . One of the two hoist brake shall be applied with a time lag of 3 sec in relation to the first. The hoisting motion should be provided with Electro Hydraulic Thruster(EHT) Brake- 01 nos. and Electro Mechanical (EM) fail safe D.C. Disc Brake – 01 nos.

Brake release should be depended on motor torque. The brake should be released only if 100 % torque is developed in the motor.

(ix) Lubrication

Grouped grease lubrication system shall be used for class M3,M5 and M7 duty cranes. Lubrication of the Gears and Pinions in the Gear Boxes shall be splash fed from the sump. In case of three reductions, vertically mounted Gear box (having limited motion) an oil pump shall be fitted to ensure lubrication of all gears.

(x) Lifting Blocks

Standard plain shank type trapezoidal action hooks should be used. The hook shall be solid , forged, heat treated , of rugged construction and provided with a standard depress type safety latch . Lifting shall have swivels and operate on thrust bearing with hardened race. Lock to prevent hook from swiveling shall be provided .These hook shall be conformed to the relevant Indian standard Specification IS: 3815 (latest). Certificate of test and examination to be submitted by the bidder. Certificate should indicate Sl. No. and date of testing.

7.0 Electrically operated monorail crane (2nos) with supporting MS structure for trashrack/screen lifting lowering.

SCOPE OF WORK:

- i) **1 Set:** Design, manufacture and supply of **5 M.T. capacity straight monorail (2 Nos.)** placed at a distance of 900 mm approx. suitable for travel length of 14 mtrs. Both the monorails shall be supported on 6 nos. independent goal post structure. Both hoist and longitudinal travel shall be electrical and to be operated by **2 Nos. 5 M.T. capacity electrical chain hoist with motorised trolley**. 1 No. hoist shall run on each monorail. The height of lift shall be 7 mtrs. For both the hoist. **The top of goal post structure shall be covered by suitable sheet metal to protect the hoist from direct sun and rain. Besides, we shall also provide side sheeting and gable end sheeting upto 8 ft. from top of goal post structure.**
- ii) **2 Sets (each set 14 mtrs. long) :** Design, manufacture and supply of 2 sets of Down shop lead arrangement i.e. power feeding arrangement to the hoist along the longitudinal travel comprising of 4 line PVC shrouded type GI conductor with supporting brackets and a set of current collector for each hoist. One set of DSL with current collector shall be required for each hoist. 2 Nos. isolating switch of suitable rating shall also be provided at two ends for connecting the DSL cable.

HOIST DATA FOR MONORAIL STRUCTURE :

Type	: Straight monorails supported on 6 Nos. independent goal post structure.
Number of monorail	: 2
Number of hoist blocks	: 2 (1 No. for each monorail)
Capacity of monorail	: 5000 kgs. each.
Length of monorail	: 14000 mm each.
Height of lift	: 7000 mm approx.
Distance between two nos. monorails	: 900 mm approx.
Width of goal post structure i.e. centre of goal post columns	: 3000 mm approx.
Height of goal post structure	: 9.0 mtrs. approx.
Number of chain falls and chain dia	: 2, 10 mm dia
Operating speeds with motor ratings :	
Hoist motion	: 4 M/Min, 4.5 KW motor or as per design.
Longitudinal speed	: 17 M/Min, 0.37 KW motor or as per design.

Power supply	: 415 V +/- 10% 3 phase 50 cycles AC.
Headroom of chain hoist	: 1000 mm approx.
Method of control	: Both the hoist shall be controlled from floor by separate 4 way independent push button switch having an operating voltage of 24 V AC.
Power feeding arrangement	: Both the hoist shall be provided with power supply by means of 4 line PVC shrouded type GI conductor with supporting brackets and a set of current collector for each hoist.
Top cover	: The top of monorail structure shall be covered with suitable sheet metal to protect the hoist from direct sun and rain and also provide side sheeting and gable end sheeting upto 8 ft. from top of goal post structur
Motor	: As per design
Brake	: Fail safe brakes shall be provided for both hoist and CT motion
Limit switches	: Suitable limit switches shall be provided for both hoist and CT motion
Protective device	: The hoist shall be provided with protective devices like air break contactor, overload relays, HRC fuses and step down transformer.
Class & duty	: The monorail structure with electric hoist shall be designed for M-5 (class – II) duty indoor operation conforming to IS: 807 and IS: 6547 as and where applicable.
Painting	: The monorail structure and goal post structure shall be supplied duly painted with one coat of red lead primer and two coats of synthetic golden yellow enamel paint.

TESTING :The monorail structure shall be fitted at site and load testing shall be done after installation. Test and guarantee certificate of the hoist block shall be provided by you.

8.0 BORE WELL

8.1 Codes and Standards

SI No	Standard	Title
01	IS:1239(Pt.I)-1979	1979 Specification for mild steel tubes, tubular and other wrought steel fittings part I Mild Steels tubes (with amendments NO. 1 to5) (fourth revision). (Reaffirmed1985)
02	IS:2800(Pt.I)-1979	Tube well Construction (first revision) (Reaffirmed 1985)
03	IS:2800 (Pt.II)-1979	Tube well testing (first revision) (Reaffirmed 1990)
04	IS:4097-1988	Gravel for use as pack in tube wells (Reaffirmed 1993)
05	IS:4270-1983	Steel tubes used for water wells (first revision)
06	IS:4412-1981	Copper wires for general engineering purpose (Reaffirmed 1991)
07	IS:5120-1977	Technical requirements for rotodynamic special purpose pumps. (Reaffirmed1991)
08	IS:5494-1969	Leaded brass sheets and strips for use in the manufacture of tube well strainers
09	IS:8110-1985	Well screens and slotted pipes (first revision) Reaffirmed 1990)
10	IS:9439-1980	Glossary of terms used in water well drilling technology (Reaffirmed 1991)

8.2 Design Features

8.2.1 Length of Slotted Pipe - The length of slotted pipe shall be governed by the thickness of aquifer and shall be sufficient to obtain the designed specified yield from tube well. However, the minimum total length shall be such that the entrance velocity is less than the permissible entrance velocity of 0.03 m/s to ensure longer life of the well. The lengths of individual pipes shall be such as to afford easy handling for transport and lowering into wells, and removal in the case of recovery, etc~ The lengths shall be such that there is minimum wastage in using combinations of various lengths inside the wells, and to ensure that the combinations from the nearest requirement to obtain the estimated specific yield of, the well. They may be in random lengths specified by the Engineer-in-Charge.

8.2.1 Diameter of the slotted pipe: -The criteria for determining the diameter of the slotted pipe shall depend on the designed yield of the tube well. It shall be ensured that the area of opening available in the slot for flow of water, after giving allowance for possible coverage of gravel, clogging, incrusation etc. shall produce a slot ~trance velocity of not more than 0.03 metre/second. The diameter of slotted pipe shall be so selected that the percentage of slot area to screen surface area is generally between 15 to 22 percent or as decided by the Engineer-in-Charge.

8.2.2 Slot Size - The shape and size of the slot shall be such that the gravel or aquifer material is not allowed to block the open space. Based on the sieve analysis of the aquifer material the size of the slot opening shall be determined in such a way those finer fractions of the formations are removed during the development stage of the well- and the coarser fractions remain outside the slots. The slots shall not be too wide to cause entry of the gravel and result in plugging. Sharp edges on the periphery of the pipe may offer resistance to flow and hence it is preferable to have smooth round edges.

8.2.3 Taper Reducer- taper reducer, made of mild steel, is intended to connect the housing pipe with assembly pipe. It also helps in reducing bridging in the gravel pack

8.2.4 Housing Pipe - It shall conform to IS:1239 (Pt.I)-1985 for diameter up to 150 mm and to IS:4270-1983 for diameter above 150 mm. The pipes shall be of heavy duty and be provided at least 0.6 m above the ground level. The inside dia. of the pipe shall be 25mm and 50 mm more than the bowl dia of the pump with capacity up to 1300 litres / minute and upto 2200 litres/minute respectively. It is necessary for housing the pump or its suction pipe. Its length depends 'On the lowest static water level taking in to account the seasonal fluctuation factors.

It furnishes a direct connection between the surface and the aquifer; when permanent surface is not used it seals out undesirable surface or shallow groundwater and the side of the hole. In areas of thick unstable materials, housing pipe casing may have to be supported at the ground surface which can be done by welding I beams to the casing .

8.2.5 Clamp- It is fixed at the top of the tube well for supporting the well assembly. It is made of mild steel.

8.2.6 Well Cap- Made of mild steel, it is used to keep the tube well closed after its completion until the pump set is installed. It is either threaded to be screwed to top of the housing or simply a plate is spot welded so as to be easily removed when required.

8.2.7 Pump set and accessories - Either vertical turbine or submersible pump comprising of the following shall be used. The selection of pump shall depend upon the pumping head and discharge.

- (i) Pump
- (ii) Motor
- (iii) Column pipe/ Delivery pipe with bend
- (iv) Air line
- (v) Sluice and Reflux valve where necessary
- (vi) Water level guard with signal cable and electrode.
- (vii) Pressure gauge.
- (viii) Water level indicator

(ix) Starter Panel

8.2.8 Column Pipe - It is G.I/PVC pipe directly connected with pump motor assembly. It acts as delivery pipe, provided with a 90° bend and a sluice valve for controlling discharges. Minimum length of column pipe is governed by SWL+ fluctuations +draw down+0.6 m and it shall have 0.9 m horizontal length. Dia. of the column pipe shall be decided by the size and capacity of the pump.

8.2.9 Valves - Gun metal sluice valve of delivery pipe size shall be used where necessary.

8.2.10 Pressure Gauge- It shall be of 100 mm size

8.2.11 Gravel- It shall conform to IS:4097-1993 or as found in the rivers of West Bengal, but shall be 3 mm to 8 mm of suitable geological formation with lime kanker in permissible limits .

8.3 Site Selection and Exploration

8.3.1 Geo physical Survey- Geophysical surveys and surface geologic investigations and exploratory drilling if necessary may permit a rapid and relatively low cost evaluation of the sub surface geology and possibly the general ground water conditions of an area. Four basic methods of geophysical surveying are available; seismic, electric resistivity, gravimetric and magnetic. Many variations of these four basic methods have been developed and prior to considering a survey, a qualified geophysicist shall be consulted about the type of survey best adopted to obtaining the data desired.

8.4 Well Logging

8.4.1 Sample of drill cutting from different strata shall be collected at suitable intervals, preferably at every 2 m depth drilled or at closer intervals, if a change in the strata is met with.

8.4.2 After the drilling, has reached sufficient depth all the samples of strata collected shall be carefully examined and analyzed.

8.4.3 The samples shall be dried and stored properly, which shall be preserved carefully by the Engineer -in-Charge of the tube well.

8.4.4 **Drilling Time Log** -It is recommended that as the drilling progresses an accurate drilling time log be kept indicating the time taken to drill every two meters depth or where there is change of strata this log will enable interpretation regarding the nature of the formations (hard, soft, unconsolidated etc.) which has a bearing on the water yielding capacity of the formation.

8.5 Design and Lowering pipe assembly

The length and diameter of the housing pipe is selected on the basis of static water level, the draw do the discharge expected from the well and the size of pump to be installed. The size and length of blind pipes and slotted/strainer pipes are selected according to the actual

requirement, according to the strata met with, the expected discharge and the depth of tube well.

- 8.5.1 **Gravel Packing-** All gravel shall consist of hard well rounded particles reasonably uniform in diameter and shall be of a size, determined after analyzing the character of the water bearing formation tapped. The thickness of the gravel around the screen shall generally not be less than 7.5cm

8.6 Development of Well

- 8.6.1 Generally all type of well shall be developed either by surging and agitating or b) over pumping and backwashing with an an-lift and high velocity jetting, etc. Any other acceptable method may also be adopted. However in alluvial area this development process shall be continued until the stabilization of sand and gravel pack has taken place and sand pumping in limits specified below.
- 8.6.2 The development of the tube well by over pumping shall be done at 15 percent to 25percent higher discharge than the expected discharge from tube well. The final discharge shall be free from sand with a maximum tolerance of 20 parts of sand in one million parts of water by volume after 20 minutes of starting the pump.

8.7 Measurement of Water Level

- 8.7.1 *Direct Measurement* - This is carried out by a steel tape or cable with a suitable sinker attached at the end. The steel tape or cable is wound round a rotating drum Measurement shall be done by measuring the length of tape or cable. Depth of immersion of sinker shall be taken into account in the measurement. A set of three readings shall be taken and effective will be their average. Any measurement which deviates from the average by more than + 0.3 percent shall be discarded and new measurement to be taken in place. Accuracy of measurement shall be decided by the Engineer -in -Charge.
- 8.7.2 **Electric Measurement (Double Pole Contact)-** Double Pole Contact (See plate 41-P/14), a sufficiently rated battery, a reel with a length of twin electric cable and an electrical indicating instrument as a high resistance voltmeter or a millimeter are required. The items shall be adjusted as shown in the, plate. One end of the enable shall be permanently connected to voltmeter/ammeter and the other end to be _connected through battery. As the cable is lowered into the tube well the circuit is completed. as soon as the two electrodes strike the water and the instrument indicates. The depth of water level is obtained by measuring the twin cable from the electrodes to the top of tube well.

8.8 Testing for Yield and Draw Down

- 8.8.1** After the well has been completely constructed and cleaned out and the depth of the well accurately measured, this test shall be conducted by installing a test pump in the tube well temporarily and pumping out water. At each rate of discharge, pumping is carried out at least for 30 minutes. The specific capacities of the well for various pumping rates is computed based on drawdown test data. Discharge may be measured by any method detailed in 13.7 of IS:5120-1991 or as specified in the technical circulars of the tube well department.
- 8.8.2** Since the yield is influenced by a number of factors such as geological formation, rainfall, neighboring tube wells, etc, the pumping rate shall, in general not exceed 60 percent of the yield by test. It is recommended however, that geological advice should be obtained on the percentage to be adopted for each location. Minimum yield have been specified at respectively for alluvium and rocky areas. The tube wells which do not give the minimum yield shall have to be declared by the Engineer in-Charge as unsuccessful wells. In such cases, the well assembly should be pulled out immediately. All assembly pulled out shall be immediately measured by the Engineer-in-Charge or his representative in the presence of the representative of the drilling agency, if necessary and the assembly so pulled out after the approval of Engineer-in-Charge may further be used. Statement of recovery and loss be maintained and should be submitted by the site in charge.
- 8.8.3** A well shall be declared by the Engineer - in - Charge as an abandoned well in case of non-verticality caving in or any other defects attributable to the poor workmanship and also in case of unsuitability of equipment. In such cases, the well assembly if lowered, (at whatever stage it may be) shall have to be pulled out immediately.
- 8.8.4** Back Filling of Abandoned or Unsuccessful Wells Back filling with natural material- of the formations encountered' shall be suitably carried out by the drill rig agency for all abandoned and unsuccessful wells after extracting the well assembly in the manner described . This back filling shall also be duly rammed at ground level with allowance for settlement. This whole operation shall be carried out by the drilling agency his own cost without any claim on this account and in a manner so as not to cause injury or accidents to any people or cattle etc.

9.0 SPECIFICATIONS FOR AC INDUCTION ELECTRIC MOTORS

9.1 Scope

The scope of this Section covers design, manufacture, supply, installation, testing and commissioning of A.C induction electric motors for all electrically driven pumps and other equipment.

9.2 Ambient Conditions

The motors shall be suitable for continuous operation at rated load for maximum ambient temperature of 50°C and maximum relative humidity of 100%, the maximum temperature and humidity not occurring simultaneously.

9.3 Codes and Standards

The design, manufacture and performance of the AC Induction Motor specified herein shall comply with the requirements of the applicable codes and standards, including but not limited to the following:

SI No	Standard	Title
01	IS: 325	Three phase induction Motor
	IS : 2223	Dimensions of Flange Mounted Induction Motors
	IS:1231	Dimension of Foot mounted induction Motor
	IS: 4691	Degrees of Protections
	IS: 2540	Dimensions of threaded centre hole
	IS/IEC600 34-1	Rotating Electrical Machine
	IS/IEC600 72-1	Dimensions and Output Series for Rotating Electrical Machines

Where the above standards are in conflict with the stipulation of tender specifications, tender specification supersedes them.

9.4 Electrical System

Voltage	415 V (earthed)
Motors	415 Volts A.C Squirrel cage
Short Circuit Level	35 MVA Symmetrical at 415 volts
L T Voltage	415 volts, 3 phase, 4 wire.
Frequency	50 Hz ± 3%
System Neutral	Directly earthed.

9.5 Operational Requirement

9.5.1 The vertical solid shaft squirrel cage type induction motors shall be suitable on voltage specified in clause 2.4 , 3-phase 50 Hz, AC supply and suitable for direct coupling with pumps stated under the detailed specification here before. The motors shall have power factor of 0.95 at duty point with capacitors.

9.5.2 The motors shall be capable to meet the power requirement of the pump in the complete range of its operation without being overloaded at any point and keeping a margin of at least 5% over entire operating range. **The tenders shall verify the KW requirement and provide motors of suitable capacity but not less than those specified in B.O.Q.** However all motors shall have the same capacity and shall be similar in all respects.

The value of motors HP shown above is tentative. The motors should be capable to meet the requirement of pump under various conditions of operations as described in B.O.Q and technical specification of VT pumps.

9.5.3 Motors shall be capable of delivering rated output with

(a) Terminal voltage differing from its rated value by +/- 6% or

(b) The frequency differing from its rated value by not more than +/-3% percent or

(c) Any combination of (a) and b) for continuous duty operation.

The contractor shall note that the motor is backed up directly by circuit breaker the design of motor should therefore be such as to withstand the starting current inrush and this starting current should not exceed maximum six times of full load current. The motors shall also be suitable for frequent start/stop operations as per the system requirements.

9.5.4 Motors when started with the drive imposing its full starting torque, under the specified supply voltage shall be capable of withstanding at least two successive starts from cold condition and one start from hot condition, without damage to the winding.

The motors shall have good starting torque and withstand high starting current and it shall also have high pull - out torque and with good overload capacity (210%)

The motor shall be capable of taking overload as per IS325 & relevant ISS.

9.5.5 Motors subject to reverse rotation shall be designed to withstand the stresses encountered when starting the non-energized shaft rotating at 125% rated speed in reverse direction.

Provision for LT Capacitor Banks across motor terminals should be provided as per specification.

9.6 Construction

- 9.6.1 Motor frames shall be rigid fabricated steel. They shall be suitably annealed to eliminate any residual stresses introduced during the process of fabrication and machining.
- 9.6.2 The dimension shall be in according with IS 325 or relevant IS code and the enclosure shall be TEFC type and conforming to IS 2148 and IS 1691 so that drops of liquid or solid particles falling on or reaching any part of the machine at any angle between the vertically downward direction and 100 from that direction cannot enter the machine when the machine is running or at rest by splashing otherwise either directory or by striking and running along the surface. The degree of protection for TEFC enclosure shall be as per IS 4691. Inspection window shall be kept for inspection and cleaning winding overhang bearing grease, space heater. They shall be blanked by air tight blanking plates fitted with bolts. Four plugged holes shall be provided at equal distance along peripheries top for inspection of air gap.
- 9.6.3 Stator lamination shall be made from suitable grade sheet steel varnished on either side and they shall be adequately designed to avoid overheating during starting and running conditions stipulated above. Rotor short circuiting end rings shall be such that it is free to move with expansion of the bars without distortion. Brazing shall make the connections of the bars to the end rings.
- 9.6.4 The rotors shall be of electrolytic grade copper bars / aluminium die cast and short circuiting end rings (for squirrel cage motors) and with insulated copper strip/wires (for wound rotor motors) unless specified otherwise. All stator and rotor cores shall be made of CRGO silicon steel laminations and the stator cores are properly secured with the enclosure with primary bolts. The rotor cores are properly fastened with the rotor shaft and fitted with motor main enclosure on double end roller/ball bearings for free rotational movement of the shaft. The motor shall be properly aligned, statically and dynamically balanced and properly lubricated. There shall be proper provision of lubrication of bearings of both ends of the motor externally. Embedded bearing temperature detectors with alarm and trip contacts (4NO+4NC) shall be provided for DE&NDE bearings.
- 9.6.5 Suitable insulation shall be provided on the shaft/ bearing housing to prevent short current. The insulation provided shall be such that it shall retain its dielectric properties even after its handling for number of times during dismantling and reassemble. Bearing assembly shall be

such that it prevents dust and water from getting into the bearing. Further, the bearing lubricant shall not find access to the motor windings.

- 9.6.6 Motor shall be provided with anti-friction bearing, unless sleeve bearings are required by the motor application. Vertical shaft motors shall be provided with thrust and guide bearings. Bearing shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, contaminated water etc into the bearing area. Sleeve bearings shall be split type, ring oiled, with permanently aligned, closed running shaft sleeves.
- 9.6.6 The bearing shall operate continuously at any speed corresponding to the pump operation range without injury. It shall operate safely at over speed at which the motor is designed for the duration which is not less than twice the over speed duration of the motor.
- 9.6.7 Separate terminal boxes shall be provided for main terminals of the motor and for Resistance Temperature Detectors (R.T.D.) and for space heaters. The terminal box for the main terminals of the motor shall be of segregated type suitable for 3 core, designed XLPE AL cable.
- 9.6.8 The frame of each motor shall be provided with two separate and distinct earthing terminals complete with tapped hole, GI bolts and washers for external earthing.
- 9.6.8 Motors shall have Space heaters suitable for 240 V. single phase 50 Hz. AC, supply. Space heaters shall have adequate capacity to maintain motor internal temperature above dew point to prevent moisture condensation on insulation during shut down period.
- 9.6.9 Motors shall be preferably of low Height to Width Ratio to have greatest stability and low vibration limits. Motor stools of suitable size shall be supplied free of cost with motor. Motors overall size should be such that it could be easily accommodated in the Pump House, being constructed as per Tender Drawings, with sufficient space for ease of operation.
- 9.6.10 Emergency stop switches near the motors should be provided for switching off the motors in case of emergency.
- 9.6.11 Motor shall be provided with eye bolt or other adequate provision of lifting in accordance with the relevant IS/IEC.
- 9.6.12 Motor including fan shall be supplied duly painted with heat resistant paint of appropriate shade after proper surface treatment.

9.7 Testing

One motor shall be type tested and all motors shall be routine tested at the supplier's works in the presence of Engineer or his representative. In addition to the above, shop tests and site tests should also be conducted on motors. The Schedule for Part- I, Part-II, Part-III and Part-IV for each of above tests i.e. type tests, routine tests, shop tests and site tests follow as below.

9.7.1 TYPE TESTS ON MOTORS - PART I

- (1) No load running of motor and reading of voltage, current , power input and speed.
- (2) Reduced voltage running up test at no load to check the ability of motor to run up to full speed on no load in each direction of rotations with $1/1.732$ of rated line voltage applied to the stator terminal.
- (3) Locked rotor reading of voltage current power inputted values of torque of motors.
(Note :- This test may please be made at reduced voltage)
- (4) Full load reading of voltage current power input and slip.
- (5) Temperature rise test.
- (6) Momentary over load test.
- (7) Insulation resistance test (both before and after high voltage test.)
- (8) Vibration test.
- (9) High voltage test.
- (10) Test to determine losses and efficiencies.

9.7.2 ROUTINE TEST ON MOTORS - PART II

- (1) Insulation resistance test.
- (2) High voltage test.
- (3) No load running of motors and readings of current in three phase and voltage
- (4) Locked rotor readings of voltage, current and power input at a suitable reduced voltage.
- (5) Reduced voltage running up test at on load to check the ability of the motor to run upto full speed on No load in each direction of rotation, with $1/1.7321$ of the rated line voltage applied to the stator terminals.

9.7.3 SHOP TEST ON MOTORS - PART III

- (1) Line out of motor and pump shafts including and fixing of coupling bolts and checking of bearing faces.
- (2) Over run test.
- (3) Vibration test.
- (4) Motor frame dimensional check and general appearance check.

- (5) General appearance of main shaft and dimension of the same.
- (6) Match mark check tests will be made only where applicable.
- (7) Insulation resistance dielectric and coil resistance tests of poles.
- (8) Dimensional checks and general appearance check and after assembly of complete motors and assembly of pump with motor
- (9) Efficiency test.
- (10) Measurement of air gap.
- (11) High voltage test.
- (12) Test to determine losses and efficiency.
- (13) Heat run test to determine the temperature rise of various parts including winding, bearing etc, of the motor when the machine is in operation continuously at the rated and over load output.

9.7.4 SITE TEST ON MOTORS- PART IV

- (1) Measurement of resistance of windings.
- (2) Insulation resistance test (Before and after High voltage test)
- (3) No load test.
- (4) Over run test
- (5) The motor and the pump is to run continuously for 72 hours at full load and temperature of various parts including windings bearing etc. to be observed. This test is to be carried out on each pump separately and measurement of discharge at rated head to be measured.
- (6) Losses and efficiency of pump set are to be carried out on any two motors selected by the Engineer.
- (7) Measurement of insulation resistance of the windings.
- (8) Alignment of motors and pump shafts.
- (9) Vibration test.

9.8 Erection

The work of erection of motors and its alignments with the pump including laying of foundations, grouting, Doweling and painting etc. shall be done by the Contractor at his own cost as per the General and Miscellaneous Specifications mentioned.

10.0 HIGH VOLTAGE VACUUM CIRCUIT BREAKER PANEL

10.1 Scope

This specification covers the requirement of design, manufacture, supply erection testing and commissioning of floor mounted extensible type H.V. Vacuum Circuit Breaker Panel . The HT supply

from CESC /WBSEDCL at 11 KV (Nominal) shall be received on H.V. Vacuum Circuit Breaker Panel the for feeding power to Transformers (two nos, 11KV/0.433 KV) of the substations for the Pumping Station.

There shall be two power transformers to step down the supply voltage from 11 KV to 433V to provide supply to the 433V (nominal) pump motors and station auxiliaries like lighting and other ancillary power loads etc through 415V, TPN , L.T panel boards and Distribution Boards.

10.2 Ambient Condition

The switchboard shall be suitable for continuous operation at rated load at maximum ambient temperature of 50 degree centigrade and maximum Relative Humidity of 100%, the maximum temperature and humidity, however, shall not occur simultaneously.

10.3 Standards & Codes

The switchgear and other equipment incorporated in the switch board shall comply with, but not limited to the following:

- IS 13118/1991 – High Voltage A.C. Circuit Breakers.
- IS 2705 (Part I to IV/1992) – Current Transformers.
- IS 2099/1986 – Bushings for Alternating Voltages.
- IS 13010/2003 IS 13779/1999 – Energy Meters
- IS 3231/1986 & 87 – Relays.
- IS 1248/2003 – Ammeters & Voltmeters.
- IS 13947/Pt 1/93 – Degree of protection provided by Enclosures.

10.4 Technical Requirements

10.4.1 H.V. Panel

The Panel board shall be of indoor type, having the incoming sectionalisation and outgoing switch gears as per IS 13118 : 1991 of VCB, IEC 62271-100 for Breakers and -200 for Panels/ IS 3427 of switch board. The degree of enclosure protection shall be IP-4X.

10.4.1.1 Rating

All panels assembled to form a board shall be suitable for the nominal operation voltage and rupturing capacity as specified. They should be rated as specified with a minimum of 630 Amps. and suitable for operation on 11 KV, 3 phase 50 Hz system. Type test certificate for the breaking capacity of the panel shall be supplied. A circuit breaker for a given duty in service is best selected by considering the individual rated values required by load conditions and fault condition.

10.4.1.2 Type

The HV Panel Board shall be metal clad, indoor, floor mounting, free standing type. It shall be totally enclosed dust, damp and vermin proof.

10.4.1.3 General Construction

Separately earthed compartments shall be provided for circuit breakers, bus bars, relay & instruments, CT&PT and cable boxes, fully and effectively segregating these from one another so that fault in any one compartment do not cause damage to equipment(s) in other compartment(s).

The housing shall be of bolted construction to ensure compact and rigid structure, presenting a neat and pleasing appearance. The sheet steel used should not be less than 2 mm thick.

The panels shall be bolted together to form a continuous flush front switch gear suitable for front operation of board and for extension at both ends.

10.4.1.4 General Design Aspect

The HV panel board shall be designed such that the switchgear, instruments, relays, bus bars, small wiring etc. are arranged and mounted with due consideration for the following:-

- (i) Facility for inspection, maintenance and repairs of testing terminals and terminal boards for ease of external connection.
- (ii) Minimum noise and vibrations.
 - Risk of accidental short circuits and open circuits.
 - Secured and vibration proof connections for power and control circuits.
- (iii) Risk of accidental contact and danger to personnel due to live connections.
- (iv) Mountings at approachable height.

10.5 Circuit Breaker

10.5.1 General Arrangement

The circuit breaker panels shall be complete with the following:

- (a) Racking in / Racking out mechanism.
- (b) Isolating plugs and sockets.
- (c) Mechanical inter-locks and safety shutters.
- (d) Mechanical ON/OFF indicator.
- (e) Minimum of 4 NO and 4 NC Auxiliary contacts directly operated by the circuit breaker. Additional NO & NC contacts can be provided with auxiliary contractors.

(f) Anti condensation space heaters suitable for operation on 240V, 1 ϕ 50 Hz A.C. for each panel wherever specified.

(g) Suitable tripping arrangement.

10.5.2 Type

The circuit breaker shall be of horizontal/ vertical isolation, horizontal draw out pattern.

10.5.3 Breaker Truck

The breaker carriage shall be fabricated from steel, providing a sturdy vehicle for the circuit breaker and its operating and tripping mechanism. The carriage shall be mounted on wheels, moving on guides, designed to align correctly and allow easy movement of the circuit breaker and for removing the carriage for inspection and maintenance purposes. Vacuum interrupters shall be hermetically sealed and shall be designed for minimum contact erosion, fast recovery of dielectric strength, maintenance free vacuum interrupter, suitable for auto-reclosing. The drive mechanism shall preferably be provided with facility for pad locking at any position namely, "Service", "Test" and "Fully Isolated". It should be possible for testing the circuit breaker for its operation without energizing the power circuit in the "Testing" position. The contacts shall be made only after the breaker is inserted into service position. Interlocking should prevent contacts from being disconnected if circuit breaker is tried to be moved from service position.

10.5.3.1 General Feature

Single break contacts are provided in sealed vacuum interrupter.

10.5.3.2 Rating

The circuit breakers shall be continuously rated as specified with a minimum rated current of 630 Amps. with voltage rating and breaking capacity as specified.

10.5.3.3 Operating Mechanism

The operating mechanism shall be one of the following as specified:-

Manually operated spring charged / motor wound spring charged with both mechanical and electrical release for closing. The operating mechanism shall be trip free.

External auxiliary supply shall be made available for charging motors & heater operation.

10.6 Bus Bar Section

10.6.1 General Requirement

The switch board shall be **single bus bar pattern** with air insulated encapsulated bus bars housed in a separate compartment, segregated from other compartments.

10.6.2 Material

The bus bars shall be of high conductivity electrolytic copper rated as specified with a minimum rated current of 1250 Amps. The bus bars shall be sized for carrying the rated and short circuit current without over-heating. Maximum bus bar temperature shall not exceed 95 degree C.

10.6.3 Current Transformer

10.6.3.1 General requirements

Accommodation shall be provided in the circuit breaker panel to mount one set of three numbers dual core dual ratio CTs for metering and protection purposes. Access to the CTs for cleaning, testing or changing shall be from the front, back or top of the panel.

10.6.3.2 Rating

Dual core & dual ratio CTs of suitable burden (but not less than 15 VA) shall be preferred with 5 Amps secondary. The ratio shall normally be one of the following as specified:

- (a) 400/200/5/5 (b) 300/150/5/5
- (c) 200/100/5/5 (d) 100/50/5/5
- (e) such other as required

Note: CT ratio shall be compatible with the loading pattern on HV side.

The CTs shall conform to relevant Indian Standards. The design and construction shall be robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitably to a terminal block which will be easily accessible for testing and terminal connections. The protection CTs shall be of accuracy class 5 P 10 of IS 2705- Part III- 1992.

The metering CTs shall conform to the metering ratio and accuracy class 0.5 of IS2705-1992 for incomer and class 1 for outgoing panels.

10.6.4 Voltage Transformer

A voltage transformer of burden not less than 150 VA and of proper ratio as specified shall be provided at the incoming panel.

The accuracy class for the VT shall be class 0.5 as per IS 3156 Parts I to III for incomer and class 1 for outgoing panels.

The transformer shall be of cast epoxy resin construction. It shall be fixed/withdraw able type. HRC fuses/ MCBs shall be provided on both HV and LV sides.

10.7 Protection and Tripping arrangement

10.7.1 Protection

The Relays shall be microprocessor based numerical relays with O/L, E/F and S/C protection. Tripping relay shall be used for tripping signal to the Shunt Trip Coil of Circuit Breaker operating on 24 V/ 30 V D C supply / Power pack / 110 V VT supply.

Alternatively Power Pack converters fed through PT/ 230V externally could be provided with 2 Nos., 12/ 15 volt, 7 AH SMF batteries (Power pack with condenser/ capacitor backup are also available which do not need batteries, these should not be used) for tripping. In cases where tripping is fed through PT, VA burden of PT shall be suitably increased (say 200 VA) as recommended by the manufacturer depending upon the number of panels and connected controls. In addition external 24 volt / 30 volt DC supply shall be provided for indications etc. through 2 No. SMF batteries of 12/ 15volts of minimum 26 AH capacity with a battery charger as per recommendation of the manufacturer.

10.7.2 Relays

Over current Relays shall have adjustable setting for current from 50% to 200% and earth fault from 10% to 40% or 20% to 80%. These should be of manual reset type. All relays shall have a LED indicator which will indicate operation for each function. It shall be possible to reset it only by manual operation. The number and types of relays shall be as specified.

10.8 Small Wiring

The small wiring shall be carried out with minimum 1.5 sq. mm FRLS/ HFFR insulated copper conductor cables. CT wiring shall be done with minimum 2.5 sq mm wires with colour code: RYB, Gray for auxiliary DC circuits and Black for auxiliary AC circuits. The wiring shall be securely fixed and neatly arranged to enable easy tracing of wires. Identification tags shall be fitted to all wire terminals to render identification easy and to facilitate checking in accordance with IS 375. Necessary terminal blocks and cable entries shall be provided for RTD relay wiring, power supply etc.

10.9 Instrument and panel accessories (Digital)

10.9.1 Instrument Panel

The instrument panel shall form part of the housing. Relays, meters and instruments shall be mounted as per general arrangement drawings to be submitted by the tenderer. They shall be preferably of flush mounting type at a maximum height of 1800 mm

10.9.2 Instrumentation

- (a) A voltmeter of class 1.5 accuracy as per IS 1248 shall be provided at each incomer panel, with selector switch. The instrument shall be calibrated for the ranges specified.
- (b) Energy meters of class 1.0 conforming to IS 722 (Part IX) and power factor meter of class of accuracy of 2 shall be provided, if specified.
- (c) Ammeter of specified range of class 1.5 accuracy as per IS 1248 shall be provided at both incomer and outgoing panels along with necessary selector switches.
- (d) The panel assembly shall also take care of the following requirements:
 - (i) Lamp indication shall be provided to indicate ON/ OFF (by red green respectively) of switch gear.
 - (ii) Panel illuminating lamp.
 - (iii) Mechanical indication for spring charged status. If possible an indicating lamp could be provided.
 - (iv) Lamp indicating tripping at fault status.
 - (v) Healthy trip supply shall be indicated by clear lamp.
 - (vi) Separate fuses/ MCBs shall be provided for lamps, heaters, voltmeter sand other instrumentation etc. on each panel.
 - (vii) Anti-condensation space heaters shall be provided, and shall be suitable for operation on 240 V, 1 phase, 50 Hz A.C. for each panel if specified.
 - (viii) Where there is more than one incomer and bus sections, these shall be castle key interlocked as per interlocking scheme as specified.

10.10 Cable Box

Provision for top (bus ducts preferred for top entry) / bottom or such other side entry shall be made as per requirement with sufficient head room for cable termination. 3mm thick removable gland plate shall be provided for cable termination.

10.11 Earthing

The earthing of the breaker body and moving portion shall be so arranged that the earthing of the non-current carrying structure to the frame earth bar is completed well before the main circuit breaker plugs enter the fixed house sockets. The entire panel board shall have a common tinned copper earth bar of suitable section with 2 earth terminals for effectively earthing metallic portion of the panels. The frame earthing of panel shall be in accordance with his specifications.

10.12 Installation

The installation work shall cover assembly of panels lining up, grouting the units etc. In the case of multi panels switch boards after connecting up the bus bar all joint shall be insulated with HV insulation tape or with approved insulation compound. A common earth bar shall be run preferably at the back of the

switch board connecting all the sections for connecting the earth system. All protection, indications & metering

Connections and wirings shall be completed.

Where trip supply battery is installed the unit shall be commissioned, completing initial charging of the batteries. All relay instruments and meters shall be mounted and connected with appropriate wiring. Calibrations checks of units as necessary and required by the licensee like CTs, VTs Energy Meters etc. shall be completed before pre-commission checks are undertaken.

10.13 Testing and Commissioning

Procedure for testing and commissioning of relay shall be in general accordance with good practice.

Commissioning checks and tests shall include in addition to checking of all small wiring connections, relays calibration and setting tests by secondary injection method and primary injection method. Primary injection test will be preferred for operation of relay through CTs. Before panel board is commissioned, provision of the safety namely fire extinguishers, rubber mats and danger board shall be ensured. In addition all routine megger tests shall be performed. Checks and test shall include following:

- (a) Operation checks and lubrication of all moving parts.
- (b) Interlock function checks.
- (c) Continuity checks of wiring, fuses etc. as required.
- (d) Insulation tests.
- (e) Trip test and protection gear tests.
- (f) The complete panel shall be tested with 5000 V megger for insulation between poles and poles to earth. Insulation test of secondary of CTs and VT to earth shall be conducted using 500 V megger.
- (g) Any other tests as may be required by the Licensee / Inspector shall be conducted.
- (h) Where specified, the entire switch board shall withstand high voltage test after installation.
- (i) Any other test required by the consignee/ inspecting officer.

11.0 Transformer

11.1 Scope

This specification covers the design, manufacture, testing, supply, delivery at site according to the following specifications of the following transformer.

It is not the intent to specify completely herein all the details of the design and construction of equipment. However the equipment shall conform in all respects to high standards of engineering,

design and workmanship and shall be capable of performing in continuous commercial operation up to the Bidder's guarantee, in a manner acceptable to the purchaser, who will interpret the meanings of drawings and specification and shall have the power to reject any work or material which, in his judgment is not in accordance there with. The offered equipment shall be complete with all components necessary for their effective and trouble free operation. Such, components shall be deemed to be within the scope of Bidder's supply irrespective of whether those are specifically brought out in this specification and/or the commercial order or not.

11.2 Code and Standards

The oil filled transformers shall comply with the following Indian Standards as amended up to date:

- (i) IS 2026 - Part I to V - power transformers.
- (ii) IS 335 - Transformer oil.
- (iii) IS 10028 (Part II & III) - Installation and Maintenance of Transformers.
IS 2099 - Bushings.
- (v) IS 2705 - Current Transformers.
- (vi) IS 6600 - Guide for loading of oil immersed transformers.

11.3 General Requirement

The transformer shall be indoor or outdoor type as specified. Unless otherwise specified the transformer in addition shall have thermal and dynamic ability to withstand external short-circuit as per clause 9 of IS 2026 (Part I) : 1977.

11.4 Insulating oil

Insulation oil shall conform to IS 335. Transformer oil to be supplied with initial fill of filtered oil.

11.5 Temperature Rise

The reference ambient temperatures assumed for the purpose of this specification are as follows: -

- (a) Maximum ambient air temperature 50°C.
- (b) Maximum daily average ambient air temperature 40°C.
- (c) Maximum yearly weighted average ambient temperature 32°C.
- (d) Minimum yearly weighted average ambient temperature (-)5°C.

The temperature rise at the above conditions and at the altitude not exceeding 1000 meters shall be as follows: -

By resistance method 55°C (maximum temperature being 95°C).

By thermometer 50°C.

If the site conditions indicated for a particular job is more severe than the refereed ambient temperature mentioned above, the temperature rise shall be suitably scaled down such that the hot spot temperature shall not exceed the values for the reference conditions.

11.6 Tap Changing Device

Tap changing device shall be provided on H.V side, circuit type, externally hand operated with necessary indications for tap position and locking arrangement at any of the tapping positions. It shall be designed for bi-directional operation and shall be of self-positioning type and shall have the following steps: @ 2.5% in 6 Step, Seven Position tap Switch From -10% to +5% (if required)

11.7 Voltage Ratio

Unless otherwise specified, the transformer shall be suitable for a voltage ratio of 11 KV/433 V.

11.8 Vector Group

In case of step down transformers, the winding connections shall conform to vector group dy. 11 unless otherwise specified. In case of step up transformer the vector group unless otherwise specified shall be star/ delta.

11.9 Cooling

Unless otherwise specified, the transformer shall be oil immersed natural air-cooled type (ONAN).

11.10 Accessories

The transformer shall be a single tank type with termination on bushings or cable end box as specified both on HV and MV side. The MV side shall be suitable to receive bus bar trunking or MV cable inter-connection suitable for full load current of the transformer.

11.11 Fittings

The transformer shall be complete with the following fittings: -

- (a) Oil conservator with oil level indicator, minimum level marking and drain plug for all transformers of capacity 50 KVA and above.
- (b) Off circuit type tap changer with position indicator and locking arrangement for all transformers.
- (c) Thermometer pocket with plug for all transformers of capacity 100 KVA and above.
- (d) 100 mm dial type /stem type thermometer with metal guard Dial type thermometer may have max. temperature indicator and resetting device for all transformers of capacity 250 KVA and above.
- (e) Lifting lugs for all transformers.
- (f) Bi-directional /Unidirectional Rollers to be specified.
- (g) Rating diagram and terminal marking plate for all transformers.
- (h) Explosion vent for all transformers of capacity 400 KVA and above
- (i) Additional Neutral separately brought out on a bushing for earthing for all transformers.

- (j) Earth terminals (2 Nos.) for body earthing for all transformers.
- (k) Valves for filtration, drainage and filling etc. with necessary plugs for all transformers.
- (l) Radiator assembly for all transformers.
- (m) Silica gel breather for all transformers.
- (n) Air release plug for all transformers.
- (o) First filling of oil to IS 335:1993 including make-up fill during installation for all transformers.
- (p) Facility to connect up Buchholtz relay for all transformers of capacity 800 KVA and above.
- (q) Inspection covers on tank cover for access to terminal connections for all transformers.
- (r) Bushing terminations or cable box terminations as specified.
- (s) Necessary hardware, clamps, lugs etc. for termination on HV/MV etc. for all

11.12 Explosion Vent

Explosion vent or pressure relief device shall be provided of sufficient size for rapid release of any pressure that may be generated within the tank and which might result in damage to the equipment. The device shall operate at a static pressure less than the hydraulic test pressure for transformer tank. Means shall be provided to prevent the ingress of moisture and of such a design to prevent gas accumulation.

11.13 Accommodation for Auxiliary Apparatus

Where specified, such as, for restricted earth fault protection, facilities shall be provided for the mounting of a neutral current transformer.

11.13.1 Rating and Diagram Plate

The following plates shall be fixed to Transformer in a visible position.

- (a) A rating plate of weather proof material bearing the data specified in the appropriate clauses of IS 2026:1977.
- (b) A diagram plate showing the internal connection and also the voltage vector relationship of the several windings in accordance with IS 2026:1977 and a plan view of the transformer giving the correct physical relationship of the terminals.

11.13.2 Joints and Gaskets

All gaskets used for making oil tight joints shall be of proven material such as granulated cork bonded with synthetic rubber gaskets or synthetic rubber or such other good.

11.13.3 Gas and Oil Actuated Buchholtz Relay

Buchholtz Relay shall be provided for transformers of capacity 800 KVA and above. The design of the relay mounting arrangements, the associated pipe work shall be such that mal-operation of the relays shall not take place under normal service. The pipe work shall be so arranged that all gas arising from the transformer shall pass through the gas and oil-actuated relay. The oil circuit through the relay shall not form a delivery path in parallel with any circulating oil pipe, nor shall it be tied into or connected through the pressure relief vent. Sharp bends in the pipe work shall be avoided.

All wiring connections, terminal boards, fuses and links etc. connected with gas actuated relays shall be suitable for tropical atmosphere. Any wiring liable to be in contact with oil shall have oil resistant insulation and the bared ends of stranded wire shall be sealed together to prevent seepage of oil entering connection boxes used for cables or wiring.

11.13.4 Cable Box

Cable box shall not be mounted on the tank covers. It shall be feasible to remove the tank covers for inspection during maintenance etc. without recourse to breaking the joints or disturbing the cables already terminated. Necessary removable links in oil approachable through inspection cover in tank cover etc. after lowering oil shall be provided for test purpose.

11.14 Test

11.14.1 Test at Work

All routine and other tests prescribed by IS 2026 shall be carried out at the manufacturer's works before dispatch of the transformer in the presence of inspecting officer if required. Copies of the test certificates shall be furnished to the department. In addition to the prescribed routine tests, temperature rise test shall be invariably done on one transformer of each design. A copy of the impulse test certificate done on the same type/ design of the transformer shall be furnished in accordance with IS for purpose of record. If no impulse test was done in an earlier unit of the same design and capacity, one transformer will be subjected to impulse test in consultation with the Inspector at the firm's cost. Copies of the certificates for pressure test, test for bushings, and type test for short circuit shall be supplied to the Department.

11.14.2 Test at site

In addition to tests at manufacturer's premises, all relevant pre-commissioning checks and tests conforming to IS code of practice No. 10028 (Part II & III) shall be done before energization. The following tests are to be particularly done before cable jointing or connecting up the bus bar trunking:

- (a) Insulation test between HV to earth and HV to MV with 5000 volts Megger.
- (b) Insulation test between MV to earth with 500 volts Megger.
- (c) Di-electric strength Test on oil.
- (d) Buchholtz relay operation by simulation test when fitted.

All test results are to be recorded and reports should be submitted to the department

11.15 Installation and Commissioning

11.15.1 The transformer shall be installed in accordance with IS 10028 (Part II & III)-Code of practice for Installation and maintenance of transformer. Necessary support channels shall be grouted in the flooring.

11.15.2 The transformer shall be moved to its location and shall be correctly positioned. Transformer wheels shall be either locked or provided with wheel stoppers. All parts of the transformers which are supplied loose, such as conservator, radiator banks, Buchholtz relay, dial thermometer, bushing etc. shall be fitted on the transformer. Transformer oil supplied in drums shall be topped up into the transformer after duly testing/filtering up to the correct level required.

11.15.3 Wiring of devices such as Buchholtz relay, dial thermometer etc. shall be carried out as per drawings, Earthing of neutral and body of the transformer shall be done in accordance with these specifications.

11.15.4 Drying out of transformer winding will be necessary when the di-electric strength of the oil is lower than the minimum value as per IS10028 or the transformer has not been energized within 6 months of leaving the works or where the radiator assembly is done at site. The transformer shall be dried out by one of the methods specified in IS 10028. Drying out with centrifugal or vacuum type filters will, however, be preferred. The contractor shall carry out the process of drying without interruption and shall maintain a log sheet indicating time, oil temperature and insulation resistance.

11.15.5 After complete drying out of the transformer, oil sample shall be collected by the contractor and shall be tested for di-electric strength as specified in IS 335:1993 with approved test kit.

13.15.6 All devices such as dial type thermometers, Buchholtz relays and main alarm and trip contacts shall be checked for satisfactory operation.

13.15.7 All tests specified in these specifications shall be carried out by the contractor in the presence of inspecting officer of the department at free of cost.

12.0 H.T. CABLE

The HT cables shall be of aluminium conductor and it shall be XLPE insulated and sheathed, steel tape armoured and PVC served and suitable for 11 KV grade (E) as per IS specification.

Manufacturer's test certificate, in triplicate, shall be furnished along with the cable. For this purpose test certificate for the full drum length of cables supplied by the manufacturers from which the required quantity has been cut will be acceptable.

The HT cable shall be laid on ready MS cable trays and clamped on the perforated trays at intervals of 600 mm of cable run.

Wherever HT and LT cables run on the same tray, there will be insulating barriers between HT and LT cables. The run of HT cables shall be at one extreme end of the trays as suitable. More than one cable (HT) running side by side and touching shall be clamped together. HT cables shall be marked properly at every 3,000 mm approx. and at each bend. The cables shall rise to their respective equipment installed above ground floor slab through openings in the floor slabs as per site requirement.

12.1 Cable Termination of 11 KV XLPE Cables

For XLPE cables either reputed make epoxy resin compound type or heat shrinkable type cable jointing kits shall be used. The epoxy jointing kit shall be of good quality and the jointing work shall be done by an experienced licensed and skilled cable jointer.

12.2 HT Cable Insulation Tests

The HT cable after installation and end terminations shall be subjected to following tests:

Insulation resistance tests with 5.0 KV meggar. The insulation value shall not be less than 1000 meg ohms for each cable (along with transformer winding wherever applicable).

13.0 LT PANEL AT PANEL ROOM

13.8.1 Scope

This specification covers the requirements of design, manufacture, supply testing erection and commissioning of extensible, multi-tier, multi-panel cubicle type double or single front construction switch board as per requirement and to be installed in the substation LT room and pump house.

The LT supply shall be received by the L.T switch board at the incoming point either from the Transformer secondary independently for feeding the loads of the substation of the pumping stations.

13.8.2 Ambient Conditions

The Switchboard shall be suitable for continuous operation at rated load for maximum ambient temperature of 50⁰ C and maximum relative humidity of 100%, the maximum temperature and humidity, however, not occurring simultaneously.

13.8.3 Standards & Codes

All switch-gear and other equipment incorporated in the switch board shall comply with, but not be limited to the following :

I.S 13947 (IEC 60947) : Air Circuit Breaker

I.S 13947 (IEC 60947) : Moulded Case Circuit Breaker

I.S 13947 (IEC 60947) : Fuse Switch Units, contactors etc.

I.S 13947 (IEC 60947) : Metal enclosed switchgear

I.S 2705 : Current Transformers

I.S 1248 & 2419 : Indicating Instruments

I.S 3231 : Protective Relays

I.S 375 : Bus bar Markings

I.S 1554 : Cables

13.8.4 Electrical System

HT supply Voltage	11 KV ± 10%
Transformer	
Primary	10 KV Delta
Secondary	i) 0.433 KV Star with directly earthed neutral
Short Circuit Level	1500 MVA Symmetrical at 33 KV 35 MVA Symmetrical at 415 V
L T Voltage	433 volts, 3 phases, 4 wires (earthed neutral) (OCV)
Frequency	50 Hz ± 3%

13.8.5 Operational requirements

The LT switchboard shall be extensible type and suitable for coupling for future extension of switch boards through the bus bars on either side.

13.8.6 Equipment Details

General

LT switchboard shall be floor mounting, vertical fully compartmentalized front operated free standing with jig set pressed and formed sheet steel cubicle having tiered compartments. The switch board shall be extensible on either sides with double or single front arrangement as per requirement with two sides access. The thickness of sheet steel of the enclosures shall be not less than 2.0 mm for outside walls and the partition walls not less than 1.6 mm.

The compartments housing Air Circuit Breaker, with indicating instruments and protection equipment (as necessary), and front operated either MCCB units with components mounted on chassis plate having incoming and outgoing power and control terminals in the cable compartment.

All Panel doors shall be interlocked with corresponding switches enclosed and all live parts shall be fully shrouded. All cable termination points shall have insulating/ metal shields to prevent accidental contacts during maintenance and inspection of cable alleys. All terminals shall be bus bar type suitable to connect the required number and size of cables considered. Feeder compartments and cable compartment shall be provided with hinged door with screw knob arrangement whereas the bus bar compartment shall be provided with bolted type arrangement. Truck for racking out Air Circuit Breaker shall be provided.

Equipment Details

All technical requirements of different circuits of switchboard are furnished in the schematic electrical single line diagram and schedule of items attached. The switch board shall comprise of all component units of reputed makes. Only one make for ACB/MCCB shall be used.

Switchboard Construction

The switchboard shall be constructed from 14 SWG (2 mm thick). M.S Sheets with integral angle iron frame work as required.

The switch board shall be provided with mounting channels (size ISMC 100 x 50 mm) at bottom, covered by skirting. Foundation bolt hole shall have easy accessibility.

Each section of the vertical panel shall comprise of one bus bar chamber / compartment, one feeder equipment compartment and one cable chamber/compartment. Each chamber shall be fully segregated with 1.6 mm thick sheet steel all round.

All cables shall enter from bottom having drilled gland plates for fixing compression type cable gland and routed through a cable alley.

The hinged doors, as well as other detachable covers shall be provided with heat resistant type neoprene rubber gaskets. The switchboard shall have IP 54 degree of protection.

The switch board shall have an Earth Bus running the entire length of switch board and shall have provision of extending the same on either side in future. The earth bus section shall be not less than 50 x 6 mm tinned copper with green colour identification. The overall height of the switchboard shall not exceed 2,400 mm.

The incoming ACB (LT) shall have proper termination arrangement for connection of requisite nos. of 3.5 core or appropriate numbers of single core (AL) PVC armoured cable from bottom or top or bus duct at the top as per requirement.

The switch board shall be finished with powder coated paints (Siemens-Grey) after proper surface treatment by 7 tank process of cleaning. Switchboard shall be touched up after installation and commissioning at site as necessary.

Name plate, inscription plates and labels etc shall be on laminated white phylum plates of 3 mm thick and 12 mm high black engraved lettering to be screwed on the front door panel of all the feeder compartment as well as on the main panel. The panel markings shall be provided on the top with 100 mm laminated phylum plate and 75 mm letter size. Each side and openable back cover of cable and bus bar chamber doors shall be provided with appropriate type of danger board

Active Component Details

The active components to be housed in the switchboard shall be as follows:

Bus bars and Connections

The bus bars shall be extensible type of hard drawn high conductivity electrolytic grade tinned copper as specified with complete PVC sleeving except at the joints. Three bus bars for phases and one bus bar for neutral of adequate capacity shall be provided for each set.

Maximum current density of 1.50A/sq.mm for copper shall be considered. Mounting insulators shall be of DMC, SMC or equivalent type. The bus bar supports shall be placed not more than 450 mm apart. (Technical data sheet of the insulation support shall be furnished by vendor). Minimum clearance between phase bars shall be 32 mm and between phase and earth shall be 25 mm. The bus bars shall be properly insulated and colour coded. The construction of the switchboard shall be robust enough to withstand system fault of minimum 35 MVA.

Air Circuit Breaker

The Air Circuit Breaker shall be of reputed make and of rating as stated elsewhere. The basic unit shall be triple pole and neutral or four pole horizontal draw-out type complete with six / eight sets of isolating contacts and proper termination arrangement with bus ducting or cables as per requirement indicated. It shall also have –

- a) A certified minimum rupturing capacity of 35 MVA at 433 volts. The symmetrical breaking capacity, peak making capacity, and short time current rating etc. shall be as per IS 13947
- b) Independent manual operated hand spring charged with independent mechanical closing and trip free mechanism with trip coil of 240 VAC.
- c) ON/OFF/TRIP/TRIP CIRCUIT SUPERVISION-HEALTHY lamp Indicators with HRC protection fuses.
- d) Push Button for manual emergency tripping and trip circuit healthy test lamps.
- e) 4 Nos spare Normally Open auxiliary Contacts.
- f) 4 Nos spare Normally Closed auxiliary contacts.
- g) CT operated direct acting microprocessor based solid state over current and short circuit releases with CTs. The O/C releases shall be provided with time delay and it shall be possible to set the O/C releases to operate within 70 – 100% of maximum rating. The protection CTS shall be mounted on the draw out portion of the circuit breaker.
- h) 3 Nos. CT operated 96 mm. sq digital Ammeter (Cl. 1.0) & current transformers of ratio matching with breaker rating.
- i) 96 mm. sq digital Voltmeter (Cl. 1.0) with selector switch and protection HRC fuses.

The ACB unit shall have three (3) distinct and separate positions of the circuit breaker marked (easily identifiable) on the circuit breaker cradle viz :

Service : All main and secondary isolating contacts in services.

Test : Main contacts separated; secondary isolating contacts in service.

Isolated / Maintenance : All main and secondary isolating contacts isolated.

It should be possible to lock the ACB in each of the first two positions. In the third position, complete access for routine maintenance including removal of arc chutes, arcing contacts, etc shall be possible.

For three phase and neutral systems, neutral shall be automatically isolated when the circuit breaker is withdrawn from "Service" position.

The trip circuit shall be continuously monitored with trip circuit supervision relay indication lamp with push buttons.

The circuit breaker to be used as incoming and bus coupler units shall be TPN type with under voltage releases.

The circuit breaker shall be used for feeding normal incoming power supply to the LT switch boards and shall be provided with three nos. phase indication lamps (R-Y-B) in the incoming side of the circuit breaker.

The draw out portion of the circuit breaker shall be effectively connected to the earth bus bar through scraping contacts.

There shall be provision of Earthing Terminals in the Cradle/Housing the Circuit Breaker.

Truck for racking out ACB(s) shall be provided with necessary handles.

Test Certificate from CPRI - Bangalore/Bhopal shall be submitted with offer.

Moulded case Circuit Breaker

The Moulded Case Circuit Breakers (MCCB) shall be used in the L.T switch board/Power Control Centre/Motor Control Centre wherever specified. These shall be having rupturing capacity not less than 50 KA at 415 V unless stated otherwise (CPRI tested). The MCCBs shall be either TP & N or 4 poles as specified in the tender schedule.

The MCCBs shall be provided with built in solid state adjustable type over current and earth fault releases with current setting range 70-100% for over current elements and 20-80% for earth fault with time delay setting element for the above.

The MCCBs shall be panel mounting type and shall be provided with operating handle fixed with the door frame for operation of the MCCB from the front of the panel with the cubicle door in closed position.

The MCCB operating handle shall be door interlocking type with defeat mechanism and padlocking facility.

The MCCBs shall be provided with 2 NO + 2 NC auxiliary 240 V, 10A, AC change over contacts for control and indication purposes. Shunt trip or under voltage releases shall be also fitted and supplied with the MCCB as per requirement.

All the feeders specified with MCCBs shall be provided with ON/OFF indication lamps in front of the compartment door with suitable HRC type protective fuses wherever specified.

Combination Fuse switch/switch fuse units

The ratings for various CFS/SFU units shall be as per requirement stated elsewhere.

The rotary type CFS units (Load Break Switches) shall be reputed make. The basic features of CFS/SF units shall be:

- i) Load make/break type with adequate short circuit withstand capacities AC-3 duty (CPRI-Bangalore/Bhopal tested) as per IS specifications unless and specified otherwise.
- ii) Operating mechanism for operation from the front of panel with ON/OFF position indicated with padlocking feature in any position.
- iii) Provided with HRC fuse links of ratings specified.
- iv) CT operated 96 mm. sq digital Ammeters (3 no.), current transformers with adequate CT ratio as specified.
- v) Door interlock shall be provided so that cubicle door cannot be opened with CFS/SFU in 'ON' position. Door defeat mechanism shall also be provided.

Ammeters

Ammeters shall be digital type and of reputed make, 96 mm sq. dial, 1.0 class accuracy.

All ammeters shall be 5 Amps CT operated unless specified otherwise and ammeter (3 nos.) shall be provided.

Current Transformer

The current transformer shall be as follows :

- i) Metering of specified rating and adequate VA burden accuracy class 1.0
- ii) Protection CT of adequate VA burden and accuracy class 5P10 or compatible with various protective relays as specified.

Voltmeters

Voltmeters shall be digital type and of reputed make, 0-500V AC. 96 mm sq dial. 1.0 class accuracy. HRC fuses with fuse base and carriers shall be provided for voltmeter and phase

indication lamps, wherever specified. Each voltmeter shall be provided with voltmeter selector switch.

Voltmeter Selector Switches

These shall be of reputed make standard instrument switches permitting measurement of all the three line & phase voltages as necessary with an off position.

Protective Relays, Releases etc

The microprocessor solid state type releases for fault tripping of circuit breaker shall be provided as specified in drawing and shall be of same make as that of ACB, Each releases shall have suitable connection diagram affixed at the back of releases.

Wiring

Internal wiring for fixed and draw-out chassis - mounted active parts of all panels, ACB sets shall be carried out as follows :

- a) Minimum conductor section for power and control wiring shall be of 2.5 sq. mm copper.
- b) Control wiring shall be multi-strand flexible type. 1.1 KV grade PVC insulated and PVC sheathed.
- c) Power wiring with section 2.5 sq. mm copper or above and shall be multi strand flexible type..
- d) Conductor insulation shall be 1.1 KV grade PVC.
- e) All cable ends shall be sleeved, ferruled and terminated at external terminal box with crimped sockets.
- f) Rectangular shaped conductors shall be of tinned copper having PVC insulation covering of 1.1 KV grade.

9.26.6.15 Identification Labels

All feeder Panels shall be provided with identification labels having 12 mm high black engraved lettering on 3 mm thick white laminate materials.

Earth Bus bar

An earth bus of minimum size of 50 x 6 mm tinned copper with PVC sleeveings shall be provided all along the length of the switch board. This shall be extensible on either side.

The earth bus of the switch board shall be suitable for connection with earth conductor at the place of installation at two points from the two sides of switchboard.

All metal stationary items of the panels shall be directly connected with the Earth Bus.

The frame of each ACB carriage shall be earthed through heavy multiple finger contacts provided in the ACB fixed section.

Cable compartments

Fully segregated cable compartment of adequate size shall be provided in the panels for easy termination of all incoming and outgoing cables entering from bottom or top. Adequate and proper supports shall be provided in cable compartments to support cables. All incoming and outgoing terminals shall be brought out to terminal blocks in the cable compartment.

Tests

The switch boards shall be accepted on the basis of routine and type / performance tests conducted as per latest issue of ISS/IES at manufacturer's premises, complete test reports shall be submitted to the Employer/Employer's representative before despatch of the switchboard.

Painting

All sheet metal parts (both inside and outside) of the switch board shall be given anticorrosive treatment by seven tank process and powder coated finish of approved shade unless specified otherwise.

Guarantee

The switch board and all components shall be guaranteed for 18 months from the date of despatch or 12 calendar months from the date of commissioning and handing over whichever is later against defective design material and/or workmanship. The bidder shall be responsible for complete operation and routine as well as breakdown maintenance of the board including supply of all spares and consumables (except HRC fuses and lamps) during 1 year defect liability period. The cost of the same shall be included in the offer. No extra amount will be paid on this account.

13.0 EARTHING SYSTEM

13.1 SCOPE

This section covers the general requirements of the earthing system for Sub-station installation. G.I. plate earthing with G.I. strip for sub-stations of 500 KVA capacity and copper plate earthing for sub-stations of higher capacity shall preferably be used.

13.2 SYSTEMS

Earthing system shall comprise earth electrodes in accordance with these specifications . For every additional transformer 2 more separate and distinct earth electrodes shall be provided for neutral earthing. The body earthing for transformers, HV & MV panels shall be done to a common earth bus connected to two separate and distinct earth electrodes.

Note: For a single transformer Sub-station, the total number of earth electrodes shall be 4 (2 for neutral and 2 for connection to a common earth bus for body earthing). For a two transformer Sub-station total number of earth electrodes shall be 6 (4 for neutral earthing, two each for two transformers, and 2 for connection to a common earth bus for body earthing).

13.3 ELECTRODES

The earth electrodes shall be as per specification in the B.O.Q.

13.4 LOCATION OF EARTH ELECTRODES

Normally an earth electrode shall not be situated less than 1.5 m from any building. Care shall be taken that the excavation of earth electrode may not affect the column footings or foundation of the building. In such cases electrodes may be farther away from the building. Location of the electrode earth will be a place where the soil has reasonable chance of remaining moist. As far as possible, entrances, pavements and road ways, are to be definitely avoided for locating the earth electrode.

13.5 WATERING ARRANGEMENT

Method of watering arrangement shall comply with as per standard practice in industry.

13.6 SIZE OF EARTH LEAD

The recommended sizes of copper earth bus lead in case of Sub-stations shall be in accordance with B.O.Q. However, the minimum size of earth lead shall be 25 mm x 5 mm copper or equivalent GI strip.

13.7 INSTALLATION

All joints shall be riveted and sweated. Joints in the earth bar shall be bolted and the joints faces tinned. Where the diameter of the bolt for connecting earth bar to apparatus exceeds one quarter of the width of the earth bar, the connection to the bolt shall be made with a wider piece of flange of copper jointed to earth bar. These shall be tinned at the point of connection to equipment and special care taken to ensure a permanent low resistance contact to iron or steel. All steel bolts, nuts, washers etc. shall be cadmium plated, main earth bars shall be spaced sufficiently on the surface to which they are fixed such as walls or the side trenches to allow for ease of connections. Copper earthing shall not be fixed by ferrous fittings. The earthing shall suitably be protected from mechanical injury by galvanized pipe wherever it passes through wall and floor. The portion within ground shall be buried at least 60 cm deep. The earthing lead shall be securely bolted and soldered to plate or pipe as the case may be. In the case of plate earthing the lead shall be connected by means of a cable socket with two bolts and nuts. All washers shall be of the same materials as the plate or pipe. All iron bolts, nuts and washers shall be galvanized.

13.8 TESTING

After installation, the tests as specified in relevant IS code shall be carried out and results recorded.

13.0 POWER FACTOR IMPROVEMENT

13.1 SCOPE

This section covers the specification for supply, installation, testing and commissioning of 433 volts, 3 phase, 50 Hz capacitor banks and other such devices.

13.2 REQUIREMENTS

Capacities of the capacitor banks shall be indicated in the B.O.Q.

13.3 CONSTRUCTION

13.3.1 The capacitor banks shall generally conform to IS 13341: 1992, 13340: 1993.

13.3.2 The capacitor units shall be indoor type, air-cooled with low viscosity impregnated paper dielectric hermitically sealed. The impregnation used shall be non- inflammable, non-oxidizing, lower freezing point type synthetic compound. Each individual cell shall be provided with pressure sensitive disconnectors / devices.

13.3.3 Main connections from the active element shall be brought out through porcelain bushing. Care shall be taken to solder the bushing to the cover to ensure perfect hermetic sealing.

13.3.4 Capacitor units shall be provided with externally mounted discharge resistors to reduce the residual voltage to less than 50 Volts in one minute of switching off.

13.3.5 Individual unit shall be provided with HRC fuses/ adequate capacity of MCBs/MCCBs, contactors (capacitor duty) bus bars and terminal chambers to make bank of required KVAR. Terminal chamber shall be suitable for bottom/top cable entry. Two earth terminals shall be provided to each capacitor bank.

13.4 TESTS AT MANUFACTURER'S WORK

All routine and type tests as per IS 2834 relevant to capacitor banks as amended up to date shall be carried out at manufacturer's works and test certificates shall be furnished to the department.

13.5 INSTALLATION

Capacitor banks shall be installed at least 30 cm away from the walls on suitable metal frame work of welded construction. The earth terminals provided on the body of capacitor bank shall be bonded to the main capacitor panel earth bus with 2 Nos. 8SWG copper or 6 SWG GI earth wires.

13.6 TESTS AT SITE

Insulation resistance with 500 V DC Megger shall be carried out and test results recorded.

14.0 SPECIFICATION FOR ELECTRICAL WIRING

14.1 General Requirements

This specification covers the requirements of wiring in pump house and sub stations for lighting and power point installation work. The lighting installation shall be designed conforming to IS : 3646 and in accordance with the guide lines given in the National Electrical code (EC) and other similar standards.

14.2 Wires & Cables

All wires and cables to be used in electrical wiring shall have ISI marking on it. If the suppliers indicate that ISI marking on wires/cables is not possible because of manufacturing process, the cables/wires shall be accepted with the submission of test certificate and copy of licence issued by B.I.S. to the manufacturers (Finolex/Havells)

14.3 Conduits

The conduits to be used in wiring shall conform to I.S 9537 (Part-II)-1981 or latest in all respects. The contractors using the particular brand of conduit shall furnish test certificate from N.T.H or any Government Approved Laboratory with each quantity of supply along with supply of conduits.

14.4 Materials

All materials, fittings, appliances, used in electrical installations, shall conform to Indian Standard Specifications wherever these exist. Only approved make of PWD schedule materials shall be used. Materials not included in the list shall be got approved by the Employer / Employer's representative prior to actual use

14.5 Main Switch Gear

Iron clad switch fuse and isolator units should conform to IS: 13947 & IEC 60947. The quick make and break mechanism shall be self-interlocked with the cover. In "Off" position there must be two breaks per pole.

Main switch gear shall be properly earthed with two numbers conductors if M.V and one number of L.V.

14.6 Busbar Chamber (B.B.C)

This shall be totally enclosed, metal clad type fabricated from rust proof I6 SWG sheet steel on angle iron frame and provided with sheet steel or cast iron detachable front cover and undrilled

detachable end plates, suitable for mounting on wall or angle iron floor stand and painted with high quality enamel paint. G.I. bolts and nuts shall be used for assembly with suitable packing materials to ensure dust proof finish. Meters shall be provided on suitable sheet steel boxes. Switch shall be provided with cable end boxes as required.

The depth of B.B.C. shall be 150 mm (minimum). Minimum clearance of phase bars to earth shall be 25 mm and between bus bars shall be minimum 32 mm.

Copper bus bars conforming to relevant I.S. specification and shall not be more than the current density of 1000 Amps per sq.in./1.5 Amp. Sq.mm.

The cross section of the neutral bus bar shall be the same as that of the phase bus bar of capacity up to 200A and for higher capacity neutral bus bars are to be rated to carry 60% of phase current. These shall be carried on glazed porcelain/DMC/SMC supports of proper dielectric and mechanical strength and shall be appropriately colour coded for identification of Phases, Neutral & Earth as per relevant IS Code.

Lettering shall be done for identification of switches as directed. The contractor shall submit fully dimensioned drawing of the board with the physical disposition of the switches and other components to the Employer's representative for their approval before the same is fabricated.

There shall be two nos. of Earth Terminals. Suitable Danger Board shall be provided.

14.7 Interconnection B.B.C, Switch Fuse, Meters, Etc

For ratings above 100 Amps these shall consist of insulated copper strips as per specification of adequate section. For rating below 100 Amps PVC copper cable tails of appropriate size, terminating in tinned copper sockets may be used. The above are to be enclosed either in sheet metal trunking or conduits so that no part is exposed.

14.8 Distribution Boards

These totally enclosed metal clad type Distribution Boards with hinged lids shall be in accordance with I.S. 2147 - 1952 and 2675 - 1966 and shall be welded/bolted construction and fabricated from rust proof sheet steel and finished with anticorrosive powder coated paint and have provision for fixing on wall with earthing /terminals as per IS code.

Power Distribution Boards (400 volts TPN) shall be constructed from I6 SWG sheet steel and Branch Distribution Boards (230 volts SPN from I8 SWG sheet steel).

The minimum ratings of phase and neutral bus bars shall be 67% (approx) of the total rating of fuse ways. Above 32 Amps Neutral Bus bars may be half the size of the Phase Bus bars.

The fuses shall be mounted on glazed porcelain DMC/SMC supports of proper dielectric & mechanical strength. TPN units should have phase separation barriers between fuse banks.

Cables shall be connected to a terminal by crimped lugs.

Where two or more B.D.B's feeding low voltage circuits are fed from different phases of a medium voltage supply, these B.D.B's shall be installed at least two meters apart.

All three phases power distribution boards shall be properly earthed with two number 10 S.W.G galvanized iron wires and provided with suitable Danger Board. All SPN B.D.B's shall be properly earthed with one number 10 SWG galvanized iron wire each unless otherwise specified.

14.9 Switches

All switches for lights, fans and plug points shall be either piano key type switches in sheet steel switch board, unless specified otherwise.

14.10 Cables and Conductors

All cables shall conform to relevant Indian Standard. Conductors of all cables except for flexible cables, shall be of aluminium, unless specified otherwise.

14.11 Flexible Cables

Conductors of flexible cables shall be of copper. The minimum size of core acceptable is 0.50 sq. mm (14/0.193 mm). The maximum weight to which the following twin flexible cords may be subjected are as follows:-

Twin 16/0.20 mm : 3.3 lbs (1.5 kgs.)

Twin 23/0.0076 inch : 5.0 lbs (2.3 kgs.)

14.12 Installation of Main Switch Board, BDB's Mains, Sub mains, Distribution Wiring to Individual Points

The exact positions of all main switch board, BDB's and all runs of mains and sub mains, and distribution wirings to individual points including the exact position of all light fittings and switch boards shall be first marked on the buildings and shall be approved by the Employer / Employer's representative before actual commencement of the work. The D.Bs shall generally be installed at a height of 2.13 m (7 ft) from floor level.

14.13 Installation of Switch Boards

These shall be installed at a height of 1.5 mtrs (5'-0") and above the floor level.

14.14 Installation of Ceiling Fans

Unless otherwise specified all ceiling fans shall be hung not less than 2.75 M (9 ft) above floor. The suspension and clamp shall be painted with approved paint without involving extra cost.

14.15 Installation of HPSV and Fluorescent Light Fittings

HPSV type light fittings shall be used for pump house indoor and outdoor lighting with suitable suspension arrangement for indoor lights and pipe brackets for outdoor lights. and fluorescent light fittings shall be used for low height areas. The fluorescent light fittings are either suspended from ceiling or mounted directly on wall. The fittings are suspended from ceiling by two down rods, or fixed to ceiling/beam wall directly, shall be made with Mechanical/Metal fasteners. Electrical drill only shall be used while making holes for the fasteners which shall be capable of sustaining at least 10 kg of dead weight for fluorescent fittings and 25 kg for HPSV lighting fittings.

The down rods and accessories shall be painted with approved paint without involving extra cost.

Unless otherwise specified these should be suspended 2.60 M (8'-6") above the floor.

14.16 Installation Of Exhaust Fans

Exhaust Fans shall be fitted by means of rag bolts embedded in the wall. The required holes in the wall shall be made and finished neatly with cement plaster and brought to the original finish of the wall

14.17 Installation of Socket Outlet

No socket outlet shall be provided in the bath room at the height less than 130 cms (4'-3") from the floor.

No switches shall be provided inside the bath rooms.

Socket outlet at locations other than bath rooms shall be either 25 cms (10") or 1.5 mtrs(5'-0") from the floor as per requirement. All switch sockets out lets shall be provided with one 6A or 16A controlling switch.

14.18 Testing of Installation

Before a completed installation or an addition to an existing installation is put into service, the following tests shall be carried out by the contractor in presence of the Employer / Employer's representative.

a) Polarity of Switches

It must be ensured by test that all single pole switches have been fitted on the live side of the circuits they control

b) Insulation Test

i) By applying a 500 volt megger between earth and the whole system of conductors or any section thereof, with all fuses in place and all switches closed, all lamps in position or both poles of installation otherwise electrically connected together:- The result in meg ohm shall not be less than 50 divided by the number of points on the circuit, and should not be less than 1 meg-ohm.

ii) Between all conductors connected to one phase and all such conductors connected to the neutral or to the other phase conductors of the supply after removing all metallic connections between the two poles of the installation and switching on all switches. The insulation resistance shall be as in (i) above.

c) Earth Continuity Test

The earth continuity conductor including metal conduits and metal sheaths of cables in all cases shall be tested for electrical continuity. Electrical resistance of the above along with the earthing lead but excluding any resistance of earth leakage circuit breaker, measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not exceed one ohm.

d) Earth Resistance Test

To ensure effectiveness of installation earth, the value of earth resistance shall be within 5 ohm for installation capacity up to 5 KW and one ohm for installation of higher capacity for 415 / 240 V AC supply system. The 11 KV and 6.6 KV supply system shall have minimum value of earth resistance not more than one ohm for individual earth stations and the equivalent (combined) earth resistance shall not be more than 0.50 ohms. The total number of earth stations shall be calculated on the basis of actual value of soil resistivity measured at site to obtain the above equivalent earth resistance.

The completed work will be taken over only if the results obtained in above tests are within the limits mentioned above, and in accordance with I.E. Rules.

On completion of the installation work, a certificate shall be furnished by the contractor holding valid Electrical contractor licence, countersigned by the supervisor under whose direct supervision the installation was carried out. The supervisor counter signing the test result shall have valid supervisory licence from the Authority. This certificate shall be in a prescribed form as required by the local Electric Supply Authority. The installation shall not be considered as complete unless the installation is got inspected and passed by the Electrical Inspector, Directorate of Electricity.

The contractor shall have to take all initiatives and follow up the matter at his own cost for early approval of the installation for permanent energisation of the installation from the Directorate of Electrical Safety, Local supply Authority No extra amount will be paid on this account.

15.1 Special Specifications

a) Illumination level for the pump house indoor areas shall be designed on the basis of IS : 3646 with average minimum illumination level of 250 lux within the pump house. The outdoor areas shall be provided with an average illumination level of 15 – 20 lux

b) Before fixing all switches, fittings etc. should be produced before Employer / Employer's representative and get approved.

c) All metal switch boards and switch/regulator boxes to be used in work shall be painted with two coats of anti-rust primer (red lead paint) prior to erection. After erection they shall be again painted with two coats of enamel paint of approved quality.

d) Before execution of any portion of conduit work for wiring a neat proper layout should be made out by the contractor and got approved from the Employer /Employer's representative. For this purpose contractor is advised to get acquainted with the layout drawings of the Employer's representative.

e) While laying the conduits for concealed wiring in the ceiling or in the beams & columns and before casting the contractor must ensure that all the inlets and both ends of the conduits are plugged by means of dead end socket so that no foreign matter can enter the conduits and choke them.

f) Damage to any fitting during erection and before handing over the installation by contractor shall be set right or replaced by the contractor at his own cost.

g) Caution Board of proper size wherever required, shall be provided, as per I.E.E. regulations for which no extra payment will be admissible.

h) Any damages made on wall shall be repaired and should match with the surrounding surface otherwise same will be got done through Building Contractor at the cost of the Electrical Contractor and the cost thereof shall be recovered from their dues.

i) Earthing Installation shall be done in the presence of Employer's representative.

j) The installations should not be energized without adequate earthing.

k) The I.C. switches and Distribution Boards shall be provided with neat lettering in block letters with paint for identification of the I.C. switches and for the points connected to each fuse way of the D.B's for which no extra payment will be admissible.

15.2 Completion Drawings

The contractor shall be required to submit along with Final bill; the under-noted drawings on CD, along with three copies of Ammonia print each.

1. Plan (as per site layout drawing) of each floor (not less than 1 : 100 metric scale) showing :-

- i) Location of Main Switch Board, Distribution boards (with the circuit numbers controlled by them).
- ii) The runs of mains and sub mains.
- iii) Location of lights, fans, wall brackets/ fittings and, other power consuming devices together with type of fittings and fixtures including circuit numbers.
- iv) Position of Lightning Conductors and route of running conductor.
- v) Position of Earthing Stations for light and power and Lightning Conductor Installation.

2. Schematic lines layout diagram of each floor showing (i) Layout and connections of Main and Sub-board, B.D.B. having descriptions of the size, capacity, type and their numbers, the system and the source of supply, (ii) Location, Size, Type, length of main and sub main cables (iii) Loading of each B.D.B. indication of phases, Departmental mark on each B.D.B and switchgear. The drawings shall be very neatly drawn and submitted properly without folding them.

3. Cable route should be marked on site plan with measurements from permanent structures.

15.3 Conduit Wiring System

15.3.1 Type and Size of Conduit

All conduit pipe shall be heavy duty M.S conduit conforming to IS: 9537 wall thickness not less than 14 SWG thickness conforming relevant IS in all respects. The conduits are to be free from burrs and internal roughness. No conduits less than 20 mm in dia shall be used, unless specified.

15.3.2 Accessories

Only good quality approved accessories are to be used when necessary. All metal accessories shall be painted and the bare thread portion is to be painted with anti-corrosive preservative.

15.3.3 Fixing of Conduits

Conduit pipes shall be fixed by heavy gauge saddles metal bars, secured to wall/ceiling by screws driven into wood plugs at an interval of not more than 76 cm apart for vertical run and 50 cm apart for horizontal run; but on other side of couplers or bend of similar fittings-saddle shall be fixed at a distance of 30 cm from the centre of such fittings. The minimum thickness for saddles shall be 24 SWG, for conduits up to 25 mm dia and 20 SWG for larger sizes.

15.3.4 Outlets

All outlets for fittings, switches etc. shall be fixed on boxes of suitable metal for either surface mounting system or flush mounting system. In case of cast iron boxes the wall thickness shall be at least 3 mm and in case of welded mild steel sheet box the wall thickness shall not be less than 16 gauge. Except where otherwise stated 3 mm thick insulated laminated sheets shall be fixed on the front with screws.

Where conduits are terminated special care shall be taken for securely fixing conduits to outlets so as to any possibility of damages to cables / wires when drawn.

15.3.5 Cables to be Used

Unless stated otherwise only single core PVC insulated cables of approved manufactures shall be used for wiring in conduit system. The number of single core cables drawn in one conduit shall not be greater than maximum set out in Table II of Indian Standard (I.S. 732-1963) Code of Practice (revised) for electrical wiring installation(system voltage not exceeding 650 volts).

15.3.6 Looping-In-System

Distribution wiring in conduit to light, points etc. shall be done in looping system. In this system no joints or connections shall be made anywhere of the system except at terminating points such as at terminals of switches, ceiling roses, etc.

15.3.7 Earthing Continuity Wires

For conduits and accessories for distribution wiring should be provided with earthing attachment by number 14 SWG G.I. wire, unless specified otherwise.

For looping earthing G.I.wire shall be run on conduits being fixed with saddles. This wire shall not be normally visible after installation when run with the conduit. Where the wire has to be taken without the conduits this will be fixed with 'U' nails at 2' feet intervals.

15.3.8 Painting

Conduit and all conduit fittings and accessories shall be painted with two coats matt paint. Painting of conduits shall be done to harmonize with colour bearing surface, i.e. wall, joists, trusses etc. after installation and as approved by the Employer / Employer's representative.

15.4 Cable Installations

15.4.1 General

All PVC / XLPE insulated and unarmoured / armoured cables to be used shall conform to I.S. 1554 part I 1964 and of 1100 volt grade. Old and used cables must not be used for installation. Only one make of cable shall be used. All cables brought to site must be tested and got approved by the Employer / Employer's representative before these can be laid. The cables shall be despatched to site on wooden drums with ends sealed. Exact lengths shall be determined by the Contractor after measurement at site

15.4.2 Laying of Cables

a) Direct in Ground

Trenches shall be 750 mm deep (minimum) for LT Cables and 0.915 M (3'-0") deep minimum) for HT Cables from ground level and trenching work shall include all pumping and bailing out water. These trenches shall be wide enough to accommodate all the cables with brick separations as per the requirements specified in the relevant I.S.

When more than one multi core cable is to be laid in the same trench, a minimum horizontal interaxial spacing between cables will be as per relevant I.S.

After excavation of the trench of proper size, the bottom of the trench shall be dressed and levelled and filled with a 75 mm layer of fine sand. The cable shall then be laid with bricks on both sides of the cable continuously. After having the space within the bricks, filled and packed up to a level of 75 mm (3") above top of cable with fine sand, the top layer of bricks shall be placed side by side in continuous series as protective cover. Total No. of bricks required being 16 per metre run. The remainder of the trench shall be filled with riddled soil, well rammed and watered to a level of 75 mm (3") above surrounding ground level. The ground level surface of the whole trench route shall be restored properly after completion of cable laying.

b) Inside Building

Cables shall be laid on walls/ceiling/structure, unless specified otherwise, with M.S. Brackets and suitable clamps or over claw type aluminium cleats fixed on M.S. Brackets spaced not more than 450 mm apart. G.I Bolts of suitable sizes are to be grouted on the wall properly for fixing the brackets.

c) **Minimum** bending radius permissible is 12D for PVC Armoured Cables and 15D for HT XLPE Armoured cables. At joints and terminations, the individual core of multi core cables should never be bent so that the radius is less than 12 times the diameter over the insulation for L.T. cables and 15 D for H.T cables.

15.4.3 Cable Jointing

All cable joints shall be carried out by experienced and licensed jointers under strict supervision. Electro plated brass cable glands, aluminium / tinned copper cable sockets and approved jointing materials must be used. The price for cable jointing and finishing the ends of the cable shall include all materials and shall also provide for tools and plants for the work. The cable armouring is to be properly terminated. All cable accessories and other associated materials shall conform to Indian Standard Specification where applicable. Proper earthing of cable glands and armoured shall be included in the job.

15.4.4 Testing of Cables

Immediately after the initial laying and jointing work is completed, a pressure test shall be applied to all cables. Cables of 1.1 KV grade suitable for use on medium voltage should withstand for one minute a test with a 1000 volt constant pressure "Megger" Insulation Tester. If the test is unsatisfactory, the cost of all repairs and replacements and all extra work of removal and relaying will be made good by the contractor.

15.5 Testing of Installation

Before the completed installation is put into service or handed over to Employer, the installation is to be subjected to the above tests to the satisfaction of the E.I.C. The completed work will be taken over only if the results are acceptable to the E.I.C..

16.0 SAFTY REQUIREMENTS

16.1 SCOPE

This section covers the requirements of items to be provided in the sub-station for compliance with statutory regulations, safety and operational needs.

16.2 REQUIREMENTS

Safety provisions shall be generally in conformity with the B.O.Q as per instruction in writing by E.I.C. But, in particular following items shall be provided:

(a) Insulation Mats

Insulation mats conforming to IS 15652: 2006 shall be provided in front of main switch boards as well as other control equipments as specified.

(b) First Aid Charts and First Aid Box

Charts (one in English, one in Hindi, one in Regional language), of giving artificial respiration to a recipient of electrical shock shall be provided at appropriate place. Standard first aid boxes containing materials as prescribed by St. John Ambulance brigade or Indian Red Cross should be provided in each sub-station.

(c) Danger Plate

Danger Plates shall be provided on HV and MV equipments. MV danger be 200 mm x 150 mm made of mild steel at least 2 mm thick vitreous name led white on both sides and with the descriptions in signal red colour on front side as required. Notice plates of other suitable materials such as stainless steel, brass or such other permanent nature material shall also be accepted with the description engraved in signal red colour.

(d) Fire Extinguishers

Portable CO₂ conforming to IS 2878: 1976/ chemical conforming to IS 2171:1976 extinguishers, HCFC Blend A (P-IV) shall be installed in the sub-station at suitable places. Other extinguishers recommended for electric fires may also be used.

(a) Fire Buckets

Fire buckets conforming to IS 2546: 1974 shall be installed with the suitable.

(b) Tool Box

A Standard tool box containing necessary tools required for operation and maintenance shall be provided in the sub-station.

(g) Caution Board

Necessary number of caution boards such as "Man on Line" 'Don't Switch on' etc. shall be available in the sub-station.

(h) Key Board

A keyboard of required size shall be provided at a proper place containing castle keys, and all other keys of sub-station and allied areas