Nepal Electricity Authority

(Government of Nepal Undertaking)

Project Management Directorate

Electricity Grid Modernization Project-Additional Financing

Chobhar Patan Chapagaun 132 kV Underground Transmission Line Project

Matatirtha, Kathmandu

Ref No: CPCUGTLP- 080/81 Cha No 12

Date: August 16, 2023

To,

All Prospective Bidders.

Subject: **Issuance of Amendment-I**

Ref: Design, Supply, Installation, Testing and Commissioning of New Patan 132/66/11 kV GIS Substation (Package A1.2) *(PMD/EGMPAF/CPCUGTLP-079/80-01)*

Dear Sirs/Madams,

In reference to the captioned Bid published on July 05, 2023, we hereby attaching the Amendment-I sought by the bidders pursuant to Clause 7.1 of the bidding documents.

It is hereby requested to acknowledge the receipt of the same.

With Regards,

(Ukesh Shrestha)
Project Manager

Nepal Electricity Authority

Amendment to Bids

Amendment - 1

Date of Publication : 16 August, 2023	
Project No and Title	**4109-NEP: Electricity Grid Modernization Project-Additional Financing**
OCB No and Title	**PMD/EGMPAF/CPCUGTLP-079/80-01:Procurement of Plant for Design, Supply, Installation, Testing and Commissioning of New Patan 132/66/11 kV GIS Substation (Package A1.2)**
In reference to the above mentioned contract, it is notified that the amendment as listed in Table-1 (Amendment in VOL I, Bid Data Sheet), Table-2 (Amendment in VOL II, Technical Specifications) and Table-3 (Amendment in VOL III, Price Schedule) has been made as per VOL I, Section I, ITB, Clause No. 8 of the bidding document.	

Table - 1

S.No.	Clause Reference	Existing Provision	Amendment
1	Volume I, Section 2, Bid Data Sheet, Clause No. 24.1	The deadline for bid submission is Date: 18 August 2023 Time 12:00 Noon (Local Time)	The deadline for bid submission is Date: 3 September 2023 Time 12:00 Noon (Local Time)
2	Volume I, Section 2, Bid Data Sheet, Clause No. 27.1	The Bid Opening of Technical Bids shall take place at: Date: 18 August 2023 Time 12:30 Noon (Local Time)	The Bid Opening of Technical Bids shall take place at: Date: 3 September 2023 Time 12:30 Noon (Local Time)
3	Volume I, Section 2, Bid Data Sheet, Clause No. 21.1	The bidder shall furnish a bid security in the amount of: US$ 279,257.00 or an equivalent amount in Nepalese Rupees (NRs) 36,758,585.00	The bidder shall furnish a bid security in the amount of: US$ 280,000.00 or an equivalent amount in Nepalese Rupees (NRs) 36,856,400.00

Table - 2

S.No.	Clause Reference	Existing Provision	Amendment
1	Volume II, Chapter 19 Clause 16	16.1 Each GIS Hall shall have an independent ventilation system. Each Ventilation system shall consist of two 100% capacity systems, one operating and one stand-by. 16.2 To ensure that the air being supplied to the GIS hall is free from dust particles, a minimum two stage dust filtration process shall be supplied. This shall consist of at least the following: 1. Pre Filters: To remove dust particles down to 10 micron in size with at least 95% efficiency. 2. Fine Filters: To remove dust particles down to 5 microns in size with at least 99% efficiency. All the filters shall be panel type.Easy access should be available to the filters for replacement/cleaning. The ventilation of the GIS hall shall be of a positive pressure type with minimum 4 air changes per hour. The pressure inside the GIS hall shall be maintained 5 mm of water above the atmospheric pressure. Fresh outdoor air shall be filtered before being blown into the GIS hall by the air fans to avoid dust accumulation on components present in the GIS hall. GIS hall shall be provided with motorized exhaust dampers with local control.	16. 1 The ventilation of the GIS hall shall be of a positive pressure type with minimum 4 air changes per hour. The pressure inside the GIS hall shall be maintained 5 mm of water above the atmospheric pressure. Fresh outdoor air shall be filtered before being blown into the GIS hall by supply air fans to avoid dust accumulation on components present in the GIS hall. GIS hall shall be provided with motorized exhaust dampers with local control. Generally, GIS Hall shall have an independent ventilation system, which shall consist of two 100% capacity systems, one operating and one stand-by to be installed in Air Handling Unit (AHU) room. Due to space constraint in new Patan Substation, space for AHU room may not be available. In this situation, wall mounted air supply fans shall be provided. The Contractor shall decide capacity and quantity of wall mounted air supply fans considering N-1 criteria. One air supply fan shall remain as standby. To ensure that the air being supplied to the GIS hall is free from dust particles, minimum two stage dust filtration process shall be supplied. This shall consist of at least the following: 1. Pre Filters: To remove dust particles down to 10 micron in size with at least 95% efficiency. 2. Fine Filters: To remove dust particles down to 5 microns in size with at least 99% efficiency. All the filters shall be panel type. Easy access should be available to the filters for replacement/cleaning. For wall mounted air supply fans, filters as mentioned above shall be fitted with each fan unit. Noise level of wall mounted air supply fans shall be kept within acceptable limit.
2	Volume II, Chapter 14 Clause 2.3.1	Bore holes of Minimum 150 mm diameter in accordance with the provisions of relevant international standards/British standards(BS) at the rate of minimum one number bore hole per hectare or minimum 3 locations up to 20meter depth(Minimum) or to refusal which ever occur earlier shall be drilled for new areas (220 kV Yards and 220/132/33 kV yards wherever applicable).	Bore holes in accordance with the provisions of relevant international standards/British standards(BS) at the rate of minimum one number bore hole per hectare or minimum 5 locations up to 30 meter depth(Minimum) or to refusal which ever occur earlier shall be drilled for new areas (132 kV Yards ~~and 132/66/11~~ kV yards wherever applicable).

3	Volume II, Chapter 14	-	Section 14.2 Specification for Pile Foundation (58 Pages) - Attached

Table - 3

S.No.	Clause Reference	Existing Provision			Amendment		
		Item Description	Unit	Quantity	Item Description	Unit	Quantity
1	Volume III, Section IV Price Schedule, Schedule No. 1: PART-A: Owner Assessed Quantities, S.No. I (5)	110 V DCDB	Sets	1	220 V DCDB	Sets	1
2	Volume III, Section IV Price Schedule, Schedule No. 1: PART-A: Owner Assessed Quantities, S.No. L (1)	110 V	-	-	220 V	-	-
3	Volume III, Section IV Price Schedule, Schedule No. 1: PART-A: Owner Assessed Quantities, S.No. M (1)	110 V Float Cum Boost Battery Charger	-	-	220 V Float Cum Boost Battery Charger	-	-
4	Volume III, Section IV Price Schedule, Schedule No. 1: PART-C: Mandatory Spares, S.No. 6.1	110V Battery Chargers	-	-	220V Battery Chargers	-	-
5	Volume III, Section IV Price Schedule, Schedule No. 4 (a): PART-A: Employer Assessed Quantities, S.No. G (5.0)	110 V DCDB	Sets	1	220 V DCDB	Sets	1
6	Volume III, Section IV Price Schedule, Schedule No.4 (a): PART-A: Employer Assessed Quantities, S.No. H (1.0)	110 V	-	-	220 V	-	-
7	Volume III, Section IV Price Schedule, Schedule No. 4(a): PART-A: Employer Assessed Quantities, S.No. I (1.0)	110 V Float Cum Boost Battery Charger	-	-	220 V Float Cum Boost Battery Charger	-	-
8	Volume III, Section IV Price Schedule, Schedule No. 4(a): PART-C: Civil Works, S.No. 1.2	Dismantling and Disposing of Existing Building deducing the salvation cost of reusable materials.,and transporting all stock/store materials to place all complete as per drawings, specifications and instructions of the Engineer.	LS	1	Dismantling and Disposing of Existing Building/Foundation deducing the salvation cost of reusable materials.,and transporting all stock/store materials to place all complete as per drawings, specifications and instructions of the Engineer.	LS	1
S.No.	**Clause Reference**	**Existing Provision**			**Amendment**		
		Item Description	**Unit**	**Quantity**	**Item Description**	**Unit**	**Quantity**
9	Volume III, Section IV Price Schedule, Schedule No. 4(a): PART-C: Civil Works, S.No. 7.2	Providing and Laying of Reinforced Cement Concrete Design Mix M25 including pre cast, shuttering, Grouting of pockets & underpining but excluding steel reinforcement.	CuM	2500	Providing and Laying of Reinforced Cement Concrete Design Mix M25 including pre cast, shuttering, Grouting of pockets & underpining but excluding steel reinforcement.	CuM	3000

10	Volume III, Section IV Price Schedule, Schedule No. 4(a): PART-C: Civil Works, S.No. 8	Providing and fixing in position Fe 500 steel reinforcement of various diameter confirming to standard code in R.C.C. works including straightening, cutting, bending, binding with 20 SWG annealed wire for tying the reinforcement bars at each junctions (binding wire shall not be measured separately) including all waste and cut pieces, provision for adequate numbers of spacers, chairs, providing and placing cement mortar (1:1) cover blocks to keep the bars in intended position at all levels all complete as per drawings, specifications and instruction of the the engineer. (Lap length shall not be measured for the payment).	MT	320	Providing and fixing in position Fe 500 steel reinforcement of various diameter confirming to standard code in R.C.C. works including straightening, cutting, bending, binding with 20 SWG annealed wire for tying the reinforcement bars at each junctions (binding wire shall not be measured separately) including all waste and cut pieces, provision for adequate numbers of spacers, chairs, providing and placing cement mortar (1:1) cover blocks to keep the bars in intended position at all levels all complete as per drawings, specifications and instruction of the the engineer. (Lap length shall not be measured for the payment).	MT	375
11	Volume III, Section IV Price Schedule, Schedule No. 4(a): PART-C: Civil Works, S.No. 12.2	132 kV GIS Hall All Civil Works related to Pre-Engineered 132 kV GIS Hall to be supplied as per Schedule 1 including foundation, internal cable trench, excavation, PCC, RCC and Reinforcement etc all complete to erect the building as per approved drawing and Technical Specifications.	-	-	132 kV GIS Hall All Civil Works related to Pre-Engineered 132 kV GIS Hall to be supplied as per Schedule 1 including foundation, internal cable trench etc. all complete but excluding excavation, PCC, RCC and Reinforcement only which shall be paid separately under respective items of BPS to erect the building as per approved drawing and Technical Specification	-	-
12	Volume III, Section IV Price Schedule, Schedule No. 4(a): PART-C: Civil Works, S.No. 16.2	0.5 HP	Nos	2	2 HP	Nos	2
13	Volume III, Section IV Price Schedule, Schedule No. 4(a): PART-C: Civil Works, S.No. 20.1	Section Having four rails	SqM	150	Section Having two Rails	SqM	150
14	Volume III, Section IV Price Schedule, Schedule No. 4(a): PART-C: Civil Works, S.No. 24	-	-	-	Boring, Providing and installation of bored cast-in-situ RCC piles of specified diameter and of any length below the pile cap with M25 grade of concrete, excluding reinforcement steel and M25 concrete in all types of soil but including temporary guide casting (supplying and providing M.S. Liner), Bentonite solution and the length of pile to be embedded in the pile cap (Length of pile for payment shall be measured form the bottoom of pile cap), all necessary labour, plants, tools and tackles, excavation with necessary lift and lead etc) complete as necessary for proper execution of the job.RCC and Reinforcement steel, shall be measured and paid separately under respective items of BPS .	-	-

S.No.	Clause Reference	Existing Provision			Amendment		
		Item Description	Unit	Quantity	Item Description	Unit	Quantity
15	Volume III, Section IV Price Schedule, Schedule No. 4(a): PART-C: Civil Works, S.No. 24.1	-	-	-	500 mm diameter RCC bored pile.	RM	400.00
16	Volume III, Section IV Price Schedule, Schedule No. 4(a): PART-C: Civil Works, S.No. 24.2	-	-	-	600 mm diameter RCC bored pile.	RM	2,000.00

17	Volume III, Section IV Price Schedule, Schedule No. 4(a): PART-C: Civil Works, S.No. 24.3	-	-	-	750 mm diameter RCC bored pile.	RM	400.00
18	Volume III, Section IV Price Schedule, Schedule No. 4(a): PART-C: Civil Works, S.No. 25	-	-	-	Conducting integrity test on pile using electronic control unit, hand held hammer, acclerometer, computer with required software to assess as-installed pile characterstics including mobilisation of necessary manpower, equipments, materials etc required for sucessful completion of the job.	Nos.	160.00
19	Volume III, Section IV Price Schedule, Schedule No. 4(a): PART-C: Civil Works, S.No. 26	-	-	-	Initial Load Test for Pile	LS	1
20	Volume III, Section IV Price Schedule, Schedule No. 4(a): PART-C: Civil Works, S.No. 27	-	-	-	Routine Test for Pile	LS	1

For further details, please visit our website https://www.nea.org.np/tender_prequalification

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CHAPTER - 4
A.C. and DC DISTRIBUTION BOARD

1.0 SCOPE

1.0.1 These specifications are intended to cover the design, engineering, manufacturing, inspection and testing at manufacturer's works, packing, supply & delivery, Testing & commissioning of 400 volts, 3 phase, 4 wire, AC distribution switch boards cubical in-door type complete with all materials, accessories and fittings, erection & maintenance tools & tackles, mandatory spares as detailed in this specification.

1.0.2 The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life.

1.0.3 Any material and equipment not specifically stated in this specification but which are necessary for satisfactory operation of the equipment shall be deemed to be included unless specifically excluded and shall be supplied without any extra cost.

1.1 STANDARDS

1.1.1 The equipment covered by this specification shall confirm to the provisions of the following IEC/International standards as amended up to date except where specified otherwise in this specification.

The Equipment and material meeting the requirement of any other Indian standards or internationally recognized standards which ensure a quality equal or better than the standard mentioned above shall also be acceptable. Where the equipment confirms to any other standards then salient points of difference between the standards adopted and those prescribed in these specifications shall be clearly brought out in the bid and a copy of the applicable standards shall also be enclosed by the bidder with the bid.

1.2 DESCRIPTION

1.2.1 The LT AC Distribution Board shall be fed from 315 KVA, 11kV/400 V distribution transformer.

1.2.2 Tentatively the following minimum feeders shall be required from the AC Distribution Board, and each shall be suitably rated as per requirement.

a. Incoming from the Station Transformers i.e. 4 wire, 3 phase supply.
b. 3 phase, 4 wires supply for oil filtration set.
c. Single phase supply to various 132 kV Circuit Breakers (separate feeders to each).
d. 3 phase, 4 wires supply for indoor lighting.
e. 3 phase, 4 wires supply for outdoor lighting.
f. 3 phase, 4 wires for transformer Marshalling boxes.

g. 1 phase supply to 33 kV switchgear panel board.

h. 1 phase supply to 132 kV C&R Panels.

i. 1 phase supply to Substation Automation System, HMI, printers etc.

j. 1 phase supply to 132 kV isolator boxes for motor operation.

k. 3 phase, 4 wires feeders for Battery chargers.

l. Supply for OPGW Communication Panel.

m. At least 20% (minimum 1) of each rating as spares.

n. Three phase/single phase supply as per requirement with individual MCCB/MCB's to Air conditioning system, Fire detection, alarm and control system, etc.

1.2.3 Incoming from transformer shall be provided with the following:

a. Suitable MCCBs (with adjustable setting) with O/L & S/C releases

b. One No. 100 mm dia. flush mounted Ammeter with range 0-600 amp with phase selector switch.

c. One No. 100 mm dia. flush mounting voltmeter scale range 0-500 V with fuse and selector switch, along with LED type, indicating lamps before the selector switch.

d. Suitable CTS having burden 25 VA and accuracy class – I

e. One No. 3 phase, 4 wires unbalanced load integrating watt – load meter operable on CT. Each circuit as indicated above shall have switch rating and labeling as mentioned against each and shall include bus-bar connections, terminals cable glands and legs etc.

f. Bus bar shall be of Aluminum and designed for 630 Amps for phases and 400A for neutral.

1.2.4 400VAC switch board cubical type shall consist of feeders as above and shall have MCBof rating and labeling as per system requirement. It shall include bus-bar connections terminals, Cable glands and lugs. The aluminum bus- bar shall be designed for 630 Amps for phases and 400 Amp for neutral based current density of 85 Amp per sq. cm. The bidder shall design the ratings of MCB/MCCBs' which shall be approved by purchaser. The above detail of outgoing feeders is provisional and is subject to change during detailed engineering.

1.2.5 The A.C. Board shall be fitted with the following accessories:

1. 230 V, AC space heater with MCB and thermostat.
2. Only MCB/MCCBs' as appropriate shall be provided. No fuses are allowed.
3. All the feeders shall be provided with single phase ammeters. For three phase supplies an ammeter with selector switch (or in yellow phase only) shall be provided. Typical ammeter size shall be 70 mm x 70 mm. These details shall be finalized during detailed engineering.

4. Necessary CTs wherever required for current measurement shall be provided. The secondary rating of each shall be 1A.
5. Indicating lamps shall be of low wattage typically 2.6 W or less.
6. All the terminals for external cabling shall be suitably rated as per the size of the external cables.
7. All the indicating instruments, lamps, handles, MCCBs', MCB's shall be flush mounted.
8. Panel shall be indoor, single front, fixed type.
9. Base frame shall be of ISMC-100.
10. Phase clearances shall be as per IS/IEC.
11. Panel Paint: will be decided during detailed engineering
12. Interior & mounting plate: Glossy white
13. Bus bars to be colour coded and also the circuits taken from it.
14. Earth bus of 50 x 6mm copper strip shall project out of the panel at both ends and shall have two holes for earth connections.
15. Control Wiring: 1.5 mm^2 copper (48 strands), 2.5 mm^2 copper for CTs (48 strands)
16. Power Switch & MCCB shall be door interlocked and shall have pad locking
17. Caution Name Plates for live terminals shall be provided.

DC DISTRIBUTION BOARD

1.3.1 The DC Distribution Board for both 220V and 48V system shall be fed from respective Battery Charger.

1.3.2 Tentatively the following minimum feeders shall be required from the DC Distribution Board, and each shall be suitably rated as per requirement.

a. Incoming 2 Nos with change-over facility from the battery chargers i.e. 4 wire, 3 phase supply.
b. Supply to various 132 kV Circuit Breakers, Disconnectors etc (separate feeders to each).
c. supply to 11 kV switchgear panel board.
d. supply to 132 kV C&R Panels.
e. supply to Substation Automation System, HMI, printers etc.
f. Supply for Communication Panel.
g. Emergency lighting
h. Others required services
i. At least 20% (minimum 1) of each rating as spares.

1.2.6 The switch board cubical type shall consist of feeders as above and shall have MCB of rating and labeling as per system requirement. It shall include bus-bar connections terminals,

Cable glands and lugs. The aluminum bus- bar shall be designed to cater the current as required by the capacity of the battery charger and loads. The bidder shall design the ratings of MCB/MCCBs' which shall be approved by purchaser. The above detail of outgoing feeders is provisional and is subject to change during detailed engineering.

1.2.7 The A.C. Board shall be fitted with the following accessories:

18. 230 V, AC space heater with MCB and thermostat.
19. Only MCB/MCCBs' as appropriate shall be provided. No fuses are allowed.
20. All the feeders shall be provided with ammeters.
21. Indicating lamps shall be of low wattage typically 2.6 W or less.
22. All the terminals for external cabling shall be suitably rated as per the size of the external cables.
23. All the indicating instruments, lamps, handles, MCCBs', MCB's shall be flush mounted.
24. Panel shall be indoor, single front, fixed type.
25. Base frame shall be of ISMC-100.
26. Phase clearances shall be as per IS/IEC.
27. Panel Paint: will be decided during detailed engineering
28. Interior & mounting plate: Glossy white
29. Bus bars to be colour coded and also the circuits taken from it.
30. Earth bus of 50 x 6mm copper strip shall project out of the panel at both ends and shall have two holes for earth connections.
31. Control Wiring: 1.5 mm^2 copper (48 strands), 2.5 mm^2 copper for CTs (48 strands)
32. Power Switch & MCCB shall be door interlocked and shall have pad locking
33. Caution Name Plates for live terminals shall be provided.

1.3 CONSTRUCTIONAL FEATURES

1.3.1 Station Supply LT Board

The supply board shall comprise of:

a. Metal enclosed, indoor /outdoor mounted, dust and vermin proof and self-supporting cubicle type made –up of mild steel sections and cold rolled sheet steel of 2 mm thickness for enclosure and all load bearing members, doors & fitting plate. The Gland Plate shall be 3 mm thick, sheet steel, with double compressions, chromium plated brass glands.

b. The board shall be stiffened properly to be free from vibration, twist and bends. The degree of protection of enclosure to be not less than IP-54 for all indoor type panels

and IP-55 for all outdoor mounted panel or boards respectively as stipulated by relevant IEC.

c. Requisite number of sheet steel enclosure for mounting circuit breakers, relays, switches, CTs and other components. Light structural members shall be jointed preferably by bolting.

d. Separate cable / bus- bar chambers duly partitioned, removable covers and metals still frames of single front double access type having feeders located in the front and vertical bus bars and cable chamber located in the rear.

e. Detachable or hinged type door with handle and locking arrangements and easy access for inspection and maintenance works.

f. Bottom frame suitable for erection on flush concrete floor by means of evenly spaced grouting bolts projecting through the base channel members.

g. Necessary facilities for entry of cable from the bottom. No access to any live part inside the panel to avoid accident. Separate cable support to avoid load on the thimble of cable as well as on the links.

h. Synthetic rubber Gaskets all-round the perimeter of cover, gland plates, removable covers and doors shall be provided.

i. Eye bolts at the top to facilitate lifting and anti-vibration pads between base frame and panel to prevent vibration.

j. Adequate strength to withstanding all stresses imposed during handling, transportation, installation and operation without distortion or damage. The panels shall be assembled to the extent possible within transporting and handling limitations duly wired up and ready for installation in accordance with this specification.

k. Each MCB to have separate bus –link wired up to terminal block so that by removal of link, the outgoing feeder is isolated without removing cable from the terminals.

l. The minimum component height will be 250 mm form the ground level for case of maintenance.

m. It must be ensured while designing the switch boards that adequate electrical clearance as required under the rules shall be provided for the various components inside the cubical.

1.3.2 Distribution Board

a. The boards shall be fabricated out of best quality cold rolled sheet steel of 2 mm including for doors & sides and shall be fully dust and vermin proof affording a degree of protection of IP – 54 for indoor DBs and IP 55 for outdoor DBs as per IS – 2174.

b. Distribution boards shall be provided both hinged door with handle and looking facility for switch on inter lock facility for switch on interlock of doors. Doors shall be gasketted all round with neoprene gaskets.

c. All accessible live connections / parts shall be shrouded and it shall possible to change /replace individual MCB /Fuse units from the front of the board without danger & coming in to contact with live parts.

d. Adequate interior cabling space and suitable removable type cable entry plates shall be provided for top/ bottom entry of cable gland plate shall be supplied undrilled. Necessary number of glands to suit the specified cable shall be provided. Cable glands shall be screwed on type and made of chromium plated brass.

e. The DB shall have two earthing terminals for connecting to the stations earthing.

f. The AC and DC DBs shall be either floor mounted type. Suitable foundations channels with necessary bolts and nuts shall be provided.

g. The danger board shall be fixed on the front of the door of DBs as per standards.

h. Wiring inside the panel shall be carried out with 1100 V grade PVC insulated stranded copper conductors of adequate size on both ends of each wire engraved identification ferrules shall be provided.

i. Bus bar shall be of copper adequately sized for the specified continuous current rating such that the maximum temperature of the busbar and links does not exceed 75^0 C.

j. All MCBs /Isolators /switches etc. shall be flush mounted with hinged door provided with locking arrangement and an inner Bakelite sheet /fibre glass sheet shall be provided inside such accidental contact.

k. Equipment mounted inside the panel shall be provided with individual labels with equipment designation /rating. Front of the panel shall be provided with label engraved with designation of the panel as furnished by the purchaser. Label shall be made of 3 ply lamicold /engraved PVC having white letters on black ground. Letter size shall be 4 mm minimum.

l. Terminal blocks shall be 1100 V grade clip on type, molded in melamine suitable for terminating incoming cable of suitable size of stranded copper conductor and outgoing circuits of approved sizes. All the terminals shall be shrouded, numbered and provided with identification strip for the feeders.

m. MCB's shall be current limiting type magnetic and thermal release suitable for manual closing and automatic tripping under fault condition single pole MCB's shall have interrupting capacity not less than 10 kA. MCB knob shall be marked with ON/OFF indication. A trip free release shall be provided to ensure tripping on

fault even if the knob is held in on position to avoid accidental contact. MCCB shall have adjustable setting, O/L & S.C. releases.

n. Fuses if required shall be HRC cartridge type complete with fuses fittings. Fuses fittings shall incorporate fully insulated shrouded contacts. Visible indication of operation of fuses shall be provided. However, purchaser would not prefer to have fuses instead MCB's should be provided.

o. The indoor panel shall be finalized during detailed engineering. The inside of the panel shall be glossy white.

1.4 PAINTING

a. All sheet work shall be phosphate in accordance with following procedure and in accordance with IS/IEC, code of practice for phosphating iron and steel, with seven tank process.

b. Oil, grease and dirt shall be thoroughly removed by emulsion cleaning.

c. Rust and scale shall be thoroughly removed by emulsion cleaning.

d. Rust and scale shall be removed by pickling with dilute acid followed by washing and running water rinsing with slightly alkaline hot water and drying.

e. After phosphating, through rinsing shall be carried out by clean water followed by final rinsing with dilute solution and oven drying.

f. The phosphate coating shall be sealed by the application of two coats of red mixed stoving type Zinc chromate primer. The coat may be 'flash dried' while the second coat shall be stove dried.

g. After the application of the primer, two coats of finishing synthetic enamel shall be applied, each coat followed by stoving. The second finishing coat shall be applied after completion of tests. The color of the finishing paint on the exterior should be got approved form the purchasers before painting. All the panels and DBs shall be painted white in the interior.

h. Each coat of primer and furnishing paint shall be of a slightly different shade to enable inspection of painting.

i. The final finished film thickness of paint on sheet steel shall not be less than 100 microns and shall not be more than 150 microns.

j. Finished painted appearance shall present an aesthetically pleasing appearance free from dents and uneven surface.

k. Adequacy quantity of finishing paint shall be supplied for minor touchup required at site after the installation of the L.T., AC station board and distribution boards.

1.5 BUS – BAR, SWITCHING DEVICES & CONNECTIONS

1.5.1 LT Station Supply Board

Bus bar system for LT station supply board shall be assembled and fully tested and certified in accordance with relevant standards i.e. IS :375 or BS : 5486 & IEC 439

The busbars of LT station supply boards shall be of high conductivity aluminum and of uniform rectangular cross section. The size of bus bar shall be got approved from the purchaser before the procurement /fabrication. The bus bars and supporting arrangements shall be designed to withstand thermal and magnetic stresses corresponding to 10 kA fault level. All bus bars and metallic bus supports shall be insulated by heat shrunk PVC sleeves with exceptional dielectric properties to provide additional protection against accidental contact and to prevent failure in the event of accidental presence of external agents. Bus bars supports shall be arc resistant flame retardant, porcelain type or sheet moulding compound having high insulation resistance and de-moulding compound having high insulation resistance and dielectric strength to avoid ground faults of bus due to dust collection. At the bus- bar joints and tap-off points, removable shrouds (sleeves) shall be provided. Temperature rise shall not exceed the maximum allowable temperature for the equipment as specified in relevant IS/IEC specification even under over load conditions and shall be of sufficient size to limit the temperature rise not to exceed the specified value in the applicable standard inside the enclosure. Ground bus shall be provided at the bottom of each station supply board throughout the entire length of the board. This bus shall be earthed solidly by connecting to the main earthling system of the sub- station. There should be provision for earthing at both ends of the switchboard Lugs, bolts, nuts and spring washers shall be provided for earth connection.

1.5.2 Distribution Board

These shall be provided whenever required to further distribute the three phase supply taken from the ACDB. The bus bars of distribution boards shall be of electrolytic copper having 99.9 % purity as per IS-440 unless otherwise specified. The size of the Bus bars be got approved form the purchaser during detailed engineering.

a) All bus bars, MCBs, Switch fuse units, fuses and connection shall be of sufficient size to limit the temperature not to exceed the specified value in the relevant standard inside the enclosure while carrying full load current. All main busbars connections and bus bar outgoing taps be tin plated and tightly clamped with through bolts to ensure maximum conductivity. All bus bars shall be rigid type. All bus bars connections shall be accessible for inspection and maintenance purpose.

b) Bus bars supports shall be made of suitable insulating material such as sheet moulding compound, glass reinforced moulded plastic material, or cast resin etc., of

thickness not less than 6 mm. Separate supports shall be provided for all three phases, anti – tracking barriers shall be incorporated.

c) The bus bars shall be protected from Accidental contact by using highly not less than 6 mm thick.

d) The size of neutral bus of the wall mounted type 3 phase 4 wire distribution board shall be rated as the phase bus-bars. The neutral bus should have sufficient terminals and detachable links for all the single phase outgoing and supports shall have sufficient strength to with stand thermal and electromechanical stresses for a short circuit level of 10 kA of the system.

1.6 MOULDED CASE CIRCUIT BREAKERS (MCCB)

The MCBs shall be of reputed make having proven performance record with minimum rupturing capacity of 10 kA. The MCCBs shall be quick make quick break, independent manual type trip free mechanism. Position of knob shall be provided to test trip the MCCBs mechanically. Overload and short circuit protection for all circuits shall be provided for MCCBs. The MCCBS shall be covered with the insulating case and covers made of high strength, high resistant and flame retardant thermosetting insulating material.

1.7 MINIATURE CIRCUIT BREAKERS (MCB)

The MCBs shall be of reputed make and the characteristics of MCB shall be suitable for control & protection circuit equipment's, high pressure mercury vapour / sodium vapor lamps / fluorescent tubes & power points etc. MCB shall be hand operated, air break, quick make, quick break confirming to applicable standards mentioned. The out-going MCBs shall be provided with overload / short circuit device for protection under overload and short circuit conditions. The MCB shall have a minimum interrupting rating of 10 kA. MCB shall be flush mounted and fitted on Zinc chromium M.S channel provided in DB construction. Single pole MCBs shall be provided for all outgoing A.C feeders.

1.8 RESIDUAL CURRENT – OPERATED CIRCUIT BREAKERS (RCCB) / EARTH LEAKAGE CIRCUIT BREAKERS (ELCB)

1.8.1 The RCCB/ELCB offered shall be suitable for particular application in conjunction with MCB and arranged for manual closing and opening and automatic tripping on earth fault condition. In case of multi-pole circuit breakers, the indication shall represent the position of all the poles. The metallic portions of the mechanism shall be either inherently resistant to or treated so as to make them resistant to atmospheric corrosion. The operating mechanism shall be trip free. The operation mechanism case shall be effectively sealed by the manufacturer to prevent access to the mechanism. The case shall be of insulating material.

1.8.2 The RCCB shall be provided with test device for testing automatic opening of the circuit breaker by an integral test device. The test device shall be arranged for external operation in such a way that the protection afforded by the cover or enclosure is not impaired.

1.8.3 The product of rated residual current (rated tripping current) in amperes and the earth loop impedance in ohm should not exceed the value 50. The RCCB shall be so chosen that the same has lowest suitable tripping current.

1.9 FUSE HOLDER /BASE

Fuse holder be suitable for HRC fuse links of required rating. They shall be made up of superior grade phenolic moulding compound with non – inflammable property. Fuses holder shall be supplied with necessary cable holding screws and terminal lug fasteners and conducting portion copper carrier with extruded brass base support. Further conducting part shall be silver plated to provide long lasting shall be complete with pressure clip so formed to provide durable firm grip of male and female parts. Fuse holder shall be fully shrouded to ensure personnel safety.

1.10 FUSES

Generally fuses shall not be used anywhere. However if approved by purchaser due to specific situation the fuses shall be of reputed make and shall be HRC Cartridge type with minimum rupturing capacity of 10 kA. The fusing factor shall be greater than 1.5 and shall be provided with visible indicator for having operated. Fuses shall be dimensionally interchangeable with any other compatible make and shall be so designed to ensure non-deteriorating time current characteristics.

1.11 INTERNAL WIRING

The LT AC and DC station supply board and the distribution boards shall be supplied with complete internal wiring. The wiring shall be carried out the 1100 V grade, PVC insulated. Stranded supper conductor cables of adequate size shall be used to suit the rated circuit current. Engraved identification ferrules, marked to correspond with the wiring diagram shall be fitted at both ends of each wire. All wiring shall be terminated on terminal blocks. Terminal blocks shall be one piece moulded and suitable for 500 V. Stud type terminal blocks shall be used for higher current rating. Terminals shall be adequately rated for the short circuit current. Typically terminals of 'Phoenix Contact' make shall be provided which shall be approved by purchaser during detailed engineering.

1.12 NAME PLATE

Name plate shall be made of non-rusting metal or engraved on PVC shall be of size 50 mm x 20 mm indicating the feeder details and shall be provided for all feeders for easy identification DB No. etc. shall be provided.

1.13 DRAWINGS & LITERATURE

After receipts of the order, the contractor shall be required to furnish 10 prints of the following drawings for approval:-

a) General arrangements drawing of AC distribution board.
b) Typical schematic diagram of AC distribution board.
c) Complete assembly drawing of AC distribution boards showing plan, elevation. sectional views and location of terminal blocks cable entry details
d) Control and wiring diagram for each module of AC distribution board including spare terminals and inter modular and inter panel wiring.
e) Foundation plan showing location, channels, foundation bolts etc.
f) Schematic control diagram for control interlocks, relays, instruments and space heaters.
g) Protective relay characteristics of each type of relay
h) Fuse characteristics curve for each type of rating
i) Technical and descriptive literature giving details of the equipment offered.

1.14 TESTING & INSPECTION

1.14.1 All tests and inspection shall be made at the manufacturer's works unless otherwise specifically agreed upon by the manufacturer and purchaser at the time of placement of purchase order. The manufacturer shall afford to the inspector representing the purchaser, all reasonable facilities, without charge to satisfy him that the material being furnished is in accordance with these specifications. The purchaser reserves the right to get any component/material being used by the manufacturer of the L.T. board tested from any recognized test house. No material shall be dispatched without prior approval of the all the test reports and certificates by the purchaser.

1.14.2 The inspection by the purchaser or his authorized representative shall not relieve the bidder of his obligation of furnishing equipment in accordance with the specification.

TABLE-1.14.2.1

TECHNICAL PARTICULARS

1.	**AC SYSTEM**	3 phase, 4 wire, solidly earthed

	a. Voltage	400 volts- 15 % to +10 %
	b. Frequency	50 Hz ± 3 %
	c. Combined variation in voltage & frequency	- 10 % to + 10 % Absolute sum
	d. Fault level	10 kA (rms)
2.	**BUS BAR**	
	a. Continuous	630 A Aluminum
	b. Short time (1 Sec)	10 kA rms
3.	**ONE MINUTE POWER FREQUENCY WITHSTAND VOLTAGE**	
	a. Power circuits	2.5 kV (rms)
	b. Control circuits	2.5 kV (rms)
4.	**MOULDED CASE CIRCUIT BREAKER**	
	a. Voltage	AC 3- phases –415 V (-15 to + 10 %)
	b. Frequency	50 Hz
	c. Short circuit Performance	10 kA (rms)
	d. Making capacity	2.5 times breaking capacity
	e. Operating Mechanism	Manual , trip free
	f. Temperature rise	As per IEC
	g. Mechanical rise	As per IEC
	h. Auxiliary contacts	4 No., 4 NC
5.	**METERS**	
	a. Accuracy class	1.0 or better
	b. one minute power frequency withstand voltage	2 .5 kV (rms)
6.	**CURRENT TRANSFORMERS**	
	a. Type	Cast resin, Bar primary
	b. Secondary circuit	1 Amp.
	c. Voltage class and Frequency	1100 V, 50 Hz
	d. Class of insulation	E or better
	e. Accuracy	
	I. Accuracy class metering CT	Class 1, 10 VA

	II. Accuracy class protection CT	5p 10 , 15 VA
	f. Short time current rating	10 kA (rms) for 1 sec.
	g. one minute power frequency withstand voltage	2.5 kV (rms)
7.	**VOLTAGE TRANSFORMERS**	
	I. Type	Cast resin
	II. Rated voltage	415 V±10%
	a. Primary	415 V /√3
	b. Secondary	110V/√3
	III. Accuracy class and VA burden	
	a. Metering	1.0, 10 VA
	b. Protection	3 p, 50 VA
	IV. Method of connection	
	a. Primary	Star
	b. Secondary	Star
	V. Rated voltage factor	1.1 continuous , 1.5 for 3 sec.
	VI. Class of insulation	E or better
	VII. One minute power frequency withstand voltage	2.5 kV (rms)
8.	**RELAY**	
	a. One minute power frequency withstand voltage	2.0 kV (rms)
9.	**CUBICLE COLOUR FINISH**	
	a. Interior	Glossy white
	b. Exterior	Decided during detailed engineering
10.	**ACCESSORIES**	
	a. Plug point with switch fuse.	
	b. Space heater with thermostat	
	c. Name plate on front of rear	
	d. Danger plate	

TECHNICAL PARTICULARS

1.	**DC SYSTEM**	3 phase, 4 wire, solidly earthed
	a. Voltage	400 volts- 15 % to +10 %
	b. Frequency	50 Hz ± 3 %
	c. Combined variation in voltage & frequency	- 10 % to + 10 % Absolute sum
	d. Fault level	10 kA (rms)
2.	**BUS BAR**	
	a. Continuous	250 A Aluminum
	b. Short time (1 Sec)	10 kA rms
3.	**MOULDED CASE CIRCUIT BREAKER**	
	a. Voltage	DC 220 V/110 V (-15 to + 10 %)
	b. Short circuit Performance	10 kA (rms)
	c. Making capacity	2.5 times breaking capacity
	d. Operating Mechanism	Manual , trip free
	e. Temperature rise	As per IEC
	f. Mechanical rise	As per IEC
	g. Auxiliary contacts	4 No., 4 NC
4.	**METERS**	
	a. Accuracy class	1.0 or better
	b. one minute power frequency withstand voltage	2 .5 kV (rms)
5.	**RELAY**	
	a. One minute power frequency withstand voltage	2.0 kV (rms)
6.	**CUBICLE COLOUR FINISH**	
	a. Interior	Glossy white
	b. Exterior	Decided during detailed engineering
7.	**ACCESSORIES**	
	a. Plug point with switch fuse.	
	b. Space heater with thermostat	
	c. Name plate on front of rear	
	d. Danger plate	

CHAPTER 5: BATTERY AND BATTERY CHARGER

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CHAPTER: BATTERY & BATTERY CHARGER

1.1. GENERAL TECHNICAL REQUIREMENTS

1.1.1. All materials/components used in battery chargers and batteries shall be free from flaws and defects and shall conform to the relevant Indian/IEC standards and good engineering practice.

1.1.2. DC System shall consist of two (2) float-cum-boost chargers and one (1) battery sets for each of 220V and 48 V systems respectively or as per BPS. The standard scheme drawing is enclosed with this specification. The design shall be redundant such that while one charger is working other shall be in stand by mode.

1.1.3. Bidder shall select number of cells, float and Boost voltage to achieve following system requirement:

System Voltage	Maximum Voltage during Float operation	Minimum voltage available when no charger working and battery fully discharged upto 1.85V per cell.	Minimum Nos of cell
220 Volt	242 Volt	198 Volt	107
110 Volt	121 Volt	99 Volt	54
48 Volt	52.8 Volt	43.2 Volt	23

Bidder shall furnish calculation in support of battery sizing, selection of number of cells, float and Boost voltages during detailed engineering for Owners acceptance.
Battery sizing calculations shall be done as per IEEE- 485 on the basis of following duty cycle:

	Load	**Duration**	**Type Of Loads**
220V DC System	Continuous Load	3 hours	Relays, IEDs, Station HMIs, spring charging, Isolator interlocking load, Miscellaneous permanently connected loads etc.
	Emergency Load	1 hour	Substation emergency lighting loads.
	Momentary Load	1 minute	Breaker closing, Tripping loads (taking simultaneous occurrence as per system)
	Load	**Duration**	**Type Of Loads**
110V DC System	Continuous Load	3 hours	Relays, IEDs, Station HMIs, spring charging, Isolator interlocking load, Miscellaneous permanently connected loads etc.
	Emergency Load	1 hour	Substation emergency lighting loads.
	Momentary Load	1 minute	Breaker closing, Tripping loads (taking simultaneous occurrence as per system)
48V DC System	Continuous Load	3 hours	Continuous load associated with PLCs.(when speech is not working)
	Momentary Load	15 minute	Loads associated with PLCs (when speech is working)

1.2. Battery

1.2.1. Type

The DC Batteries shall be VRLA (Valve Regulated Lead-Acid) type and shall be Normal Discharge type. These shall be suitable for a long life under continuous float operations and occasional discharges. Air-conditioning shall be provided in Battery room the requirement of which has been specified elsewhere in the Technical Specification. The 220 V / 110V DC system is unearth and 48 V DC system is + ve earth system.

1.2.2. Constructional Requirements

The design of battery shall be as per field proven practices. Partial plating of cells is not permitted. Paralleling of cells externally for enhancement of capacity is not permitted. Protective transparent front covers with each module shall be provided to prevent accidental contact with live module/electrical connections.

1.2.3. Containers

The container material shall have chemical and electro-chemical compatibility and shall be acid resistant. The material shall meet all the requirements of VRLA batteries and be consistent with the life of battery. The container shall be fire retardant and shall have an Oxygen Index of at least 28 %. The porosity of the container shall be such as not to allow any gases to escape except from the regulation valve. The tensile strength of the material of the container shall be such as to handle the internal cell pressure of the cells in the worst working condition. Cell shall not show any deformity or bulge on the sides under all working conditions. The container shall be capable of withstanding the rigours of transport, storage and handling. The containers shall be enclosed in a steel tray.

1.2.4. Cell Covers

The cell covers shall be made of suitable material compatible with the container material and permanently fixed with the container. It shall be capable to withstand internal pressure without bulging or cracking. It shall also be fire retardant. Fixing of Pressure Regulation Valve & terminal posts in the cover shall be such that the seepage of electrolyte, gas escapes and entry of electro-static spark are prevented.

1.2.5. Separators

The separators used in manufacturing of battery cells, shall be of glass mat or synthetic material having high acid absorption capability, resistant to sulphuric acid and good insulating properties. The design of separators shall ensure that there is no misalignment during normal operation and handling.

1.2.6. Pressure Regulation Valve

Each cell shall be provided with a pressure regulation valve. The valve shall be self re-sealable and flame retardant. The valve unit shall be such that it cannot be opened without a proper tool. The valve shall be capable to withstand the internal cell pressure specified by the manufacturer.

1.2.7. Terminal Posts

Both the +ve and –ve terminals of the cells shall be capable of proper termination and shall ensure its consistency with the life of the battery. The surface of the terminal post extending above the cell cover including bolt hole shall be coated with an acid resistant and corrosion retarding material. Terminal posts or any other metal part which is in contact with the electrolyte shall be made of the same alloy as that of the plates or of a proven material that does not have any harmful effect on cell performance. Both +ve and –ve posts shall be clearly and unambiguously identifiable.

1.2.8. **Connectors, Nuts & Bolts, Heat Shrinkable Sleeves**

Where it is not possible to bolt the cell terminals directly to assemble a battery, separate non-corroding lead or copper connectors of suitable size shall be provided to enable connection of the cells. Copper connections shall be suitably lead coated to withstand corrosion due to sulphuric acid at a very high rate of charge or discharge.
Nuts and bolts for connecting the cells shall be made of copper, brass or stainless steel. Copper or brass nuts and bolts shall be effectively lead coated to prevent corrosion. Stainless steel bolts and nuts can be used without lead coating.

All inter cell connectors shall be protected with heat shrinkable silicon sleeves for reducing the environmental impact including a corrosive environment.

1.2.9. **Flame Arrestors**

Each cell shall be equipped with a Flame Arrestor to defuse the Hydrogen gas escaped during charge and discharge. Material of the flame arrestor shall not affect the performance of the cell.

1.2.10. **Battery Bank Stand**

All batteries shall be mounted in a suitable metallic stand/frame. The frame shall be properly painted with the acid resistant paint. The suitable insulation shall be provided between stand/frame and floor to avoid the grounding of the frame/stand.

1.2.11. **Capacity Requirements**
When the battery is discharged at 10 hour rate, it shall deliver 80% of C (rated capacity, corrected at 27º Celsius) before any of the cells in the battery bank reaches 1.85V/cell.

The battery shall be capable of being recharged from the fully exhausted condition (1.75V/cell) within 10 hrs up to 90% state of charge. All the cells in a battery shall be designed for continuous float operation at the specified float voltage throughout the life.

The capacity (corrected at 27ºCelcius) shall also not be less than C and not more than 120% of C before any cell in the battery bank reaches 1.75V/cell. The battery voltage shall not be less than the following values, when a fully charged battery is put to discharge at C/10 rate:
(a) After Six minutes of discharge : 1.98V/cell
(b) After Six hours of discharge : 1.92V/cell

(c) After 8 hours of discharge : 1.85V/cell
(d) After 10 hours of discharge : 1.75V/cell

Loss in capacity during storage at an average ambient temperature of 35º Celsius for a period of 6 months shall not be more than 60% and the cell/battery shall achieve 85% of its rated capacity within 3 charge/discharge cycles and full rated capacity within 5 cycles, after the storage period of 6 months. Voltage of each cell in the battery set shall be within 0.05V of the average voltage throughout the storage period. Ampere hour efficiency shall be better than 90% and watt hour efficiency shall be better than 80%.

1.2.12. **Expected Battery Life**

The battery shall be capable of giving 1200 or more charge/discharge cycles at 80% Depth of discharge (DOD) at an average temperature of 27º Celsius. DOD (Depth of Discharge) is defined as the ratio of the quantity of electricity (in Ampere-hour) removed from a cell or battery on discharge to its rated capacity. The battery sets shall have a minimum expected life of 20 years at float operation.

1.2.13. **Routine Maintenance of Battery system**

For routine maintenance of battery system, the contractor shall supply 1 set of following tools:

a) Torque wrench.
b) Cell test voltmeter(-3-0-+3) volts with least count of 0.01Volt.

1.2.14. **Type Test of Battery**

1.2.14.1. Contractor shall submit type test reports of following tests as per IEC 60896-21 & IEC 60896-22, 2004. The type test reports shall be submitted in accordance with the requirements stipulated in clause no. 9.2 of Technical Specification, Chapter 2: GTR except that the requirement of tests having been conducted within last five years as mentioned therein shall not be applicable.

S.No.	Description of test
1.	Gas emission
2.	High current tolerance
3.	Short circuit current and d.c. internal resistance
4.	Protection against internal ignition from external spark sources
5.	Protection against ground short propensity
6.	Content & durability of required markings
7.	Material identification
8.	Valve operation
9.	Flammability rating of materials
10.	Intercell connector performance
11.	Discharge Capacity
12.	Charge retention during storage
13.	Float service with daily discharges for reliable mains power
14.	Recharge behaviour
15.	Service life at an operating temperature of 40^0 C for brief duration exposure time.

16.	Impact of a stress temperature of 60^0 C for brief duration exposure time with 3 h rate discharge test.
17.	Abusive over-discharge
18.	Thermal runaway sensitivity
19.	Low temperature sensitivity
20.	Dimensional sensitivity at elevated internal pressure and temperature
21.	Stability against mechanical abuse of units during installation

Tests shall be conducted in accordance with IEC 60896-21 & IEC 60896-22, 2004

1.2.14.2. **List of Factory & Site Tests for Battery**

Sl. No.	Test	Factory Tests	Site Tests
1.	Physical Verification		√
2.	C/10 Capacity test on the cell	√	
3.	8 Hrs. Charge and 15 minutes discharge test at full rated load		√

1.2.15. **Installation and commissioning**

1.2.15.1. Manufacturer of Battery shall supervise the installation and commissioning and perform commissioning tests as recommended in O&M manual / or relevant standards. All necessary instruments, material, tools and tackles required for installation, testing at site and commissioning are to be arranged by Battery manufacturer/ Contractor

1.2.16. Contractor shall be submitted following documents for approval:

a) Data sheet as per Annexure-I
b) GA of cell and layout drawing
c) Discharge Data for 10 Hour, 8 Hour, 3 Hour, 2 Hour, 1 Hour, 15 Minutes and One Minute indicating capacity factors for end cell voltage of 1.75 V & 1.85 V.
d) Temperature correction factors
e) Installation and commissioning Instructions
f) O & M Manual

1.3. **Battery Charger**

The DC system for 220 V & 110V DC is unearthed and for 48 V DC is +ve earthed. The Battery Chargers as well as their automatic regulators shall be of static type and shall be compatible with offered VRLA batteries. All battery chargers shall be capable of continuous operation at the respective rated load in float charging mode, i.e. Float charging the associated Lead-Acid Batteries at 2.13 to 2.27 Volts per cell while supplying the DC load. The chargers shall also be capable of Boost charging the associated DC Battery at 2.28 to 2.32 volts per cell at the desired rate.
Charger shall regulate the float/boost voltage in case of prescribed temperature rise of battery as per manufacturer's recommendation to avoid thermal runaway. Necessary temperature sensors shall be provided in mid location of

battery banks and shall be wired up to the respective charger for feedback control. The manufacturer shall demonstrate this feature during testing of each charger.

1.3.1. All Battery Chargers shall be provided with facility for both automatic and manual control of output voltage and current. A selector switch shall be provided for selecting the mode of output voltage/current control, whether automatic or manual. When on automatic control mode during Float charging, the Charger output voltage shall remain within ±1% of the set value, for AC input voltage variation of ±10%, frequency variation of ±2.5%, a combined voltage and frequency variation of ±10%, and a DC load variation from zero to full load.

1.3.2. All battery chargers shall have a constant voltage characteristics throughout the range (from zero to full load) at the floating value of the voltage so as to keep the battery fully charged but without harmful overcharge.

1.3.3. All chargers shall have load limiters having drooping characteristic, which shall cause, when the voltage control is in automatic mode, a gradual lowering of the output voltage when the DC load current exceeds the Load limiter setting of the Charger. The Load-limiter characteristics shall be such that any sustained overload or short circuit in DC System shall not damage the Charger, nor shall it cause blowing of any of the Charger fuses. The Charger shall not trip on overload or external short circuit.

1.3.4. Uniform and step less adjustments of voltage setting (in both manual and automatic modes) shall be provided on the front of the Charger panel covering the entire float charging output range specified. Step less adjustments of the Load-limiter setting shall also be possible from 80% to 100% of the rated output current for Charging mode.

1.3.5. During Boost Charging, the Battery Charger shall operate on constant current mode (when automatic regulator is in service). It shall be possible to adjust the Boost charging current continuously over a range of 50 to 100% of the rated output current for Boost charging mode.

1.3.6. The Charger output voltage shall automatically go on rising, when it is operating on Boost mode, as the Battery charges up. For limiting the output voltage of the Charger, a potentiometer shall be provided on the front of the panel, whereby it shall be possible to set the upper limit of this voltage any where in the output range specified for Boost Charging mode.

1.3.7. The Charger manufacturer may offer an arrangement in which the voltage setting device for Float charging mode is also used as output voltage limit setting device for Boost charging mode and the Load-limiter of Float charging mode is used as current setting device in boost charging mode.

1.3.8. Suitable filter circuits shall be provided in all the chargers to limit the ripple content (Peak to Peak) in the output voltage to 1%, irrespective of the DC load level, when they are not connected to a Battery.

1.3.9. **MCCB**

All Battery Chargers shall have 2 Nos. MCCBs on the input side to receive cables from two sources. Mechanical interlock should be provided such that

only one shall be closed at a time. It shall be of P2 duty and suitable for continuous duty. MCCB's should have auxiliary contacts for annunciation.

1.3.10. **Rectifier Transformer**

The rectifier transformer shall be continuously rated, dry air cooled (A.N) and of class F insulation type. The rating of the rectifier transformer shall have 10% overload capacity.

1.3.11. **Rectifier Assembly**

The rectifier assembly shall be fully/half controlled bridge type and shall be designed to meet the duty as required by the respective Charger. The rectifier shall be provided with heat sink having their own heat dissipation arrangements with natural air cooling. Necessary surge protection devices and rectifier type fast acting HRC fuses shall be provided in each arm of the rectifier connections.

1.3.12. **Instruments**

One AC voltmeter and one AC ammeter alongwith selector switches shall be provided for all chargers. One DC voltmeter and DC ammeter (with shunt) shall be provided for all Chargers. The instruments shall be flush type, dust proof and moisture resistant. The instruments shall have easily accessible means for zero adjustment. The instruments shall be of 1.5 accuracy class. In addition to the above a centre zero voltmeter with selector switch shall also be provided for 220 V chargers for testing purpose.

1.3.13. **Air Break Switches**

One DC output switch shall be provided in all chargers. They shall be air break type suitable for 500 volts AC/ 250 DC. The contacts of the switches shall open and close with a snap action. The operating handle of the switch shall be fully insulated from circuit. `ON' and `OFF' position on the switch shall be clearly indicated. Rating of switches shall be suitable for their continuous load. Alternatively, MCCB's of suitable ratings shall also acceptable in place of Air Break Switch.

1.3.14. **Fuses**

All fuses shall be HRC Link type. Fuses shall be mounted on fuse carriers which are in turn mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, fuses shall be directly mounted on plug-in type base. In such case one insulated fuse pulling handle shall be supplied for each charger. Fuse rating shall be chosen by the Bidder depending on the circuit requirement. All fuses in the chargers shall be monitored. Fuse failure annunciation shall be provided on the failure of any fuse.

1.3.15. **Blocking Diode**

Blocking diode shall be provided in the positive pole of the output circuit of each charger to prevent current flow from the DC Battery into the Charger.

1.3.16. **Annunciation System**

Audio-visual indications through bright LEDs shall be provided in all Chargers for the following abnormalities:

a) AC power failure
b) Rectifier/chargers fuse blown.
c) Over voltage across the battery when boost charging.
d) Abnormal voltage (High/Low)
e) Any other annunciation if required.

Potential free NO Contacts of above abnormal conditions shall also be provided for common remote indication "CHARGER TROUBLE" in Owner's Control Board. Indication for charger in float mode and boost mode through indication lamps shall be provided for chargers. A potential free contact for float/boost mode shall be provided for external interlocks.

1.3.17. **Name Plates and Marking**

The name plates shall be white with black engraved letters. On top of each Charger, on front as well as rear sides, larger and bold name plates shall be provided to identify the Charger. Name plates with full and clear inscriptions shall also be provided on and inside of the panels for identification of the various equipments and ease of operation and maintenance.

1.3.18. **Charger Construction**

The Chargers shall be indoor, floor-mounted, self-supporting sheet metal enclosed cubicle type. The Contractor shall supply all necessary base frames, anchor bolts and hardware. The Chargers shall be fabricated from 2.0mm cold rolled sheet steel and shall have folded type of construction. Removable gland plates for all cables and lugs for power cables shall be supplied by the Contractor. The lugs for power cables shall be made of electrolytic copper with tin coat. Power cable sizes shall be advised to the Contractor at a later date for provision of suitable lugs and drilling of gland plates. The Charger shall be tropicalised and vermin proof. Ventilation louvers, if provided shall be backed with screens. All doors and covers shall be fitted with synthetic rubber gaskets. The chargers shall have hinged double leaf doors provided on front and on backside for adequate access to the Charger's internals. All the charger cubicle doors shall be properly earthed. The degree of protection of Charger enclosure shall be at least IP-42 as per IEC:- 60947 Part 1.

1.3.18.1. All indicating instruments, control switches and indicating lamps shall be mounted on the front side of the Charger.

1.3.18.2. Each Charger shall be furnished completely wired upto power cable lugs and terminal blocks and ready for external connections. The control wiring shall be carried out with PVC insulated, 1.5 sq.mm. stranded copper wires. Control terminals shall be suitable for connecting two wires, with 2.5 sq.mm stranded copper conductors. All terminals shall be numbered for ease of connections and identification. Each wire shall bear a ferrule or tag on each end for identification. At least 20% spare terminals shall be provided for control circuits.

1.3.18.3. The insulation of all circuits, except the low voltage electronic circuits shall withstand test voltage of 2 KV AC for one minute. An air clearance of at least ten (10) mm shall be maintained throughout for such circuits, right up to the terminal lugs. Whenever this clearance is not available, the live parts shall be insulated or shrouded.

1.3.19. **Painting**

All sheet steel work shall be pre-treated, in tanks, in accordance with IEC/International Standards. Degreasing shall be done by alkaline cleaning. Rust and scale shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be in accordance with IEC/International Standards. Welding shall not be done after phosphating. The phosphating surfaces shall be rinsed and passivated prior to application of stoved lead oxide primer coating. After primer application, two coats of finishing synthetic enamel paint of shade-692 (smoke grey) shall be applied, unless required otherwise by the Owner. The inside of the chargers shall be glossy white. Each coat of finishing synthetic enamel paint shall be properly staved. The paint thickness shall not be less than fifty (50) microns.

1.3.20. **TESTS**

1.3.20.1. Battery chargers shall conform to all type tests as per relevant International Standard. Performance test on the Chargers as per Specification shall also be carried out on each Charger as per specification. Rectifier transformer shall conform to all type tests specified in IEC: 60146 and short circuit test as per IEC:60076. Following type tests shall be carried out for compliance of specification requirements:

i) Voltage regulation test
ii) Load limiter characteristics test
iii) Efficiency tests
iv) High voltage tests
v) Temperature rise test
vi) Short circuit test at no load and full load at rated voltage for sustained short-circuit.
vii) Degree of protection test
viii) Measurement of ripple by oscilloscope.
ix) Temperature compensation feature demonstration

1.3.20.2. The Contractor may be required to demonstrate to the OWNER that the Chargers conform to the specification particularly regarding continuous rating, ripple free output, voltage regulation and load limiting characteristic, before despatch as well as after installation at site. At site the following tests shall be carried out :

i) Insulation resistance test
ii) Checking of proper annunciation system operation.

1.3.20.3. If a Charger fails to meet the specified requirements, the Contractor shall replace the same with appropriate Charger without affecting the commissioning schedule of the Sub-station, and without any extra cost to the OWNER.

1.3.20.4. The Contractor shall present for inspection, the type and routine test certificates for the following components whenever required by the OWNER.

(i) Switches.
(ii) Relays/ MCCBs
(iii) Instruments.
(iv) DC fuses.
(v) SCR.

(vi) Diodes.
(vii) Condensers.
(viii) Potentiometers.
(ix) Semiconductor
(x) Annunciator.
(xi) Control wiring
(xii) Push buttons and contactors.

Makes of above equipment shall be subject to Owner's approval.

Annexure-I

BATTERY SYSTEM DATA SHEETS

S.No.	Description of Data	Unit	220 V	48 V
1	General Data			
a)	Battery Type:			
	Grid alloy: Pure lead(Pb), lead calcium (Pb-Ca),lead antimony (Pb-Sb), or lead selenium (Pb-Se) or other pl. specify			
	Cell type: Absorbed glass mat or gel cell or other please specify			
	Seller's type number			
	Number of positive plates per cell			
b)	Does each battery and battery [rack]/ [cabinet] meet the seismic requirements	[Yes] [No]		
c)	Manufacturer's Designed Life of Battery	Yrs		
d)	Recommended Battery Charger Data:			
	Floating voltage range	V		
	Boost charge	V		
	Current rating	Amps.		
	Recharge time	hr		
e)	Heat Released During:			
	Discharge duty cycle	Watt		
	Float charge	Watt		
	Boost Charge	Watt		
f)	Maximum Amount of Hydrogen Gas Evolved			
	During Battery-Boost Charge (2.33 V per cell) at Maximum Battery Temperature	(Litre /h)		
	Hydrogen Gas Evolution at Float	(Litre /h)		
g)	Time Battery may be Stored Without a Freshening Charge	months		
h)	Temperature Compensation Provided and its Details			

S.No.	Description of Data	Unit	220 V	48 V
2.	Physical Description.			
a)	Battery Cell:			
	Size (L x W x H)	mm		

	Weight	Kg				
	Volume of electrolyte gal	L				
	Jar cover material					
	Jar container material					
	Separator material					
	Retainer material					
	Limiting-oxygen index (LOI)					
b)	Battery [Rack] [Cabinet]:					
	Outline or catalog number					
	Quantity of [racks][cabinets] for the battery					
	Description (tier or step type)					
c)	Total Net Weight of Battery Including [Racks] [Cabinets]	kg				
d)	Total Shipping Weight of Each Battery Jar and Associated Equipment	kg				
e)	Connectors:					
	Intercell:					
	Type					
	Material					
	No. per connection					
	Inter-[Tier] [Step]:					
	Type					
	Material					
	No. per connection					
	Terminal Detail:					
	Type					
	Material					
f)	Terminal Lugs for Power Cable:					
g)	Torque Data:		**Initial Torque Value**	**Re-torque Value**	**Initial Torque Value**	**Re-torque Value**
	Intercell Connectors					
	Inter-[Tier] [Step]:					

S.No.	**Description of Data**	**Unit**	**220 V**	**48 V**
3.	Performance Data.			
	Battery String Designation No. [1] [ ]			
	Float Voltage Without Boost	V/cell		
	Float Voltage With Boost	V/cell		
	Boost Charge Voltage	V/cell		
	Recommended Frequency of Boost Charge			
	Recommended Duration of Boost			

	Charge			
	Open-Circuit Voltage	V/cell		
	Short-Circuit Current at Battery Terminals at Float Voltage at (27°C):			
	Battery Discharge Characteristics	A or A /positive plate		
	Guaranteed Amp-Hour Capacity (at the 10-hr rate) to Specified Final Voltage	AH		
	One-minute	A/cell		
	Fifteen-minute	A/cell		
	One-hour	A/cell		
	Two-hour	A/cell		
	Three-hour	A/cell		
	Eight-hour	A/cell		
	Ten-hour	A/cell		
4.	Required operating environment.			
	Battery Room Ambient Temperature Range	(°C to °C)		
	Battery Room Ambient Design Temperature	°C		
	Battery Room Minimum/Maximum Design Temperature	(°C to °C)		
	Maximum temperature at which battery can be stored	°C		

CIVIL WORKS
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1.0 GENERAL

The intent of specification covers the following:

Design, engineering, drawing and construction of all civil works at sub-station. All civil works shall also satisfy the general technical requirements specified in other Sections of Specification and as detailed below. They shall be designed to the required service conditions/loads as specified elsewhere in this Specification or implied as per relevant British standard codes (B S Codes)/ equivalent International Standards.

All civil works shall be carried out as per applicable Standards and Codes. All materials shall be of best quality conforming to relevant International Standards and Codes. In case of any conflict between Standards/ Code and Technical Specification, the provisions of Technical Specification shall prevail.

The Contractor shall furnish all design, drawings, labour, tools, equipment, materials, temporary works, constructional plant and machinery, fuel supply, transportation and all other incidental items not shown or specified but as may be required for complete performance of the Works in accordance with approved drawings, specifications and direction of NEA/Consultant.

The work shall be carried out according to the design/drawings to be developed by the Contractor and approved by the NEA/Consultant. For all buildings, structures, foundations etc. necessary layout and details shall be developed by the Contractor keeping in view the functional requirement of the substation facilities and providing enough space and access for operation, use and maintenance. Certain minimum requirements are indicated in this specification for guidance purposes only. However, the Contractor shall quote according to the complete requirements.

2.0 GEOTECHNICAL INVESTIGATION

2.1 The Contractor shall perform a detailed soil investigation to arrive at sufficiently accurate, general as well as specific information about the soil profile and the necessary soil parameters of the Site in order that the foundation of the various structures can be designed and constructed safely and rationally.
A detailed soil report including field data duly certified by site engineers of NEA/Consultant will be submitted by the Contractor for specific approval of NEA/Consultant**.** The report shall contain all soil parameters along with recommendation of soil consultant for type of foundation i.e. pile or open type, soil treatment if any etc. to be used for the design of civil foundations.

2.2 The Contractor may visit the site to ascertain the soil parameters. Any variation in soil data shall not constitute a valid reason for any additional cost & shall not affect the terms & conditions of the contract. Field tests must be conducted covering entire substation area including all the critical locations i.e. Control Room and GIS Building, township buildings, Lightning Mast. Towers, transformer/Reactor etc.

2.3 SCOPE OF WORK

This specification covers all the work required for detailed soil investigation and preparation of a detailed report. The work shall include mobilisation of necessary equipment, providing necessary engineering supervision and technical personnel, skilled and unskilled labour etc. as required to carry out field investigation as well as, laboratory investigation, analysis and interpretation of data and results, preparation of detailed Geo-technical report including specific recommendations for the type of foundations and the allowable safe bearing capacity for different sizes of foundations at different founding strata for the various structures of the substation. The Contractor shall make his own arrangement for locating the co-ordinates and various test positions in field as per the information supplied to him and also for determining the reduced level of these locations with respect to the benchmark indicated by the

NEA/Consultant. The soil investigation for substation extension in existing switch yard has not been envisaged. Soil data of existing substation shall be referred for the design of foundations in switch yard extension under present scope of work.

All the work shall be carried out as per latest edition of the corresponding relevant British standard codes (B S Codes)/ equivalent International Standards. The Agency carrying out the soil investigation work must have the experience of carrying out soil investigation successfully in the relevant field. NEA shall assess the capability of the agency for soil investigation work for which technical inputs may be furnished by consultant to NEA.

2.3.1 **Bore Holes**

Bore holes in accordance with the provisions of relevant international standards/British standards(BS) at the rate of minimum one number bore hole per hectare or minimum 5 locations up to 30meter depth(Minimum) or to refusal which ever occur earlier shall be drilled for new areas (132 kV Yards and 132/66/11 kV yards wherever applicable). In any case number of boreholes shall not be less than three for new substations. By refusal it shall mean that a standard penetration blow count (N) of 100 is recorded for 30 cm penetration. Number of boreholes may be increased in case soil strata are varying from borehole to borehole in order to have fair idea of soil profile. In case of deep pile foundations soil investigation is to be carried out up to 30 m depth from ground level or refusal whichever is earlier. In case rock is encountered, coring in all the boreholes shall be carried out up to 3 meter in rock.

Performing Standard Penetration Tests at approximately 1.5 m interval in the borehole starting from 1.5 m below ground level onwards and at every change of stratum. The disturbed samples from the standard penetrometer shall also be collected for necessary tests. Standard Penetration Test shall be performed as per relevant British standard codes (B S Codes)/ equivalent International Standards.

Undisturbed samples shall be collected in accordance with the recommendation of relevant British standard codes (B S Codes)/ equivalent International Standards. Or an alternative recognize method as agreed by NEA/Consultant. Undisturbed samples shall be taken in cohesive material or weak cemented granular material where ever possible at 1.0 m interval or at each change in stratum.

The depth of Water Table, if encountered, shall be recorded in each borehole. In case the soil investigation is carried out in winter/summer, the water table for rainy season shall be collected from reliable sources and recorded in the report.

All samples, both disturbed and undisturbed, shall be identified properly with the borehole number and depth from which they have been taken.

The sample shall be sealed at both ends of the sampling tubes with wax immediately after the sampling and shall be packed properly and transported to the Contractor's laboratory without any damage or loss.

The logging of the boreholes shall be compiled immediately after the boring is completed and a copy of the bore log shall be handed over to the Engineer-in-change.

2.3.2 **Trial Pits**

The Contractor shall excavate one number trial pits per substation (New) and as directed by NEA/Consultant, of area 2m*2m and not exceeding 4 m depth. Undisturbed samples shall be taken from the trial pits as per the direction of the NEA/Consultant. All Trial Pits shall be re-filled with approved material after the tests are complete and shall be compacted in layers of not more than 500mm.

2.3.3 Electrical Resistivity Test

This test shall be conducted to determine the Electrical resistivity of soil required for designing safety-grounding system for the entire station area. The specifications for the equipments and other accessories required for performing electrical resistivity test, the test procedure, and reporting of field observations shall confirm to relevant British standard codes (B S Codes)/ equivalent International Standards. The test shall be conducted using Wagner's four electrode method as specified in relevant British standard codes (B S Codes)/ equivalent International Standards.. Unless otherwise specified at each test location, the test shall be conducted along two perpendicular lines parallel to the coordinate axis. On each line a minimum of 8 to 10 readings shall be taken by changing the spacing of the electrodes from an initial small value of 1 m upto a distance of 50.0 m.

2.3.4 Plate load test

Two number of Plate load tests per substation (for new substations) shall be conducted each at the location of control room/ GIS building and township area as applicable only to determine the bearing capacity, modulus of sub grade reaction and load/settlement characteristics of soil at shallow depths by loading a plane and level steel plate kept at the desired depth and measuring the settlement under different loads, until a desired settlement takes place or failure occurs. The specification for the equipment and accessories required for conducting the test, the test procedure, field observations and reporting of results shall conform to relevant BS standard. Plate load test shall be performed at the proposed foundation depth below finished ground level for bearing capacity.

Undisturbed tube samples shall also be collected from the pit at 1.0 m depth and bottom of pit from natural ground level for carrying out laboratory tests.

The size of the pit in plate load test shall not be less than five times the plate size and shall be taken up to the specified depth. All provisions regarding excavation and visual examination of pit shall apply here.

Unless otherwise specified the reaction method of loading shall be adopted. Settlement shall be recorded from dial gauges placed at four diametrically opposite ends of the test plate.

The load shall be increased in stages. Under each loading stage, record of Time vs. Settlement shall be kept as specified in relevant British standard codes (B S Codes)/ equivalent International Standards.
Backfilling of the pit shall be carried out as per the directions of the NEA/Consultant**.** Unless otherwise specified the excavated soil shall be used for this purpose. In cases of gravel-boulder or rocky strata, respective relevant codes shall be followed for tests.

2.3.5 Water Sample

Representative samples of ground water shall be taken when ground water is first encountered before the addition of water to aid drilling of boreholes. The samples shall be of sufficient quantity for chemical analysis to be carried out and shall be stored in air-tight containers.

2.3.6 Back Filling of Bore Holes

On completion of each hole, the Contractor shall backfill all bore holes as directed by the NEA/Consultant. The backfill material can be the excavated material.

2.3.7 Laboratory Test

1. The laboratory tests shall be carried out progressively during the field work after sufficient number of samples has reached the laboratory in order that the test results of the initial bore holes can be made use of in planning the later stages of the field investigation and quantum of laboratory tests.

2. All samples brought from field, whether disturbed or undisturbed shall be extracted/prepared and examined by competent technical personnel, and the test shall be carried out as per the procedures laid out in the relevant British standard codes (B S Codes)/ equivalent International Standards.

   The following laboratory tests shall be carried out

   a) Visual and Engineering Classification

   b) Atterberg limits Tests.

   c) Natural moisture content, bulk density and specific gravity.

   d) Grain size distribution analysis.

   e) Swell pressure and free swell index determination.

   f) California bearing ratio.

   g) Consolidated drained test with pore pressure measurement.

   h) Chemical tests on soil and water to determine the carbonates, sulphates, nitrates, chlorides, Ph value, and organic matter and any other chemical harmful to the concrete foundation.

   i) In case rock is encountered, the soil test required for rock as per relevant British standard codes (B S Codes)/ equivalent International Standards including following tests shall also be conducted.
      (i) UCC test.
      (ii) Point load index test.

2.3.8 **Test Results and Reports**

The Contractor shall submit the detailed report in two (2) copies wherein information regarding the geological detail of the site, summarised observations and test data, bore logs, and conclusions and recommendations on the type of foundations with supporting calculations for the recommendations. The contractor shall also submit the bearing capacity calculation in editable soft copy to NEA/consultant. Initially the contractor shall submit draft report and after the draft report is approved, the final report in four (4) copies shall be submitted. The field and laboratory test data shall bear the signatures of the Investigation Agency, Contractor and also site representative of NEA/Consultant.

The report shall include, but not limited to the following:-

a) A plan showing the locations of the exploration work i.e. bore holes, trial pits. Plate load test, electrical resistivity test, CBR sample location etc.

b) Bore Logs: Bore logs of each bore holes clearly identifying the stratification and the type of soil stratum with depth. The values of Standard Penetration Test (SPT) at the depths where the tests were conducted on the samples collected at various depths shall be clearly shown against that particular stratum.

Test results of field and laboratory tests shall be summarised strata wise as well in combined tabular form. All relevant graphs, charts tables, diagrams and photographs, if any, shall be submitted along with report. Sample illustrative reference calculations for settlement, bearing capacity, pile capacity shall be enclosed.

Recommendations: The report should contain specific recommendations for the type of foundation for the various structures envisaged at site. The Contractor shall acquaint himself about the type of structures and their functions from the NEA/Consultant. The observations and recommendations shall include but not limited to the following:

a) Geological formation of the area, past observations or historical data, if available, for the area and for the structures in the nearby area, fluctuations of water table etc.

b) Recommended type of foundations for various structures. If piles are recommended the type, size and capacity of pile and groups of piles shall be given after comparing different types and sizes of piles and pile groups.

c) Allowable bearing pressure on the soil at various depths for different sizes of the foundations based on shear strength and settlement characteristics of soil with supporting calculations. Minimum factor of safety for calculating net safe bearing capacity shall be taken as 3.0 (three). Recommendation of liquefaction characteristics of soil if applicable shall be provided.

d) Recommendations regarding slope of excavations and dewatering schemes, if required.

e) Comments on the Chemical nature of soil and ground water with due regard to deleterious effects of the same on concrete and steel and recommendations for protective measures.

f) If expansive soil is met with, recommendations on removal or retainment of the same under the structure, road, drains, etc. and thickness of treatment shall be given. In the latter case detailed specification of any special treatment required including specification or materials to be used, construction method, equipments to be deployed etc. shall be furnished. Illustrative diagram of a symbolic foundation showing details shall be furnished.

g) Recommendations for additional investigations beyond the scope of the present work, if considered such investigation as necessary.

f) In case of foundation in rocky strata, type of foundation and recommendation regarding rock anchoring etc. should also be given.

3.0 CONTOUR SURVEY, SITE LEVELLING

3.1 **CONTOUR SURVEY & SITE LEVELLING**:

The land for construction of substation will be handed over to the successful bidder as on where basis progressively after award of work. The contractor shall carry out survey work by taking spot level at 05 m x05 m grid interval with respect to temporary bench mark transferred from permanent bench mark in the locality if available either on bridge , government buildings of local authorities or any other permanent structure. The contractor shall submit the spot levels (in grid format) in editable soft copy in excel format and contour map with contour interval of 0.5 m in editable auto cad soft drawing.

The contractor will level the area required for construction of substation work either at single level, multi level or gradual slope with the finished ground level as approved by NEA/Consultant during detailed engineering based on highest flood level. The levelling area shall be decided by NEA/Consultant during detailed Engineering stage.

The layout and levels of all structure etc. shall be made by the Contractor at his own

cost from the general grids of the plot and benchmarks set by the Contractor and approved by NEA/Consultant. The Contractor shall provide all assistance in instruments, materials and personnel to NEA/Consultant for checking the detailed layout and shall be solely responsible for the correctness of the layout and levels.

3.2 **SCOPE**

This clause covers clearance of site, contour survey, site levelling, maintaining finished ground level by cutting/filling in all types of soil and soft/ disintegrated rock, supplying and compaction of fill material if required. Cutting/felling of trees and their disposal has not been envisaged under the present scope.

3.3 **GENERAL**

Site shall be cleared, surveyed and levelled/sloped by the contractor as per approved general arrangement drawing or levelling area decided during detailed engineering after award of work.

Work covered under this clause comprises the site clearance, survey work/setting out and making profiles (preparation of plot plan, setting up Bench Mark and taking spot levels at 05m x 05 m interval, preparation of contour plan with contour interval of 0.20 m), Earth work in Excavation &filling in specified area with all lifts and leads and earth work in filling with borrowed earth with all leads and lifts (Borrow areas including payment of royalty for borrowed earth shall be arranged by the contractor at his own cost). During detailed engineering stage, the contractor will prepare the levelling proposal for optimum levelling and submit to NEA/Consultant for approval. Contractor shall submit the hard copy and editable soft copy of levelling proposal (levelling quantity calculation in Excel form and levelling drawing in Auto CAD) to NEA/Consultant for approval.

3.4 Filling material shall conform to relevant British standard codes (BS Codes)/ equivalent International Standards. Unsuitable filling material if any shall be removed and replaced by suitable fill material. The filling shall be compacted in layers to achieve 95% of standard Proctor's density at Optimum moisture contents (OMC). Cohesion less material shall be compacted to 70% relative density (minimum). Levelling/Filling shall be carried out as per relevant British standard codes (B S Codes)/ equivalent International Standards.

3.5 All materials involved in excavation shall be classified by NEA/ Consultant in the following groups:

3.5.1 **All kinds of soils and soft/disintegrated rocks (Not requiring blasting):** The material which can be quaried/excavated with pick, shovel, jumpers, scarifiers, crowbars and mechanical implements and will include various types of soils, plain cement concrete, shingle, river/nallah boulders, soling of road/foot path, stone masonary, soft conglomerate and laterite stone, lime stone and hard conglomerate etc.

3.5.2 **Hard Rocks**: All kinds of rocks which can only be excavated by machines and requires blasting, chiselling in edging or in another agreed method and will also include reinforcement cement concrete.

3.6 The quantity of excavation in all types of soils and soft/disintegrated rock shall be worked out by using initial and final level and no void deduction shall be made to calculate net quantity of earth work with 95% compaction.

3.7 The volume of hard rock shall be computed on the basis of stack of excavated rubble after making 50 % deduction for voids.

3.8 The surface of excavation or filling shall be neatly dressed to the required formation level with tolerance of (±) 100 mm.

4.0 SITE PREPERATION, EXCAVATION, BACKFILL & DISPOSAL OF SURPLUS EARTH.

4.1 **SITE PREPERATION**

The layout and levels of all structure etc. shall be made by the Contractor at his own cost from the general grids of the plot and benchmarks set by the Contractor and approved by the NEA/Consultant. The Contractor shall give all help in instruments, materials and personnel to the NEA/Consultant for checking the detailed layout and shall be solely responsible for the correctness of the layout and levels.

4.2 SCOPE

This clause covers clearing of the site, maintaining the finished ground level with available surplus excavated suitable back fill material generated from foundation works etc.

4.3 GENERAL

1) The Contractor shall develop the site area to meet the requirement of the intended purpose. The site preparation shall conform to the requirements of relevant sections of this specification or as per stipulations of relevant British standard codes (B S Codes)/ equivalent International Standards.

2) The fill material shall be suitable for the above requirement. The fill shall be with such a material that the site so designed shall not be affected by erosion from wind and water from its final compacted position or the in-situ position of undisturbed soil.

3) Material unsuitable for founding of foundations shall be removed and replaced by suitable fill material to be approved by the NEA/Consultant.

4) Backfill material around foundations or other works shall be suitable for the purpose for which it is used and compacted to the density described under Compaction. Excavated material not suitable or not required for backfill shall be disposed off in areas as directed by purchaser up to a maximum lead of 2 km.

5) Contractor may record the initial level of the site as per present condition and submit the quantity of volume of earthwork required.

6) Contractor may propose any suitable alternative for better optimization of project.

4.4 EXCAVATION AND BACKFILL

SCOPE

This clause covers excavation for foundation works of Towers, Equipment support structures, Transformer/Reactor foundations, External Lighting poles, Cable trenches, Buildings, Car parking shed, Fire Wall, DG set, Water tanks, etc, backfilling of Foundations Works.

1. Excavation and backfill for foundations shall be in accordance with the relevant British standard codes (B S Codes)/ equivalent International Standards.

2. Whenever water table is met during the excavation, it shall be dewatered and water table shall be maintained below the bottom of the excavation level during excavation, concreting and backfilling.

3. When embankments are to be constructed on slopes of 15% or greater, benches or steps with horizontal and vertical faces shall be cut in the original slope prior to placement of embankment material. Vertical faces shall

measure not more than 1 m in height.

4. Embankments adjacent to abutments, culverts, retaining walls and similar structures shall be constructed by compacting the material in successive uniform horizontal layers not exceeding 15 cm in thickness. (Of loose material before compaction). Each layer shall be compacted as required by means of mechanical tampers approved by the Purchaser. Rocks larger than 10 cm in any direction shall not be placed in embankment adjacent to structures.

5. Earth embankments of roadways and site areas adjacent to buildings shall be placed in successive uniform horizontal layers not exceeding 20 cm in thickness in loose stage measurement and compacted to the full width specified. The upper surface of the embankment shall be shaped so as to provide complete drainage of surface water at all times.

4.5 COMPACTION

1. The density to which fill materials shall be compacted shall be as per relevant BS and as per direction of NEA/Consultant. All compacted sand filling shall be confined as far as practicable. Backfilled earth shall be compacted to minimum 95% of the Standard Proctor's density at OMC. The sub grade for the roads and embankment filling shall be compacted to minimum 95% of the Standard Proctor's density at OMC. Cohesion less material sub grade shall be compacted to 70% relative density (minimum).

2. At all times unfinished construction shall have adequate drainage upon completion of the road's surface course, adjacent shoulders shall be given a final shaping, true alignment and grade.

3. Each layer of earth embankment when compacted shall be as close to optimum moisture content as practicable. Embankment material which does not contain sufficient moisture to obtain proper compaction shall be wetted. If the material contains any excess moisture, then it shall be allowed to dry before rolling. The rolling shall begin at the edges overlapping half the width of the roller each time and progress to the centre of the road or towards the building as applicable. Rolling will also be required on rock fills. No compaction shall be carried out in rainy weather.

4.6 REQUIREMENT FOR FILL MATERIAL UNDER FOUNDATION

The thickness of fill material under the foundations shall be such that the maximum pressure from the footing, transferred through the fill material and distributed onto the original undisturbed soil will not exceed the allowable soil bearing pressure of the original undisturbed soil. For expansive soils, the fill materials and other protections etc. to be used under the foundation is to be got approved by the NEA/Consultant.

4.7 DISPOSAL OF SURPLUS EARTH

The surplus earth generated from foundation work shall be disposed away from levelling area boundary at low lying areas within 2Km lead. The surplus earth if disposed within substation main boundary, the same shall be spread in uniform layers and compacted with suitable compacting equipment to achieve 95% compaction at O.M.C.

5.0 ANTIWEED TREATMENT & STONE SPREADING

5.1 SCOPE OF WORK

The Contractor shall furnish all labour, equipment and materials required for complete

performance of the work in accordance with the drawings, specification.

Stone spreading along with cement concrete layer shall be done in the areas of the switchyard under present scope of work within fenced area. However the stone spreading along with cement concrete layer in future areas within fenced area shall also be provided in case step potential without stone layer is not well within safe limits.

5.2 GENERAL REQUIREMENT

The material required for site surfacing/stone filling shall be free from all types of organic materials and shall be of standard quality, and as approved by the Purchaser.

The material to be used for stone filling/site surfacing shall be uncrushed/crushed/broken stone of 40mm nominal size (ungraded single size) conforming to relevant BS. Hardness, flakiness shall be as required for wearing courses shall be as are per relevant BS.

(a) Hardness
Abrasion value as per relevant BS.
Impact value as per relevant BS.

(b) Flakiness Index
One test shall be conducted as per relevant British standard codes (B S Codes)/ equivalent International Standards.

After all the structures/equipments are erected, anti weed treatment shall be applied in the switchyard where ever stone spreading along with cement concrete is to be done and the area shall be thoroughly de-weeded including removal of roots. The recommendation of local agriculture or horticulture department may be sought where ever feasible while choosing the type of chemical to be used. The anti weed chemical shall be procured from reputed manufacturers. The doses and application of chemical shall be strictly done as per manufacturer's recommendation. Nevertheless the effectiveness of the chemical shall be demonstrated by the contractor in a test area of 10MX10M (appx.) and shall be sprinkled with water at least once in the afternoon every day after forty eight hours of application of chemical. The treated area shall be monitored over a period of two to three weeks for any growth of weeds by the NEA/Consultant. The final approval shall be given by NEA/Consultant based on the results.

NEA/Consultant shall decide final formation level so as to ensure that the site appears uniform devoid of undulations. The final formation level shall however be very close to the formation level indicated in the approved drawing.

After anti weed treatment is complete, the surface of the switchyard area shall be maintained, rolled/compacted to the lines and grades as decided by NEA/Consultant. The sub grade shall be consolidated by using half ton roller with suitable water sprinkling arrangement to form a smooth and compact surface. The roller shall run over the sub grade till the soil is evenly and densely consolidated and behaves as an elastic mass.

In areas that are considered by the NEA/Consultant to be too congested with foundations and structures for proper rolling of the site surfacing material by normal rolling equipments, the material shall be compacted by hand, if necessary. Due care shall be exercised so as not to damage any foundation structures or equipment during rolling compaction.

The sub grade shall be in moist condition at the time the cement concrete is placed. If necessary, it should be saturated with water for not less than 6 hours but not exceeding 20 hours before placing of cement concrete. If it becomes dry prior to the

actual placing of cement concrete, it shall be sprinkled with water and it shall be ensured that no pools of water or soft patches are formed on the surface.

Over the prepared sub grade, 75mm thick base layer of cement concrete in 1:5:10 (1 cement :5 sand : 10 Stone aggregates) shall be provided in the area excluding roads, drains, cable trenches as per detailed engineering drawing. For easy drainage of water, the slope of 1:1000 is to be provided from the ridge to the nearest drain. The ridge shall be suitably located at the centre of the area between the nearest drains. The above slope shall be provided at the top of base layer of cement concrete in 1:5:10. A layer of cement slurry of mix 1:6 (1 cement: 6 sand) shall be laid uniformly over cement concrete layer. The cement consumption for cement slurry shall not be less than 150 kg. Per 100 sq.m.

A final layer of 100mm thickness of uncrushed/crushed/broken stone of 40mm nominal size (ungraded size) shall be spread uniformly over cement concrete layer after curing is complete.

6.0 SITE DRAINAGE

Preparation of overall drainage layout, design, drawing and providing rain water drainage system within the substation boundary under the present scope including connection at one or more points to the outfall point located outside the substation boundary wall is in the scope of contractor. Invert level of drainage system at outfall point shall be decided in such a way that the water can easily be discharged outside the substation boundary wall. In case outfall point is more than 100 m away from boundary wall, only 100 metre drain outside the boundary wall is in the scope of contractor. Outfall point shall be got approved from NEA/Consultant before commencement of construction. While designing the drainage system following points shall taken care of:

(a) The surface of the switchyard shall be sloped to prevent accumulation of water.

(b) Drain shall be constructed at suitable locations in such a way that substation is not flooded and roads are not affected with ponding of surface water. In the switchyard maximum spacing between two drains shall not be more than 100 meter. It will be ensured that no area is left undrained.

(c) Open surface drains having 300mm bottom width and 300mm depth at starting point of drain shall be provided. The depth of drain shall be measured with respect to finished ground level of switch yard i.e. from bottom of switch yard stone filling.

(d) Longitudinal slope shall not be less than 1 in 1000.

(e) Open surface drains shall be constructed with brick masonry or concrete blocks. As per design of contractor. PCC (1:2:4) shall be laid over 40mm thick layer of PCC 1:4:8 (1 cement: 4coarse sand: 8 stone aggregate 20mm nominal size.)

(f) The side wall of the drains shall be 25 mm above the gravel level to prevent falling of gravel into drain. Groove of 125 mm width shall be provided at 2000 mm spacing with suitable mild steel grating..

(g) The maximum velocity for pipe drains and open drains shall be limited to 2.4m/sec and 1.8m/sec respectively. However, minimum non-silting velocity of 0.6m/sec shall be ensured.

(h) Pipe drains shall be provided in areas of switchyard where movement of crane will be necessary in operating phase of the substation.

(i) For pipe drains, concrete pipe of class NP2 shall be used. However, for road crossings etc. higher strength pipe of class NP3 shall be provided. For rail crossings, RCC pipes of class NP4 shall be provided. For design of RCC pipes for drains and culverts, relevant British standard codes (B S Codes)/ equivalent International

Standards. Shall be followed.

(j) Two Nos. of portable pumps of 5 hp capacity for drainage of water shall be provided by the Contractor.

(k) Pipe drains shall be connected through manholes at an interval of max. 30m.

(l) If the invert level of outfall point is above the last drain point in the substation boundary, sump of suitable size has to be constructed with in the substation boundary.

(m) The drainage scheme and associated drawings shall be got approved from NEA/Consultant before commencement of construction.

6.1 RAINWATER HARVESTING:

In addition to drainage of rainwater in accordance with above clause 6.0, the contractor shall design, prepare drawings and provide rainwater harvesting system also. Rainwater harvesting shall not be done if the depth of underground water table is within 8.0m from finished ground level or as per provision of relevant British standard codes (B S Codes)/ equivalent International Standards. While designing the rain water harvesting system, following points may be taken care of:

Rainwater harvesting shall be done by providing two numbers recharge structures with bore wells. The recharge structures shall be suitably located within the sub-station. Branch drains from the main drain carrying rainwater from entire switchyard, constructed in accordance with clause 5.0, shall be connected to the recharge structures.

The internal diameter of recharge shafts shall be 4.5 meter with 230mm thick lining of brick work up to a depth of 2.0 meter from ground level and 345mm thick brickwork below 2.0 meter depth. The brick/concrete block work shall be constructed with cement mortar 1:6 (1 cement: 6 coarse sand). The overall depth of shaft shall be 5.0 meter below invert level of drain. The shaft shall be covered with RCC slab for a live load of 300 kg. Per sq. m. Two openings of size 0.7 x 0.7 meter shall be provided in the RCC cover slab as shown in the drawing. An iron cover made of 5mm thick chequered plate with hinges shall be provided on the openings. Galvanized M.S. rungs of 20mm diameter at spacing of 300 mm shall be provided in the wall of shaft below the opening in the RCC slab to facilitate cleaning of shaft.

A 300 mm diameter bore well shall be drilled in the centre of the shaft. The depth of bore well shall be 5.0 meter more than the depth of sub soil water.

A 100 mm dia medium duty MS pipe conforming to relevant BS shall be lowered in the bore well keeping bail plug towards bottom of bore well. The pipe shall have 1.58mm holes for 4.0 meter length starting from 1.0 meter from bottom of bore well. Holes of 3.0mm dia. shall be provided for a length of 2.0 meter starting from the bottom level of coarse sand and down wards. The overall length of pipe shall be equal to total depth of bore well plus depth of shaft.

Gravel of size 3mm to 6mm shall be filled around 100 dia. MS pipe in the bore well. The shaft shall be filled with 500 mm thick layers each from the bottom of shaft with boulders of size 50mm to 150mm, gravel of size 5mm to 10mm, coarse sand having particle size 1.5mm to 2.0mm and boulders of size not less than 200mm respectively.

7.0 ROADS

a) All the roads as shown in the General Arrangement drawing for the substation issued along with the tender documents are in the present scope. Adequate turning space for vehicles shall be provided and bend radii shall be set accordingly. Road to the Transformer /Reactor shall be as short and straight as possible.

b) All concrete roads within substation boundary wall shall be with 3.75 m RCC concrete pavement of suitable thickness and 1.3 m wide earthen shoulder on either side of the road. Below RCC concrete pavement, water bound macadam of adequate thickness as per design (WBM) shall be laid.

d) Strengthening of existing roads as shall be carried out with 2.5 cm thick premix carpet and 100 mm thick compacted layer of WBM (Water Bound Macadum) after filling the pot holes of existing roads with WBM material.

e) All roads shall be designed as per relevant British standard codes (B S Codes)/ equivalent International Standards. All drawings of road and culverts shall be prepared by the contractor.

f) All the culverts and allied structures (required for road/rail, drain, trench crossings etc.) shall be designed as per relevant British standard codes (B S Codes)/ equivalent International Standards.

7.1 Road Outside NEA boundary (Access Road)

The construction site will be accessible by vehicle during fair weather. The scope of works in this section comprises construction of access road and repair and maintenance of the same during the construction period so that it shall be left in well and good condition at the end of the project construction.

Asphalt Pavement

General
This specification covers all construction works for 4 - 6 meter wide driveway road within Employer's premises.

Grading
Finish grade of roads and packing area shall be as directed by Employer.
Pavement Materials
Sub-base

Sub-base shall be a non-plastic, sandy, granular material with a C.B.R. value greater than 15. It shall be free of deleterious material and subjected to the Employer's approval. Thickness of sub-base course shall be 30cm compacted.
The compaction of the sub-base course shall be carried out by at least 8 ton capacity steel roller with proper watering. The required density for the applied sub-base course is at least 90%.

Base course
Base shall be of WBM (water bound macadam) using crushed aggregate with a CBR value greater than 80. The filler material for WBM shall be stone dust. It shall be free of deleterious material and subjected to the Employer's approval. Thickness of base course shall be 15cm compacted.

It shall conform to following gradation:

Sieve size	Percentage passing
1 1"/2	100
3/4"	90 - 100
3/8"	50 - 80
No.4	35 - 55
No.30	10 - 30
No.200	2 - 9

Wearing course

Wearing course shall be of asphalt concrete mixture (min. 40mm compacted).

Asphalt Concrete Mixture
Asphalt concrete shall be a mixture of mineral aggregate and paving asphalt mixed at a central mixing plant. Its components shall be as specified herein.

Paving asphalt shall be a stream -refined asphalt produced from crude asphalt petroleum or mixture of refined liquid asphalt and refined solid asphalt. It shall be homogeneous and free from water and residues of coal, coal tar or paraffin oil. It shall have a penetration grade of 85-100 when tested according to ASTM D-5.

Aggregate for asphalt concrete shall be a composition of coarse aggregate and fine aggregate. Both shall be clean and durable.

Composition of Grading
The grading of the combined aggregates and the percentage of asphalt shall be as follows.

Percentages shown are based on weight of dry aggregates.

Sieve size	Percentage passing	
	Minimum	Maximum
3/4"	100	
1/2"	95	100
3/8"	72	88
No.4	46	60
No.8	28	42
No.30	15	27
No.50	10	20
No.200	4	7
Asphalt content (%)	4.8	6.0

Road curb
Both side of road edge shall be provided with R.C.C curb having it's corner chamfered. Minimum projection of curb from road surface shall not be less than 100mm.

Payment
The unit price bid in the Price Schedule shall include the cost of design, all labor, all material, civil construction works, etc.

Payment for the Contract item "Asphalt Road" will be made at the unit price per sq. m. of finish surface bid, therefore in the Price Schedule, such unit price shall include full compensations for all costs incurred in grading, furnishing all materials, equipment and labor and all other operations.

8.0 TRANSFORMERS/REACTOR FOUNDATION, RAIL TRACK/ RAIL CUM ROAD TRACK

The Contractor shall design, prepare drawing and provide a RCC Rail cum road system integrated with the Transformer/Reactor foundation to enable installation and the replacement of any failed unit. The transfer track system shall be suitable to permit the movement of any failed unit fully assembled (including OLTC, bushings) with oil. This system shall enable the removal of any failed unit from its foundation to the nearest road. If trench/drain crossings are required then suitable R.C.C. culverts shall be provided in accordance with relevant BS.

The Contractor shall provide a pylon support system for supporting the fire fighting system.

Each Transformer /Reactor including oil conservator tank and cooler banks etc. shall be placed in a self-sufficient pit surrounded by retaining walls (Pit walls). The clear

distance of the retaining wall of the pit from the Transformer/Reactor shall be 20% of the Transformer /Reactor height or 0.8m whichever is more. The oil collection pit thus formed shall have a void volume equal to 200% volume for 220 kV & above and 130% for 132 kV& below of total oil in the Transformer /Reactor. The minimum height of the retaining walls shall be 15 cm above the finished level of the ground to avoid outside water pouring inside the pit. The bottom of the pit shall have an uniform slope towards the sump pit. While designing the oil collection pit, the movement of the Transformer must be taken into account.

The grating shall be made of MS flat of size 40mmx 5mm placed at 30mm center to center and 25mmx5mm MS flat at spacing of 150mm at right angle to each other. Maximum length of grating shall be 2000mm and width shall not be more than 500mm. The gratings, supported on ISMB 150mm, shall be placed at the formation level and will be covered with 100mm thick layer of broken/crushed/non-crushed stone having size 40mm to 60mm which acts as an extinguisher for flaming oil. All steel works used for grating and support in transformer foundation shall be painted with Zinc phosphate primer (two packs) conforming to relevant British standard codes (B S Codes)/ equivalent International Standards.

Each oil collection pit shall be drained towards a sump pit within the collection pit whose role is to drain water and oil due to leakage within the collection pit so that collection pit remains dry.

8.1 MATERIALS

Complete foundation shall be made of reinforced cement concrete and shall be designed as per guidelines for design of foundations given in clause 10.0 in the specification.

8.2 DRAINAGE

One 0.5 H.P pump for each pit shall be supplied and installed by the Contractor to evacuate the fire fighting& rain water from the sump pit in to the nearest drain.

9.0 FIRE PROTECTION WALLS

9.1 GENERAL

Fire protection walls shall be provided, if required, in accordance with Local Advisory Committee (LAC) recommendations. The scope of works covers design, preparation of drawing and construction of RCC fire protection walls. While designing the wall, following points may be taken care of:

9.1.1 FIRE RESISTANCE

The firewall shall have a minimum fire resistance of 3 hours. The partitions, which are made to reduce the noise level, shall have the same fire resistance. The walls of the building, which are used as firewalls, shall also have a minimum fire resistance of 3 hours.

The firewall shall be designed to protect against the effect of radiant heat and flying debris from an adjacent fire.

9.1.2 DIMENSIONS

The firewall shall extend 600 mm on each side of the Transformer /Reactors and 600 mm above the conservator tank or safety vent.

These dimensions might be reduced in special cases, as per the approval of owner where there is lack of space. A minimum of 2.0meter clearance shall be provided between the equipments e.g. Transformer /Reactors and firewalls.

The building walls, which act as firewalls, shall extend at least 1 m above the roof in order to protect it.

9.1.3 **MATERIALS**

The firewall will be made of reinforced cement concrete as per the relevant British standard codes (B S Codes)/ equivalent International Standards.

10.0 CABLE TRENCHES AND CABLE TRENCH CROSSINGS

The work covered under this clause comprises of design, drawing and construction of cable trenches and cable trench crossings. While designing, following points may be taken care of:

a) The cable trenches and pre-cast removable RCC cover (with lifting arrangement) shall be constructed using RCC of M25 (Minimum) grade as per relevant British standard codes (B S Codes)/ equivalent International Standards.

b) The cable trench walls shall be designed for the following loads.

(i) Dead load of 155 kg/m length of cable support + 75 Kg on one tier at the outer edge of tier.
(ii) Earth pressure + uniform surcharge pressure of 2T/m2.

c) Cable trench covers shall be designed for self-weight of top slab + concentrated load of 150 kg at centre of span on each panel.

d) Necessary sumps shall be provided and each sump shall be provided with pumps of 5 HP capacity shall be supplied for pumping out water collected in cable trench. Cable trenches shall not be used as storm water drains.

e) The top of trenches shall be kept at least 100 mm above the finished ground level. The top of cable trench shall be such that the surface rainwater do not enter the trench.

f) All metal parts inside the trench shall be connected to the earthing system.

g) Trench wall shall not foul with the foundation. Suitable clear gap shall be provided.

h) The trench bed shall have a slope of 1/500 along the run & 1/250 perpendicular to the run.

i) Cable trenches shall be blocked at the ends if required with brick masonry in cement sand mortar 1:6 and plaster with 12mm thick 1:6 cement sand mortar.

J) Cable trench crossings shall be designed for critical load likely to be passed over the crossing. The cable trench crossing may be of either RCC box culvert type or RCC hume pipes embedded in plain concrete as per design of contractor.

11.0 FOUNDATION / RCC CONSTRUCTION

11.1 GENERAL

1. Work covered under this Clause of the Specification comprises the design ,drawing and construction of foundations and other RCC constructions for

switchyard tower structures, bus supports, equipment supports, cable trenches, Transformer /Reactors, jacking pad, pulling blocks, fire protection walls, control cubicles, marshalling kiosks, auxiliary equipments, Control Room Cum Administrative building, GIS hall, Fire fighting Pump house, fire fighting water tanks, Auxiliary Building, Panel room, ,township buildings, Parking shed ,RCC retaining wall, or for any other equipment or service and any other foundation required to complete the work. This clause is as well applicable to the other RCC constructions.

2. Concrete shall conform to the requirements mentioned in relevant British standard codes (B S Codes)/ equivalent International Standards. And all the tests shall be conducted as per relevant British standard codes (B S Codes)/ equivalent International Standards. However, a minimum grade of M25 (design Mix) concrete shall be used for all foundations and structural/load bearing members as per relevant British standard codes (B S Codes)/ equivalent International Standards.

3. If the site is sloppy, the foundation height will be adjusted to maintain the exact level of the top of structures to compensate such slopes.

4. The switchyard foundation's plinths and building plinths shall be minimum 300mm and 500 mm above finished ground level respectively.

5. Minimum 75mm thick lean concrete (1:4:8) shall be provided below all underground structures, foundations, trenches etc. to provide a base for construction.

6. Concrete made with Portland slag cement shall be carefully cured and special importance shall be given during the placing of concrete and removal of shuttering.

7. The design and detailing of foundations shall be done based on the approved soil data and sub-soil conditions as well as for all possible critical loads and the combinations thereof. The Spread footings foundation or pile foundation as may be required based on soil/sub-soil conditions and superimposed loads shall be provided.

8. If pile foundations are adopted, the same shall be cast-in-situ driven/bored or pre-cast or under reamed type as per relevant parts of relevant British standard codes (B S Codes)/ equivalent International Standards. Only RCC piles shall be provided. Suitability of the adopted pile foundations shall be justified by way of full design calculations. Detailed design calculations shall be submitted by the contractor showing complete details of piles/pile groups proposed to be used. Necessary initial load test shall also be carried out by the bidder at their cost to establish the piles design capacity. Only after the design capacity of piles has been established, the Contractor shall take up the job of piling. Routine tests for the piles shall also be conducted. All the work (design & testing) shall be planned in such a way that these shall not cause any delay in project completion.

11.2 **DESIGN**

While designing foundations, following may be taken care of:

11.2.1. All foundations except for external lighting poles shall be of reinforced cement concrete. The external lighting pole shall be embedded in plain cement concrete (1:2:4) foundation. The design and construction of RCC structures shall be carried out as per relevant BS and minimum grade of concrete shall be M-25 (design Mix). Higher grade of concrete than specified above may be used at the discretion of Contractor without any additional financial implication to the NEA/Consultant.

11.2.2. Limit state method or any other method as per relevant British standard codes (B S Codes)/ equivalent International Standards of design shall be adopted unless specified otherwise in the specification.

11.2.3. For detailing of reinforcement relevant BS followed. Cold twisted deformed bars conforming to relevant British standard codes (B S Codes)/ equivalent International Standards. Two layers of reinforcement (on inner and outer face) shall be provided for wall & slab sections having thickness of 150 mm and above. Clear cover to reinforcement shall be as per relevant British standard codes (B S Codes)/ equivalent International Standards.

11.2.4. RCC water retaining structures like storage tanks, etc. shall be designed as uncracked section in accordance with relevant British standard codes (B S Codes)/ equivalent International Standards. However, water channels shall be designed as cracked section with limited steel stresses as per relevant BS.

11.2.5. The procedure used for the design of the foundations shall be the most critical loading combination of the steel structure and or equipment and/or superstructure and other conditions which produces the maximum stresses in the foundation or the foundation component and as per the relevant British standard codes (B S Codes)/ equivalent International Standards of foundation design. Detailed design calculations shall be submitted by the bidder showing complete details of piles/pile groups proposed to be used.

11.2.6. Design shall consider any sub-soil water pressure that may be encountered following relevant standard strictly.

11.2.7. Necessary protection to the foundation work, if required shall be provided to take care of any special requirements for aggressive alkaline soil, black cotton soil or any other type of soil which is detrimental/harmful to the concrete foundations.

11.2.8. RCC columns shall be provided with rigid connection at the base.

11.2.9. All sub-structures shall be checked for sliding and overturning stability during both construction and operating conditions for various combinations of loads. Factors of safety for these cases shall be taken as mentioned in relevant British standard codes (B S Codes)/ equivalent International Standards or as stipulated elsewhere in the Specifications. For checking against overturning, weight of soil vertically above footing shall be taken and inverted frustum of pyramid of earth on the foundation should not be considered.

11.2.10. Earth pressure for all underground structures shall be calculated using co-efficient of earth pressure at rest, co-efficient of active or passive earth pressure (whichever is applicable). However, for the design of substructures of any underground enclosures, earth pressure at rest shall be considered.

11.2.11. In addition to earth pressure and ground water pressure etc., a surcharge load of 2T/Sq. m shall also be considered for the design of all underground structures including channels, sumps, tanks, trenches, substructure of any underground hollow enclosure etc., for the vehicular traffic in the vicinity of the structure.

11.2.12. Following conditions shall be considered for the design of water tank in pumps house, channels, sumps, trenches and other underground structures:

a) Full water pressure from inside and no earth pressure & ground water pressure & surcharge pressure from outside (application only

to structures which are liable to be filled up with water or any other liquid).

b) Full earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.

c) Design shall also be checked against buoyancy due to the ground water during construction and maintenance stages. Minimum factor of safety of 1.5 against buoyancy shall be ensured ignoring the superimposed loadings.

11.2.13. Base slab of any underground enclosure shall also be designed for empty condition during construction and maintenance stages with maximum ground water table (GWT). Minimum factor of safety of 1.5 against buoyancy shall be ensured ignoring the super-imposed loadings.

11.2.14. Base slab of any underground enclosure like water storage tank shall also be designed for the condition of different combination of pump sumps being empty during maintenance stages with maximum GWT. Intermediate dividing piers of such enclosures shall be designed considering water in one pump sump only and the other pumps sump being empty for maintenance.

11.2.15. The foundations shall be proportioned so that the estimated total and differential movements of the foundations are not greater than the movements that the structure or equipment is designed to accommodate.

11.2.16. The foundations of transformer/reactor and circuit breaker shall be of lock type foundation. Minimum reinforcement shall be governed by relevant British standard codes (B S Codes)/ equivalent International Standards.

11.2.17. The tower and equipment foundations shall be checked for a factor of safety as per relevant British standard codes (B S Codes)/ equivalent International Standards for two conditions i.e. Normal condition and short circuit condition against sliding, overturning and pullout. The same factors shall be used as partial safety factor over loads in limit state design also.

11.3 ADMIXTURES & ADDITIVES

11.3.1. Only approved admixtures shall be used in the concrete for the Works. When more than one admixture is to be used, each admixture shall be batched in its own batch and added to the mixing water separately before discharging into the mixer. Admixtures shall be delivered in suitably labelled containers to enable identification.

11.3.2. Admixtures in concrete shall conform to relevant British standard codes (B S Codes)/ equivalent International Standards. The water proofing cement additives shall conform to relevant BS. Concrete Admixtures/ Additives shall be approved by NEA/Consultant.

11.3.3. The Contractor may propose and the NEA/Consultant may approve the use of a water-reducing set-retarding admixture in some of the concrete. The use of such an admixture will not be approved to overcome problems associated with inadequate concrete plant capacity or improperly planned placing operations and shall only be approved as an aid to overcoming unusual circumstances and placing conditions.

11.3.4. The water-reducing setting-retarding admixture shall be an approved brand as per relevant British standard codes (B S Codes)/ equivalent International Standards.

11.3.5 The water proofing cement additives shall be used as required/advised by

NEA/Consultant.

12.0 CHAINLINK FENCING AND GATE

12.1 General

Work covered under this clause comprises of design, drawing, supply, fabrication, erection, painting or galvanisation as specified etc of switch yard Fencing and gate, construction of foundation of steel posts and toe wall .While providing switch yard fencing and gate, Following points may be taken care of :

12.2 Areas requiring Fencing

12.2.1 Fencing shall be provided for complete switchyard as per drawing. Separate gate shall be provided for men and equipment.

12.2.2 Internal fence surrounding the various equipments (if) mounted on ground or a height lower than 2.5m. Necessary gates shall be provided for each area so surrounded.

12.3 Product materials

The minimum requirements are as follows:

Chain link fence fabric (galvanization) in accordance to relevant British standard codes (B S Codes)/ equivalent International Standards.

12.4 Posts

The posts shall be of medium M.S. tubes of 50mm diameter conforming to grade as per relevant international /BS standard. The tubes shall also conform relevant British standard codes (B S Codes)/ equivalent International Standards. The length of tubular post shall be 2600 mm.

An M.S. base plate of size 160 X 160 X 6mm thick shall be welded with the tubular post. The post shall be provided on the top with M S plate.

The tubular post shall be welded with 8 number of M S flat of size 50 x 6mm – 75mm long at suitable locations. Two number of 13.5 mm diameter holes on each cleats shall be provided to bolt the fence fabric panel. The cleats shall be welded at equal spacing in such a way that 4 numbers of cleats are on one side and remaining 4 cleats are on the opposite side of the post. The cleats on the corner posts shall be welded in such a way that it suits the site requirement.

The whole assembly of tubular post shall be hot dip galvanized. The zinc coating shall be minimum 610 gram per sq. meter. The purity of zinc shall be 99.95% as per relevant BS.

12.5 Fence Fabric & Fence Panel

Chain link fencing shall be made of 3.15 mm diameter wire with 75 X 75 mm mesh size. Fence fabric shall be galvanised. Chain link fencing shall be fabricated in the form of panel 1300 X 2928 mm. An M.S. flat of at least 50x6 mm size shall be welded all-round fence fabric to form a panel. Four pairs of 13.5mm diameter holes on the vertical M S flat matching the spacing of holes in cleats fixed with pipe shall be provided to fix the fence panel with the tubular posts. A washer shall also be provided below each nut. The contractor, for fixing the panels, shall supply the 12mm diameter bolts including nuts and washers. All nuts, bolts and washers shall be hot dip galvanized.

The fence panel shall be provided with two or more coats of approved standard Zinc

paint over approved standard steel primer.

12.6 **Installation**

1. Fence shall be installed along the switchyard line as shown in the approved drawings.
2. Post holes shall be excavated by approved method.
3. All posts shall be 3.0m apart measured parallel to ground surface.
4. Posts shall be set in 1:2:4 Plain Cement Concrete block of minimum 0.40x0.40x1.2m depth. 75mm thick plain cement concrete 1:4:8 shall be provided below concrete blocks. Posts shall be braced and held in plumb position and true alignment and elevation until concrete has set.
5. Fence fabric shall not be installed until concrete has cured a minimum of 7 days.
6. Fence fabric panel shall be fixed to the post at 4 nos. MS flat each of 50x6, 75 long through 2 nos. of bolts (12mm diameter) on each flat.

12.7 **Gate**

1. The gate shall be made of medium duty M.S. pipe conforming to relevant I.S. with welded joints. The main frame (outer frame) of the gate shall be made of 40mm dia pipe and vertical pipes of 15mm dia @ 125mm spacing (maximum) shall be welded with the main frame. Two number of 1.25 mm thick and 125 mm wide MS plates (Horizontal) @ 500 mm centre to centre distance shall be welded on each gate leaf. Gate leaves shall be fixed with a vertical post of 2700 mm long two steel channels-150 welded together. A 8 mm thick 200X 200 mm size MS plate shall be welded at the bottom of channel frame.
2. The gates shall be fabricated with welded joints to achieve rigid connections. The gate frames shall be painted with one coat of approved steel primer and two coats of synthetic enamel paint.
3. The gates shall be provided with suitable locking arrangement welded on 4 mm thick MS plate on the gate leaf.
4. The main gate shall be 5.0m wide and shall be of double leaf type (as shown in the drawing). Next to the main gate, a men gate (1.25m wide single leaf) shall also be provided.
5. Steel roller shall be provided with the gate.
6. Gate shall be installed in location as shown in approved G.A. drawing.
7. The vertical post of gate shall be embedded in PCC foundation of 500 X500X1250 mm deep size.

13.0 BUILDINGS

13.1 **GENERAL**

The scope includes the design, drawing, engineering and construction including anti-termite treatment, plinth protection, DPC of Building including sanitary, water supply, electrification, false ceiling etc as applicable,complete of control room building, fire fighting building, Auxiliary building and panel room. Electrification and air conditioning of building shall be provided as detailed in other sections of electrical portion.

13.2 **CONTROL ROOM CUM ADMINISTRATIVE BUILDING (GIS BUILDING, CONTROL ROOM IF ALTERNATIVE LAYOUT IS FOLLOWED)**

GENERAL

The scope includes design, engineering and construction, including anti-termite treatment, plinth protection, DPC, peripheral drains, water supply, plumbing, sanitation, fire-fighting, electrification etc. of Control Room Building.

The Control Room Building and other building shall be of size as per the quantity available in BOQ approximately. It will be a single / double storeyed RCC Framed structure if constructed separately away from GIS hall. The building shall follow Nepalese architect design with specifications as mentioned in Annexure B1 of Chapter 14. It shall be so designed that most of the area of switchyard is visible from the Control Room.

The building auxiliary services like air conditioning systems, fire protection and detection systems and all other miscellaneous services shall be designed in accordance with the requirements as specified in relevant section or elsewhere in this Specification. The building shall be constructed as per the design and drawings to be developed by the contractor. Tentative carpet area requirement for different rooms of control room cum administrative building is given as below for guidance to the contractor:

TENTATIVEAREA REQUIREMENTS (Will be decided during detail engineering)

• Control Room	As required
• ACDB & DCDB Room	As per requirement.
• Battery Room	As per requirement.
• Electrical Lab	
• Conference Room with attached Toilet	
• Telecom Room	As per requirement
• S/S-In-charge office with attached Toilet	
• Room for executives	
• Room for non-executives	
• Lobby -Reception	
• Corridor width	Minimum width of corridor shall be as per design.
• Portico	
• Common Toilet-Men	
• Toilet for Women	
• Janitor Room	
• Pantry	
• Provision of shaft for electrical, sanitary, water supply facilities shall also be kept.	

Minimum Height to be maintained in case alternative layout is followed.

132kV GIS Building	9m
11kV Room	5m
Control Room Building	4.5m

If the layout with combined alternative is followed during DDE considering the pile Foundation, payment for Transformer hall will be made as per the rate of 132kV GIS Hall.

13.3 DESIGN CRITERIA

The Building shall be designed:

1. To the requirements of the International standards/British Standards.
2. for the specified climatic and loading conditions.
3. To adequately suit the requirements of the equipments and apparatus contained in the buildings and in all respects to be compatible with the intended use and

occupancy.

4. with a functional and economical space arrangement.
5. To be aesthetically pleasing. Different buildings shall show a uniformity and consistency in architectural design, as far as possible.
6. To allow for easy access to the equipments as well as maintenance of the equipments.
7. Wherever access to the roof is required, RCC stair case shall be provided.
8. Fire retarding materials for walls, ceilings doors etc., which would prevent supporting or spreading of fire and wherever required, shall be decided by the bidder.
9. Suitable Expansion joints, wherever required, shall be provided as per Codal Provisions.
10. All the members of the buildings frame shall be designed for the worst combination of loads as per relevant British standard codes (B S Codes)/ equivalent International Standards.
11. Permissible stresses for different load combinations shall be taken as per relevant British standard codes (B S Codes)/ equivalent International Standards.
12. Seismic coefficient Method or Response spectrum method shall be used for seismic analysis of the building for Earthquake forces, as per relevant British standard codes (B S Codes)/ equivalent International Standards.
13. **The architecture design of the buildings shall be as per the Nepalese Architecture & Style. Refer attached conceptual drawing and annexure B1 of chapter 12. Drawing shall be developed as per requirement with complete details**

13.4 DESIGN LOADS

1. Building structure shall be designed for the most critical combinations of dead loads, super-imposed loads, equipment loads, erection loads, wind loads, seismic loads etc. Any other incidental load, if anticipated, shall be duly accounted for in the design, and shall be clearly mentioned by the bidder.
2. Dead loads shall include the weight of structures complete with finishes, fixtures and partitions, and shall be taken as per relevant British standard codes (B S Codes)/ equivalent International Standards.
3. Super-imposed loads in different areas shall include live loads, minor equipment loads, cable trays, small pipe racks/hangers and erection, operation and maintenance loads, wherever these loads are expected. Equipment loads shall constitute, if applicable, all load of equipments to be supported on the building frame.

AREA	Load
1. For Offices.	5.0 kN/m2
If higher than 5.0 kN/m2.	As per actual Requirement.
2. For Equipment Floors.	10.0 kN/m2
If higher than 10 kN/m2 (Based on Equipment weight and layout plans).	As per actual Requirement.

3. Staircases & Balconies.	5.0 kN/m2
4. Toilets.	2.0 kN/m2
5. Chequered Plate.	4.0 kN/m2
6. Cooridoors/Walkways.	3.0 kN/m2
7. Accessible Roofs.	1.5 kN/m2
8. Non-accessible Roofs.	0.75 kN/m2

4. Wind loads shall be calculated as per relevant British standard codes (B S Codes)/ equivalent International Standards. The Factors affecting the wind speed shall be taken based on the site conditions.

5. Earthquake loads shall be calculated as per relevant British standard codes (B S Codes)/ equivalent International Standards.

6. Wind forces and Seismic forces shall not be considered to act simultaneously.

7. All the load combinations to create worst combinations of loads shall be as per relevant International standards/British Standards.

8. Floors/ Slabs shall be designed to carry loads imposed by equipments, cables, piping, movement of maintenance trucks (if required) and any other load associated with the building. In general, floors shall be designed for live loads as per relevant British standard codes (B S Codes)/ equivalent International Standards. Cable and piping loads shall also be considered in addition to the live loads for floors where these loads are expected.

13.5 FLOORS, WALLS & ROOFS

1. All walls shall be non-load bearing in filled panel walls, in brickwork as per the specification. Minimum thickness of external walls shall be 230 mm (one brick) with 1:6 cement sand mortar. Ornamental Brick (Dachi Appa) shall be addedto the external walls as per design/ drawings. Partition walls if any shall be of 115 mm thick brick masonary in cement sand mortar (1:4).
2. All Floor/Roof slabs shall be regular beam slab construction. However, sunken RCC slab shall be provided in toilet areas as per the requirement.
3. False ceiling as per requirement shall be provided as detailed in Table-1 (Detailed Finish Schedule).
4. Minimum height of skirting above finished floor level shall be 150 mm. The skirting material shall match with the floor finish.
5. Minimum height of the parapet walls shall be 750 mm.
6. Ground floor finish shall be laid over 20 mm thick cement sand mortar,100 mm thick plain cement concrete (PCC) 1:4:8 (1 cement: 4 sand : 8 stone aggregates),100 mm thick local sand filling. The earth below ground floor shall be well rammed before laying sand filling.
7. First floor details shall comprise of finish as per schedule, 20 mm cement sand mortar and 50 mm thick PCC(1:4:8) over RCC slab.

13.6 DETAILS OF ROOF

Roof of the Building shall consist of Cast-in-situ RCC slab treated with a water proofing system which shall be an integral cement based treatment conforming to relevant British standard codes (B S Codes)/ equivalent International Standards. The water proofing treatment shall be of following operations:

(a) Applying and grouting a slurry coat of neat cement using 2.75 kg/m2 of cement admixed with proprietary water proofing compounds conforming to relevant British standard codes (B S Codes)/ equivalent International Standards. Over the RCC slab including cleaning the surface before treatment.

(b) Laying cement concrete using broken stone of size from 25mm to 100mm size

with 50% of cement mortar 1:5 (1 cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to relevant British standard codes (B S Codes)/ equivalent International Standards over 20mm thick layer of cement mortar of min 1:5 (Cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to relevant British standard codes (B S Codes)/ equivalent International Standards to required slope and treating similarly the adjoining walls up to 300mm height including rounding of junctions of walls and slabs.

(c) After two days of proper curing applying a second coat of cement slurry admixed with proprietary water proofing compound conforming relevant British standard codes (B S Codes)/ equivalent International Standards.

(d) Finishing the surface with 20mm thick joint less cement mortar of mix 1:4 (1 cement: 4 course sand) admixed with proprietary water proofing compound conforming to relevant British standard codes (B S Codes)/ equivalent International Standards and finally finishing the surface with trowel with neat cement slurry and making of 300 x 300 mm square.

(e) The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test. All above operations to be done in order and as directed and specified by the Engineer-in-charge.

(f) Average thickness of water proofing shall be 120 mm and minimum thickness at khurra shall be 65 mm.

13.7 PARTITIONS

Partitions wherever provided, shall be made of powder coated aluminum frame provided with 5.5 mm thick clear glass or pre-laminated board depending upon the location of partition.

13.8 PLASTERING

External surfaces of buildings shall have 18 mm thick plaster in two layers, with the under layer 12mm thick 1:5 cement sand plaster and the top layer 6 mm thick 1:6 cement sand plaster. Inside wall surfaces shall have 12/15 mm thick 1:6 cement sand plaster. Rough surfaces shall have 15mm and smooth surface shall have 12 mm thick cement sand plaster.

All RCC ceilings shall be provided with 6 mm thick cement sand (fine) plaster (1:3) except for areas with false ceiling.

13.9 EXTERNAL PAINTING

External surfaces of the Control Room Building shall be painted with acrylic exterior flat paint as per manufacturer's specification and approval of NEA/Consultant.

13.10 DOORS, WINDOWS AND VENTILATORS

The schedule of doors, windows and ventilators of the Control Room Building shall be as per the detailed finish schedule given in Table-1 (Detailed Finish Schedule), and shall conform to the relevant British standard codes (B S Codes)/ equivalent International Standards. Rolling Steel shutters shall be provided as per the layout and requirements of the building. Main entrance door to control room building shall be made of powder coated aluminium frame with 5.5 mm thick glazing.

13.11 CABLE TRENCH INSIDE CONTROL ROOM BUILDING

All cable trenches inside the Control Room Building shall be covered with minimum 6mm thick steel chequered plate with suitable stiffeners.

13.12 PLINTH PROTECTION

750 mm wide and 50 mm thick plain cement concrete 1:2:4 (1 cement:2 sand:4 graded 20 mm nominal size stone aggregate) shall be laid over 75 mm thick dry stone aggregates well rammed and consolidated with interstices filled with local sand including smooth finishing top.

13.13 PLUMBING & SANITATION

1. All plumbing and sanitation works shall be executed to comply with the requirements of the appropriate bye-laws, rules and regulations of the Local Authority having jurisdiction over such matters. The Contractor shall arrange for all necessary formalities to be met with regards to the inspection, testing, obtaining approval and giving notices etc.
2. 'SINTEX' or an equivalent make PVC Roof water tank(s) of adequate capacity depending on the number of users for 24 hours storage shall be provided. However, a minimum of 2 nos. 1500 liter capacity shall be provided.
3. Chlorinated Polyvinyl chloride (CPVC) pipes having thermal stability for hot and cold water supply including all CPVC plain and brass threading conforming to relevant British standard codes (B S Codes)/ equivalent International Standards shall be used for internal piping works for water supply.
4. UPVC pipes conforming to relevant British standard codes (B S Codes)/ equivalent International Standards shall be used for sanitary works above ground level and RCC pipes shall be used for sanitary works below ground.
5. Each toilet shall have the following minimum fittings:
   (i) WC (Western type) 390 mm high along with toilet paper roll holder and all other fittings, in toilets attached to conference room and S/S In-charge office; and WC (Indian Type) Orissa Pattern (580 x 440 mm) with all fittings shall be provided in common toilets.
   (ii) Urinal (430 x 260 x 350 mm size) with all fittings and built-in-sensor for automatic flush after use.
   (iii) Wash basin (550 x 400 mm) with all fittings.
   (iv) Bathroom mirror (600 x 450 x 6 mm thick) with hard board backing.
   (v) CP brass towel rail (600 x 20 mm) with CP brass brackets.
   (vi) Soap holder and liquid soap dispenser.
   (vii) Automatic Hand Dryer.
6. Water cooler for drinking water with adequate water storage facility shall be provided which shall preferably be located near pantry and away from the toilet block.
7. One no. stainless steel kitchen sink with Drain board (510 x 1040 x 178 mm bowl depth) for pantry shall be provided.
8. All fittings, fasteners, gratings shall be chromium plated.
9. All sanitary fixtures and fittings shall be of approved quality and type, manufactured by reputed manufacturers. All items brought to site must bear identification marks of the Manufacturer.
10. Contractor shall provide necessary nos. of septic tank and soak pit of adequate capacity to treat the sewage/sullage from the buildings.
11. Contractor shall undertake all other activities required to complete and commission the building.

13.14 BUILDING STORM WATER DRAINAGE

1. The building design shall provide for the collection of storm water from the roof. This water shall be drained to the main drainage system of the Sub-station.
2. PVC Rainwater down comer pipes conforming to relevant International standards/British Standards with water tight lead joints conforms to relevant British standard codes (B S Codes)/ equivalent International Standards shall be provided to drain off the rain water from the roofs. These pipes shall be suitably concealed with masonry work or cement concrete or cladding material. The number and size of down comer pipes shall be governed by relevant British

standard codes (B S Codes)/ equivalent International Standards.

3. All drains inside the buildings shall have minimum 40 mm thick grating covers; and in areas where heavy equipment loads are envisaged, Pre-Cast RCC covers shall be provided in place of steel grating.
4. Suitable arrangements for draining out water collected from equipment blow downs, leakages, floor washings, fire fighting etc. shall be provided for each floor.

13.15 DETAILED FINISH SCHEDULE

The detailed finish schedule for Control Room Building Cum Administrative building is given below:

Table- 1: DETAILED FINISH SCHEDULE

Sl. No.	LOCATION	FLOORING & SKIRTING 150 MM HIGH	WALL(INTERNAL)	CEILING	DOOR, WINDOWS & VENTILATOR
1.	Control Room	Vitrified tiles 8mm thick size 600 x 600mm	Premium acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	White wash above False Ceiling*	Windows shall be of 10mm thick toughened glass by using suitable patch fittings/spider fittings. The glass shall extend horizontally from column to column and vertically from sill level of 0.75 m to bottom of lintel/roof beam. All doors shall be glazed powder coated aluminium doors with 5.5.mm Thk. Glazing.
2.	Conference Room	Vitrified tiles 8mm thick size 600 x 600mm	Premium acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	White wash above False Ceiling*	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing
3.	S/S In-charge Room.	Vitrified tiles 8mm thick size 600 x 600mm	Premium acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	White wash above False Ceiling*	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
4	Office Rooms	Vitrified tiles 8mm thick size 600 x 600mm	Premium acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	White wash above False Ceiling*	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
5.	Electrical/Electronics Test Lab./Telecom Room	Vitrified tiles 8mm thick size 600 x 600mm	Premium acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	White wash above False Ceiling*	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
6.	ACDB & DCDB	62mm thick cement	Oil bound washable	Oil bound washable	Steel door 45mm thick double sheet 18 gauge MS

Sl. No.	LOCATION	FLOORING & SKIRTING 150 MM HIGH	WALL(INTERNAL)	CEILING	DOOR, WINDOWS & VENTILATOR
	Room	concrete flooring with metallic hardener topping . Skirting shall be of cement sand plaster.	distemper on smooth surface applied with plaster of paris putty	distemper on smooth surface applied with plaster of paris putty	steel suitably reinforced and filled with mineral wool. Windows/ventilator shall be of powder coated aluminium with 4mm glazing.
7.	Battery Room	Vitrified tiles 8mm thick size 600 x 600mm	Premium acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	White wash above False Ceiling*	Steel door 45mm thick double sheet 18 gauge MS steel suitably reinforced and filled with mineral wool. Windows/ventilator shall be of powder coated aluminium with 4mm glazing.
8.	Reception/ Lobby	Vitrified tiles 8mm thick size 600 x 600mm	Premium acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	Oil bound washable distemper on smooth surface applied with plaster of paris putty	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
9.	Corridor	Vitrified tiles 8mm thick size 600 x 600mm	Premium acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	Oil bound washable distemper on smooth surface applied with plaster of paris putty	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be glazed powder coated aluminum doors with 5.5.mm thk. Glazing.
10.	Portico	Cast-in-situ 52mm thk. Cement concrete with metallic hardener .	Granite cladding	Oil bound washable distemper on smooth surface applied with plaster of paris putty	All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
11.	Toilet	Ceramic tiles	DADO glazed tile 2100mm high, oil bound washable distemper above DADO	Oil bound washable distemper	Windows/ ventilator shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be flush door shutters made of pre-laminated particle board with powder coated aluminium frame.
12.	Janitor room	Ceramic tiles with white cement	Vitrified tiles 8mm thick size 600 x 600mm	Oil bound washable distemper	Windows/ ventilator shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be flush door shutters made of pre-laminated particle board with

Sl. No.	LOCATION	FLOORING & SKIRTING 150 MM HIGH	WALL(INTERNAL)	CEILING	DOOR, WINDOWS & VENTILATOR
					powder coated aluminium frame.

*Providing and fixing 15mm thick approximately 600 X 600mm Mineral fiber board panel false ceiling and making cut-outs for electrical fixtures, AC diffusers, openable access etc complete with silhouette profile system with 15mm wide flange incorporating 6mm central recess white / black main runners at 1200mm centre-centre and not greater than 600mm from the adjacent wall. The cross tees shall be provided to make a module of approximately 600mm X 600mm by fitting 600 mm long cross tees centrally placed between 1200 mm long cross tees .Cross tees also have 15mm wide flange incorporating 6mm central recess white/black. The module formed above shall be anchored to the slab with channels or angles, suspenders as per manufacturer's specifications.

13.16 SUBMISSIONS

The following information/documents/drawings shall be submitted for review and approval:

1. Structural design calculations, Structural drawings (including construction/ fabrication), both in hard and soft copies, for all reinforced concrete and structural steel structures.
2. Fully dimensioned and detailed floor plans, cross-sections, longitudinal sections and elevations identifying the major building components.
3. Product information of building components and materials, including walls, partitions, flooring, ceilings, roofing, doors, wall paneling and windows and building finishes along with BOQ.
5. A detailed schedule of building finishes including colours schemes along with item description.
6. A door & window schedule showing door & window types and locations, lock sets and latch sets and other door hardware along with item details.

Approval of the above information shall be obtained before ordering materials or starting construction/fabrication, as applicable.

13.17 FALSE CEILING

Providing and fixing seamless ceiling with Gypsum board of 12mm thick fixed to the underside of GI frame work. The GI is fixed to the roof Slab with metal expansion fastener. The joint shall be finished with joint paper tape by using jointing Compound recommended by manufacturer with the approval of NEA/Consultant. The rate includes for all necessary cutting of ceiling for the fixing of complete fixtures.

13.18 Under deck Insulation

The method of fixing shall consist of slotted M.S. angles of appropriate size (minimum 65x50x2mm) fixed to soffit of RCC roof slab at 600mm centres in both directions by Rawl plugs of adequate strength. The slots shall have 14g G.I. tie wire drawn through them.
50mm thick insulation mat Fibreglass Crown - 100 or equivalent shall, be made out of fibre-glass or approved equivalent conforming to IS: 8183, backed with 34g aluminium foil and 22g x 12mm mesh wire netting. The net shall be stretched tightly across the slotted angles or slotted plates holding it in place by means of wires. The joints of the wire netting shall be butted and tightly laced down with 14g G.I. wire. The system shall be got approved from NEA/Consultant.

13.19 ELECTRIFICATION

All electrification shall be executed as per details specified elsewhere in the technical specification. All details shall be as per relevant British standard codes (B S Codes)/ equivalent International Standards.

14.0 FIRE FIGHTING PUMP HOUSE BUILDING (Not Required)

GENERAL

The scope includes design, engineering and construction, including anti-termite treatment, plinth protection, DPC, peripheral drains, fire-fighting, electrification etc. of fire fighting pump house building.

The fire fighting pump house building shall be essentially single storied reinforced cement concrete (RCC) framed Building. The building auxiliary services like internal electrification, fire protection systems shall be designed in accordance with the requirements as specified in relevant section of technical Specification. The design and layout of foundation of various pumps and cable trenches inside building shall be prepared by the contractor as per requirement of proposed fire fighting system.

AREA REQUIREMENTS

Dimensions of the Building shall be decided by the bidder depending upon the requirement. The approximate size of building shall be as per attached drawing. The height of building shall be measured from finished floor level to top of roof slab.

DESIGN CRITERIA

The Building shall be designed:

1. To the requirements of the relevant/British standards/ equivalent International standards quoted therein, and as specified in this specification.
2. for the specified climatic and loading conditions.
3. To adequately suit the requirements of the pumps and fire fighting system contained in the buildings and in all respects to be compatible with the intended use and occupancy.
4. with a functional and economical space arrangement.
5. To be aesthetically pleasing. Different buildings shall show a uniformity and consistency in architectural design, as far as possible.
6. To allow for easy access to the equipments as well as maintenance of the equipments.
7. Spiral staircase with 1.5 m diameter shall be provided for access to the roof.
8. With, wherever required, fire retarding materials for walls, ceilings doors etc., which would prevent supporting or spreading of fire and shall be decided by the bidder.
9. Suitable Expansion joints, wherever required, shall be provided as per Codal Provisions.
10. All the members of the buildings frame shall be designed for the worst combination of Loads as per relevant International standards/British Standards.
11. Permissible stresses for different load combinations shall be taken as per relevant International standards/British Standards.
12. Seismic analysis of the building for Earthquake forces shall be carried out as per relevant International standards/British Standards.

DESIGN LOADS

1. Building structure shall be designed for the most critical combinations of dead loads, super-imposed loads, equipment loads, wind loads, seismic loads etc. Any other incidental load, if anticipated, shall be duly accounted for in the design, and shall be clearly mentioned by the bidder.
2. Dead loads shall include the weight of structures complete with finishes, fixtures and partitions, and shall be taken as per relevant International standards/British Standards.
3. Super-imposed loads in different areas shall include live loads, cable trays, and small pipe racks/hangers, piping system and erection, operation and maintenance loads wherever these loads are expected.

   1) Non-accessible Roof – 0.75 kN/m2.

   2) Accessible Roof – 1.5 kN/m2
4. Wind loads shall be calculated as per relevant International standards/British Standards. The Factors affecting the wind speed shall be taken based on the site conditions.
5. Earthquake loads shall be calculated as per relevant International standards/British Standards.
6. Wind forces and Seismic forces shall not be considered to act simultaneously.
7. All the load combinations to create worst combinations of loads shall be as per relevant International standards/British Standards.
8. Floors shall be designed to carry loads imposed by Pumps, cables, piping, movement of maintenance trucks (if required) and any other load associated with the building. In general, floors shall be designed for live loads as per relevant International standards/British Standards. Cable and piping loads shall also be considered in addition to the live loads for floors where these loads are expected.

FLOORS, WALLS & ROOFS

The floor shall be constructed with 52 mm thick cement concrete finished with metallic hardener topping. 150 mm thick base plain cement concrete layer,100 mm thick compacted local sand filling and 200 mm thick hard core of stone ballast with interstices filled with local sand shall be laid below cement concrete flooring top. The earth filling below floor shall be well rammed.

PLASTERING

External surfaces of building shall have 18 mm thick plaster in two layers, with the under layer 12mm thick 1:5 cement sand (coarse) plaster and the top layer 6 mm thick 1:6 cement sand (coarse) plaster. Inside wall surfaces shall have 12/15 mm thick 1:6 cement sand (coarse) plaster. Rough surfaces shall have 15mm and smooth surface shall have 12 mm thick cement sand plaster. Ceiling shall be plastered with 6 mm thick cement sand plaster (1 Cement: 3 Sand).

EXTERNAL PAINTING

External surfaces of the Building shall be painted with acrylic exterior flat paint as per manufacturer's specification and approval of NEA/Consultant.

DOORS, WINDOWS AND VENTILATORS

The schedule of doors, roller shutter, windows and ventilators of the Building shall be of steel as per relevant International standards/British Standards. Rolling Steel shutters shall be provided as per the layout and requirements of the building. Main entrance door to the Building shall be MS door frame with M.S. sheet double shutter. Windows and ventilators shall be of steel made of hot rolled sections windows and ventilators shall be provided with 5.5 mm thick glazing.

CABLE TRENCH INSIDE FIRE FIGHTING PUMP HOUSE BUILDING

All cable trenches inside the building shall be covered with minimum 6 mm thick steel chequered plate with suitable stiffeners. The structural steel used for cable tray

support, earthing cleat, chequerred plates for internal cable trenches of fire fighting pump house building shall be measured and paid under miscellaneous steel item of BPS

PLINTH PROTECTION

750 mm wide plinth protection all-around the building shall be provided. Plinth protection shall comprise of 50 mm thick PCC (1:2:4) laid over 75 mm thick well compacted stone aggregates with interstices filled with local sand including smooth finishing top.

PARAPET

230 mm thick and 750 mm high brick parapet shall be provided. The parapet shall be plastered with cement sand plaster (1:6).

BUILDING STORM WATER DRAINAGE

1. The building design shall provide for the collection of storm water from the roof. This water shall be drained to the main drainage system of the Sub-station.
2. PVC down comer pipes conforming to relevant International standards/British Standards with water tight lead joints or medium class galvanized mild steel pipes conforms to relevant International standards/British Standards shall be provided to drain off the rain water from the roofs. These pipes shall be suitably concealed with masonry work or cement concrete or cladding material.
3. Suitable arrangements for draining out water collected from equipment blow downs, leakages, floor washings, fire fighting etc. shall be provided, if found necessary.

DETAILS OF ROOF

Roof of the Building shall consist of Cast-in-situ RCC slab treated with a water proofing system which shall be an integral cement based treatment conforming to relevant International standards/British Standards. The water proofing treatment shall be of following operations:

(a) Applying and grouting a slurry coat of neat cement using 2.75 kg/m2 of cement admixed with proprietary water proofing compounds conforming to relevant International standards/British Standards over the RCC slab including cleaning the surface before treatment.

(b) Laying cement concrete using broken stones 25mm to 100mm size with 50% of cement mortar 1:5 (1 cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to relevant International standards/British Standards over 20mm thick layer of cement mortar of min 1:5 (Cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to relevant International standards/British Standards to required slope and treating similarly the adjoining walls up to 300mm height including rounding of junctions of walls and slabs.

(c) After two days of proper curing applying a second coat of cement slurry admixed with proprietary water proofing compound conforming to relevant British standard codes (B S Codes)/ equivalent International Standards. (d) Finishing the surface with 20mm thick joint less cement mortar of mix 1:4 (1 cement: 4 course sand) admixed with proprietary water proofing compound conforming to relevant International standards/British Standards and finally finishing the surface with trowel with neat cement slurry and making of 300 x 300 mm square.

(e) The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test. All above operations to be done in order and as directed and specified by the Engineer-in-charge.

(f) Average thickness of water proofing shall be 120 mm and minimum thickness at khurra shall be 65 mm.

DETAILED FINISH SCHEDULE

The detailed finish schedule for Fire Fighting Pump House Building is given below:

Table- 2 : DETAILED FINISH SCHEDULE

S.	LOCATION	FLOORING & SKIRTING 150 MM HIGH	WALL(INTERNAL)	CEILING	LLER SHUTTER,DOOR, WINDOWS & VENTILATOR
1.	Fire Fighting Pump House	62mm thick cement concrete flooring with metallic hardener topping .skirting shall be of cement sand plaster.	Oil bound washable distemper on masonry portion.	As per Manufacturer details.	Windows/ ventilator shall be hot rolled steel section with 5.5mm thick glazing. Entry door shall be of M.S. Sheet double shtter and rolling shutter shall be of steel.

ELECTRIFICATION

All electrification shall be executed as per details specified elsewhere in the technical specification. All details shall be as per relevant British standard codes (B S Codes)/ equivalent International Standards.

15.0 AUXILLIARY BUILDING (Not Required)

Auxiliary building shall be single storeyed reinforced cement concrete framed structure building. The size of building shall be about 15 m X 20 m approximately. However, bidder may suggest suitable size as per his requirement. The building shall house 11 kV indoor switchgear.

The details like floor details, door, windows, ventilator, internal finish details etc shall match with respective room of RCC control room building. External finish shall also match with control room building.

1. Contractor shall develop the layout in such a way that its aesthetic look is pleasant. The design of Auxiliary building shall be carried out as per relevant International standard/British Standards.
2. The internal cable trenches, panel etc shall be designed by the contractor as per requirement. Layout of these cable trenches, panel layout shall also be prepared by the contractor as per requirement.

CABLE TRENCH INSIDE AUXILLIARY BUILDING

All cable trenches inside the building shall be covered with minimum 6 mm thick steel chequered plate with suitable stiffeners. The structural steel used for cable tray support, earthing cleat, chequerred plates for internal cable trenches shall be measured and paid under miscellaneous steel item of BPS.

ELECTRIFICATION

All electrification shall be executed as per details specified elsewhere in the technical specification. All details shall be as per relevant British standard codes (B S Codes)/ equivalent International Standards.

16.0 FIRE FIGHTING WATER TANK

1. Reinforced cement concrete water tank with capacity of 150 Cubic Meter shall be constructed. A sump of size 2.5 m X 2.5 m x 0.5 m deep shall be provided at one corner in each compartment. Finished floor level of water tank shall be about 200 mm above finished ground level of switch yard. Base slab of water tank shall rest on 75 mm thick plain cement concrete (1:3:6) laid over 800 mm thick well compacted stone packing (Stone Size from 25 mm to 150 mm) with interstices filled with local sand.
2. The roof of Water tank shall be of Coloured. The sheet shall be supported on suitable steel purlins etc. Suitable gutter shall be provided to drain off rain water.
3. A steel door of size 900 mm X 1850 mm with single shutter made of hot rolled

steel section and MS steel door frame shall be provided at about (+) 4.5 m level for access inside water tank.

4. Suitable MS rungs of 20 mm diameter rod @ 300 mm centre to centre staggered on both faces (External and internal) of wall at suitable location shall be provided to act as ladder.
5. Integral water proofing compound of reputed brand shall be added to the concrete and plaster of water tank. Quantity of compound shall be as per manufacturer's recommendation.
6. All inserts, nozzles, pipe sleeves etc shall be provided during concreting at suitable locations as per fire fighting system. The size is to be decided by the contractor to meet the requirement.
7. Inside surfaces of water tank shall be plastered with cement sand plaster (1 Cement:6 sand).
8. The outer surface of water tank shall be painted with the paint matching with Fire fighting pump house building.
9. P.V.C. water stopper shall be provided at all construction joints of water tank.
10. The design of water tank shall be carried out as per relevant British standard codes (B S Codes)/ equivalent International Standards.

17.0 SWITCH YARD PANEL ROOM

RCC switchyard panel room with the size as mentioned in bid price schedule shall be constructed. RCC sloped roof shall be provided. The sloped roof shall be covered with suitable tiles to enhance aesthetic look. The floor details (sand, PCC, cement mortar)shall match with that of other buildings. The floor finish shall be provided with vitrified tiles. Plinth protection as per other buildings. The finish details like painting, plaster shall match with other buildings. Doors shall be aluminium glazed .
All walls, floor and roof shall be provided with suitable chicken wire mesh which shall be connected with earthing system through 75 x 12 mm MS flat. Air conditioning and internal electrification of panel room shall be done as mentioned in respective technical specification and BPS in Electrical portion. The size and layout of internal cable trenches of panel room shall be decided by the contractor as per requirement. All cable trenches inside the panel room shall be covered with minimum 6 mm thick steel chequered plate with suitable stiffeners. The structural steel used for cable tray support, earthing cleat, chequerred plates for internal cable trenches shall be measured and paid under miscellaneous steel item of BPS
The design shall conform to relevant British standard codes (B S Codes)/ equivalent International Standards.

18.0 CAR PARKING SHED

Aesthetically pleasant RCC car parking shed as per design and drawings as developed by the contractor and suitable to park 10/5 cars as per BoQ shall be constructed at suitable location to be decided during detailed engineering stage

19.0 WATER SUPPLY

(i) Water shall be made available by NEA/consultant at any feasible point within substation boundary at single point to the contractor. Contractor shall state the total water requirement both in terms of quantity and head to NEA/Consultant.

(ii) The contractor shall carry out all the plumbing/erection works required for supply of water in control room cum administrative building beyond the single point as at (i) above.

(iii) The contractor shall carry out all the plumbing/erection works required for supply of water to Fire Fighting pump house beyond the single point as at (i) above.

(iv) The details of tanks, pipes, fittings, fixtures etc for water supply are given elsewhere in the specification under respective sections.

(v) A scheme shall be prepared by the contractor indicating the layout and details of water supply which shall be got approved by NEA/Consultant before actual start of work including all other incidental items not shown or specified but as may be required for complete performance of the works. All drawings shall be prepared by the contractor for approval of NEA/Consultant.

(vi) Bore wells and pumps for water supply is not in the scope of contractor.

20.0 SEWERAGE SYSTEM

(i) Sewerage system shall be provided for all buildings wherever applicable.

(ii) The Contractor shall construct septic tank and soak pit suitable for 50 and 10 users each for control room building, transit camp and town ship buildings is constructed .If septic and soak pit system is not acceptable by local Nepal Authority, contractor will have to install suitable sewerage system as per local statutory requirement.

(iii) The system shall be designed as per relevant British standard codes (B S Codes)/ equivalent International Standards. All drawings shall be prepared by the contractor for approval of NEA/Consultant.

21.0 GIS HALL CUM CONTROL ROOM BUILDING

21.1 Control Room and GIS Hall

The GIS building shall be of pre-engineered steel structure. Control room building, if attached to GIS hall, shall be of pre-engineered steel structure similar to GIS hall and shall be RCC framed structure, if it is not connected with GIS hall. In case of steel control room building all walls shall be of brick masonry and roof of ground floor shall be of RCC. Internal access to the GIS hall from control room building shall be provided.

Material specification and other details for construction of Pre-engineered steel building shall be as described in subsequent paragraphs. The base plate of steel columns shall be mounted on the RCC foundation by means of hot dip galvanised foundation bolts (Galvanisation of 610 gms/Sq. M). In order to facilitate inspection and maintenance, the structures shall be provided with climbing devices. Separate fire escape doors shall also be provided in the GIS Building.

Panels shall be kept in an air-conditioned enclosure. A glazed partition made of aluminium frame and 5.5mm thick glass shall be provided between GIS hall and panel room. The glazing shall be kept at a sill level of 0.9 m above floor level. The height of glazing shall be minimum 2.1 m above sill level.

Walkway of width of 1.0m shall be provided at gantry girder level on the two longer side of GIS hall along with climbing arrangement to facilitate maintenance of crane.

All the material required for Pre-engineered (steel) building shall be procured from reputed manufacturer for which prior approval shall be obtained. Manufacturing of various parts of the building shall start only after approval of “Manufacturing Quality Plan to be prepared by the bidder during detailed engineering stage”. Complete material shall be offered for inspection by QA&I department of Consultant/NEA before dispatch. Inspection shall be carried out based on assembly (fabrication) drawings approved by consultant/NEA and “BILL OF MATERIAL” & Shop drawing prepared by the Manufacturer and certified by the Contractor for its correctness. Approval of BOM and shop drawing from employer is not required.

21.2 Material Specification

21.2.1 Primary members fabricated from plate sand sections with minimum yield strength of 345 Mpa or to suit design by continuous swelding.

21.2.2 Secondary members for Purlins and Grits shall conform to the physical specification of ASTMA570(Grade50)or equivalent BS/equivalent international standard shaving a minimum yield strength of 345 MPa. The minimum thick ness of secondary members shall be 2.5 mm.

21.2.3 Rod / ANGLE/pipe bracing shall conform to the physical specification of relevant BS/equivalent international standards of minimum 245MpaYieldStrength

21.2.4 All hot rolled sections shall conform the physical specifications of BS/equivalent international standards. All other miscellaneous secondary members shall have minimum yield strength of 250 MPa.

21.3 **DESCRIPTION**

21.3.1 **PRIMARY MEMBERS:**

Primary structural framing shall include the transverse rigid frames, columns, corner columns, end wall wind column sand crane gantry girder sand Frames at Door openings.

21.3.2 **SECONDARY MEMBERS:**

Secondary structural framing shall include the purlins, girts, eaves truts, wind bracing, flange bracing, base angles, clips, flashing sand other miscellaneous structural parts. Suitable wind bracings sag rods to be reckoned while designing the structure.

21.3.3 **PURLINS, GIRTS,CLIPS:**

Purlins, girts and clips should be of Pre Galvanised steel of 345Mpa havinga coating thickness of 275 gms/sq. M inclusive of both sides.

21.3.4 ROOF SHEETING

Factory assembled 50mm thick puff (density 40kg/cu.m. +2 Kg/cu m as per BS/equivalent International Standards) sandwiched panels shall be provided. These panels shall be made of puff insulation sandwiched between two high tensile steel sheets each of 0.5 mm thickness. The material of sheets shall confirm to ASTM 792 M Grade 345B with minimum yield strength of 345 Mpa .The steel sheets shall be provided with hot dip coating of Zinc aluminium alloy (approximately 55% Al , 43.5% Zn and 1.5 % silicon) .Total mass of zinc aluminium alloy coating shall be minimum 200 gm/Sq. m inclusive of both sides. The tolerance of base metal thickness (BMT) of steel sheet shall be as per BS/equivalent International Standards . After hot dip coating of Zinc aluminium alloy ,the sheet shall be provided with steel primer and silicon modified polyester (SMP) paint. The total thickness of primer and paint shall be 40 microns inclusive of both sides (TCT) comprising of 20 microns of SMP paint on top surface and 10 microns of backer coat (polyester coat) on back surface over 5 microns thick primer each on both surfaces with inorganic pigments coated free from heavy metals. Painting shall conform to BS/equivalent International Standards . In case SMP paint is not available, Super Durable Polyester paint (SDP) can also be used by the bidder without cost implication to NEA.

21.3.5 **Wall Panels**

Wall panel material specifications shall be same as roof panels.

21.3.6 **SHEETING FASTENERS:**

Standard fasteners shall be selft aping zinc plated metal screws with EPDM bonded zinc plated washers. All screws shall be colour coated to match roof and

wall sheeting.

21.3.7 **SEALER**:

This is to be applied at all side lap sand end laps of roof panel sand around self lashing windows. Sealer shall be pressure sensitive elastomeric Butyl tapes. The sealer shall be non-asphaltic, non-shrinking and non toxic and shall be superior adhesive metals, plastics and painted at temperatures from 51°C to +104°C.

21.3.8 **CLOSURES**:

Solid or closed cell closures matching the profiles of the panel shall be installed along the eaves, rake and other locations specified on drawings.

21.3.9 **FLASHING AND TRIM:**

Flashing and/or trim shall be furnished at the rake, corners, eaves, and framed opening sand wherever necessary to provide weather tightness sand finished appearance. Colour shall be matching with the colour of wall. Material shall be 26 gauge thick conforming to the physical specifications of sheeting.

21.3.10 **WALL LIGHTS:**

For day lighting purpose of GIS hall, minimum 2mm thick approved translucent polycarbonate sheet shall be provided for wall lighting in addition to windows for at least 10% of wall area on upper portion of both long walls. The polycarbonate sheet shall be fixed with necessary EPDM, rubber gasket, Silicon Sealant, cold forged fastener, aluminium profile etc. including MS supporting structural steel (conforming to relevant BS/equivalent International Standards) frame to ensure water tight arrangement.

21.3.11 **GUTTERS AND DOWN SPOUTS:**

Gutters and down spouts shall be adequately designed to ensure proper roof drainage system. Material shall be same as that of sheeting with matching colour.

21.3.12 PAINTING OF BUILT UP STEEL FRAMES, CRANE GANTRY GIRDERS, FRAMES AT DOOR OPENINGS, WALK WAY STEEL AND LADDER:

The built up frame ,Crane gantry girders, frames for door openings and steel for walk way shall be applied with a priming coat of standard steel primmer followed by one coat coating of epoxy paint and final coating of PU (Minimum 100 Micron) . The steel work for aforesaid members shall be provided with suitable treatment of shot blasting before application of steel primer. The steel material of ladder shall be galvanized.

21.3.13 COLOUR SCHEME:

Colour Scheme matching with local aesthetic and best industry practices shall be submitted by vendors for approval of NEA. Three alternatives of coloured isometric views with colour codes shall be submitted for approval. The monotony of external colour of sheet shall be avoided by providing vertical bands of different coloured sheet. The colour of roof sheet shall be light coloured to minimize heat absorption. External and internal masonry walls shall be painted with suitable colour matching with colour of steel sheet.

21.4 **CONNECTIONS:**

21.4.1 **SITECONNECTIONS**

a) All primary bolted connections shall be provided with galvanized high strength bolts, washers, nuts conforming to specifications of relevant

standard.

b) All secondary bolted connections shall be furnished with bolts, nuts, washers conforming to the specifications of grade 4.6 of relevant standard or ASTM-A307.

21.4.2 **SHOPCONNECTIONS**

All shop connections shall be welded with appropriate arc welding process and welding shall be in accordance with relevant standard, AWSD 1.1. as appropriate. The Webs should be welded on to the flanges at both the faces at top and bottom for columns, beams and crane girders. Weld material should have strength more than the parent metal.

21.4.3 **ROOF & WALLBRACINGS**

Roof and wall bracings shall have minimum yield strength of 250Mpa and shall conform to the specifications of relevant standard.

21.5 INTERNAL FINISH SCHEDULE

The finishing schedule is given in subsequent clauses and table-1. Areas not specified in finish schedule shall be provided with vitrified tile flooring, and Premium Acrylic emulsion paint oil bound washable distemper over two mm thick putty. Paints used in the work shall be of best quality specified in relevant standard.

21.5.1 FLOORING

Flooring in various rooms of control room building and GIS hall shall be as per detailed schedule given in Table -1.

21.5.2 WALLS

All walls of control room building shall be non-load bearing walls. Min. thickness of walls shall be 230 mm (one brick) with 1:6 cement sand mortar. Partition walls (115mm thick) in toilets and pantry can be half brick walls with 1:4 cement sand mortar and two nos. 6mm dia MS bars at every third course.

In GIS building and the attached relay room 230mm thick brick wall shall be provided up to roof level of relay room attached to GIS hall. 50mm thick puff sandwiched panels as described above shall be provided above brick wall.

21.5.3 ROOF

(A) GIS Building and Control Room (if steel structure)

Roofing Panel: 50mm thick puff (density 40kg/cu.m.) sandwiched panels shall be provided as described in previous clauses.

21.6 CABLE TRENCH IN GIS HALL

All cable trenches in GIS hall shall be covered with minimum 6mm thick steel chequered plate with suitable stiffeners. Chequered plate shall be painted with two or more coats of Epoxy paint as per relevant standards.

21.7 EXTERNAL PLASTER AND PAINTING

External plaster 18mm thick shall be of 1:6 cement sand plaster in two layers. External surface of the control room building and GIS building (brick wall portion) shall be painted with Premium acrylic smooth exterior paint with silicon additives over and including priming coat of exterior primer as per relevant standards.

21.8 INTERNAL FINISH SCHEDULE

Internal finish Schedule for control room building and GIS hall is given in Table - 1 below:

Table -1

S.No.	LOCATION	FLOORING & SKIRTING 150MM HIGH	WALL (INTERNAL)	CEILING	DOOR, WINDOWS & VENTILATOR
1.	Control Room	Vitrified tiles size 600 x 600mm	Premium Acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	False ceiling and White wash above False Ceiling	Windows shall be of 10mm thick toughened glass by using suitable patch fittings/spider fittings. The glass shall extend horizontally from column to column and vertically from sill level of 0.75 m to bottom of lintel/roof beam. All doors shall be glazed powder coated aluminium doors with 5.5.mm Thk. Glazing.
2.	Conference	Vitrified tiles size 600 x 600mm	Premium Acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	False ceiling and White wash above False Ceiling	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
3.	In-charge Room	Vitrified tiles size 600 x 600mm	Premium Acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	False ceiling and White wash above False Ceiling	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
4	Other Office Rooms	Vitrified tiles size 600 x 600mm	Premium Acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	False ceiling and White wash above False Ceiling	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
5.	Electronics Test Lab.	Vitrified tiles size 600 x 600mm	Premium Acrylic emulsion paint on smooth	False ceiling and White wash above False Ceiling	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be

S.No.	LOCATION	FLOORING & SKIRTING 150MM HIGH	WALL (INTERNAL)	CEILING	DOOR, WINDOWS & VENTILATOR
			surface applied with plaster of paris (2 mm thick)		glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
6.	ACDB & DCDB Room	62mm thick cement concrete flooring with metallic hardener topping	Oil bound washable distemper on smooth surface applied with plaster of paris putty as perrelevant standards	Oil bound washable distemper on smooth surface applied with plaster of paris putty	Steel door 45mm thick double sheet 18 gauge MS steel suitably reinforced and filled with mineral wool. Windows/ventilator shall be of powder coated aluminium with 4mm glazing.
7.	Battery room	Vitrified tiles size 600 x 600mm	Premium Acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	False ceiling and White wash above False Ceiling	Steel door 45mm thick double sheet 18 gauge MS steel suitably reinforced and filled with mineral wool. Windows/ventilator shall be of powder coated aluminium with 4mm glazing.
8.	Lobby	18mm thick granite flooring	Premium Acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	False ceiling and White wash above False Ceiling	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
9.	Corridor	Vitrified tiles size 600 x 600mm	Premium Acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	False ceiling and White wash above False Ceiling	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
10.	Portico	18mm thick granite flooring	Granite cladding	Acrylic emulsion paint over a coat of cement primer on	All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.

S.No.	LOCATION	FLOORING & SKIRTING 150MM HIGH	WALL (INTERNAL)	CEILING	DOOR, WINDOWS & VENTILATOR
				smooth surface applied with readymade putty 1 mm thick as perrelevant standards	
11.	Toilet	Ceramic tiles	DADO glazed tile 2100mm high, oil bound washable distemper above DADO	Acrylic emulsion paint over a coat of cement primer on smooth surface applied with readymade putty 1 mm thick as per relevant standards	Windows/ ventilator shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be flush door shutters made of pre-laminated particle board (with powder coated aluminium frame.
12.	Janitor room	Ceramic tiles	DADO glazed tile 2100mm high, oil bound washable distemper above DADO	Acrylic emulsion paint over a coat of cement primer on smooth surface applied with readymade putty 1 mm thick as per relevant standards	Windows/ ventilator shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be flush door shutters made of pre-laminated particle board with powder coated aluminium frame.
13.	GIS Hall	62mm thick cement concrete flooring with metallic hardener topping (DSR item code 11.5). Two coats of PU coating over the metallic hardener shall be provided. The final coat of PU shall be applied after	Premium Acrylic emulsion paint having Volatile Organic Compound (VOC) content less than 50 gms per liter of approved brand and manufacturer on smooth surface applied with	In case of RCC roof, ceiling shall be finished with Premium Acrylic emulsion paint having Volatile Organic Compound (VOC) content less than 50 gms per liter of approved	Windows/ ventilator shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be flush door shutters with powder coated aluminium frame.

S.No.	LOCATION	FLOORING & SKIRTING 150MM HIGH	WALL (INTERNAL)	CEILING	DOOR, WINDOWS & VENTILATOR
		Installation of equipments. Total thickness of PU coats shall be minimum 300 microns.	plaster of paris (2 mm thick) over approved primer coat .	brand and manufacturer over approved primer coat	
14.	Panel/Relay Room	Vitrified tiles 8mm thick size 600 x 600mm	Premium Acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	False ceiling and White wash above False Ceiling	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
15.	AHU Room	62mm thick cement concrete flooring with metallic hardener topping	Premium Acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	Acrylic emulsion paint over a coat of cement primer on smooth surface applied with readymade putty 1 mm thick as per relevant standards	Windows/ ventilator shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be flush door shutters with powder coated aluminium frame.

21.9 Staircase shall be provided with stainless steel railing and 18mm thick granite slab in risers and treads.

21.10 DOORS AND WINDOWS

The details of doors and windows of the control room building shall be as per finish schedule Table-1 conforming to relevant BS/equivalent International Standards. Rolling steel shutters shall be provided as per layout and requirement of buildings. Main entrance door to control room building shall be made of powder coated aluminium frame with 5.5 mm thick glazing.

21.11 PARTITION

Partitions, if required, shall be made of powder coated aluminium frame provided with 5.5 mm thick clear glass or pre- laminated board depending upon the location of partition.

21.12 FALSE CEILING

Fifteen millimeter thick densified regular edged eco friendly light weight calcium silicate false ceiling as per relevant standards shall be provided in the areas specified in Finish Schedule.

21.13 PLUMBING & SANITATION

(i) All plumbing and sanitation shall be executed to comply with the requirements of the appropriate bye-laws, rules and regulations of the Local Authority having jurisdiction over such matters. The Contractor shall arrange for all necessary formalities to be met in regard to inspection, testing, obtaining approval and giving notices etc.

(ii) PVC "SYNTEX" or equivalent make Roof water tank of adequate capacity depending on the number of users for 24 hours storage shall be provided. Minimum 2 Nos 1500 liter capacity shall be provided.

(iii) Chlorinated Polyvinyl chloride (CPVC) pipes having thermal stability for hot and cold water supply including all CPVC plain and brass threading conforming to relevant standards shall be used for internal & external piping work for potable water supply.

(iv) UPVC pipes conforming to relevant standards shall be used for sanitary works above ground level and RCC pipe shall be used for works below ground.

(v) Each toilet shall have the following minimum fittings.

(a) WC (Western type) 390 mm high with toilet paper roll holder and all fittings in toilets attached to conference and sub-station in charge office.

and

WC (Indian Type) Orissa Pattern (580 x 440 mm) with all fittings shall be provided in common toilets.

(b) Urinal (430 x 260 x 350 mm size) with all fittings.

(c) Wash basin (550 x 400 mm) with all fittings.

(d) Bathroom mirror (600 x 450 x 6 mm thick) hard board backing

(e) CP brass towel rail (600 x 20 mm) with C.P. brass brackets

(f) CP Soap holder and CP liquid soap dispenser.

(g) All urinals and washbasins shall be provided with built in sensors.

(vi) Water cooler for drinking water with adequate water storage facility shall be provided and located near control room and not near toilet block.

(viii) 1 no. stainless steel kitchen sink with Drain board (510 x 1040 x 178 mm bowl depth) for pantry shall be provided.

(ix) All fittings, fastener, grating shall be chromium plated.

(x) All sanitary fixtures and fittings shall be of approved quality and type manufactured by well known manufacturers. All items brought to site must bear identification marks of the type of the Manufacturer.

(xi) Stoneware pipes may be used for soil, waste and drain pipes in the areas not subjected to heavy loads otherwise Heavy duty cast iron pipes may be used.

(xii) Contractor shall provide septic tank and soak pit of adequate capacity to treat the sewage / sullage from the building.

(xiii) Contractor shall implement all other jobs required to complete and commission the building.

22.0 Residential and Non Residential Buildings

All buildings shall be constructed as RCC Framed buildings. The architectural features shall match with local architecture. For preparation of architectural drawings of these buildings, the contractor shall depute local Architect of repute who must be well aware of local bye laws and statutory clearances required for residential and guest house/field hostel/Transit camp building from Nepal Authority. The buildings shall be designed for loads as applicable in accordance to relevant standards. The plumbing and sanitary works including over head water tanks placed on terrace and for each building shall also be deemed to be included in the civil works of building.

Construction of man holes/chambers, connection of internal plumbing and sanitary system with external sewerage and water supply system shall be considered as a part of civil works of buildings. These works will not be measured and paid separately.

The details and approximate size of various buildings are as below:

(a) D-Type Quarter: One Number with size 15 m x 14 m-Single Storeyed.
(b) C-Type Quarters: Four Numbers: One Block of four quarters having two quarters on ground floor and two quarters on first floor. Block will have an area of about 12 m X 25 m on each floor.
(c) B-Type Quarters: Four Numbers : One Block of four quarters having two quarters on ground floor and two quarters on first floor. Block will have an area of about 10 m X 25 m on each floor.

The area for above buildings has been indicated as tentative. The Contractor shall adopt the suitable size to accommodate various rooms and services for each type of building. The size of various rooms shall be in accordance to local laws.

The finish schedule has been tabulated as below:

Schedule of Finishes for Quarters					
Floor	**Room Name**	**Flooring**	**Walls**	**Ceiling**	**Remarks**
Typical Flat	Living	Polished Vitrified Tiles	Plastered & Painted OBD Over 2mm POP Finish	Plastered & Painted with Wash Over 2MM POP	
	Living Balcony	Antiskid Vitrified Tiles	Plastered & Painted with Exterior Paint	DO	For Qrts. As applicable
	Kitchen	Antiskid Ceramic Glazed 1st Quality Floor Tiles-0.3x0.3M IS 15622	Plastered & Painted OBD Over 2mm POP Finish	DO	Ceramic Tiles UP to 0.6M Above Kitchen Platform
	Toilet	Do	Ceramic Tiles 0.2x0.3M up to 2.1M	DO	Above 2.1M Plaster & Painted OBD over 2MM POP Finish
	Bed Room	Vitrified Tiles	Plastered & Painted OBD Over 2mm POP Finish	DO	
	Bed Room Balcony	Antiskid Vitrified Tiles	Plastered & Painted with Exterior Paint	DO	
	Attached Toilet/ Bed Room Toilet	Antiskid Ceramic Glazed 1st Quality Floor Tiles-0.3x0.3M IS 15622	Ceramic Tiles 0.2x0.3M up to 2.1M	DO	Above 2.1M Plaster & Painted OBD over 2MM POP Finish
	Passage	Vitrified Tiles With Light Shade	Plastered & Painted OBD Over 2mm POP Finish	DO	
	Cupboard	1:2:4 Concrete with neat cement	Plastered & Painted OBD	DO	

		finish			
	Staircase	Marble Stone Treads & Landings	Plastered & Painted OBD Over 2mm POP Finish	DO	Enamel Paint for M.S. Railing
	Car Parking	80mm Flexi Paver Blocks	Plastered & Painted with Exterior Paint	Plastered & Painted OBD over 2mm POP Finish	For D Type Qtrs. Only
Schedule of Finishes for Transit Camp					
Floor	Room Name	Flooring	Walls	Ceiling	Remarks
	Porch	60mm thk. Flexi Paver Blocks	Plastered & Painted with Exterior Paint	Plastered & Painted with OBD Over 2mm POP Finish	
	Drawing & Dining	Polished Vitrified Tiles 0.6x0.6M	Plastered & Painted Plastic Emulsion Paint over 2mm POP Finish	Minera Fbre False Ceiling POP Cornice & Moulding Painted with Plastic Emulsion Paint	Vitrified Tiles Skirting of 150mm high to be Provided
	Lobby	DO	DO	Plastered & Painted OBD Over 2mm POP Finish	DO
	Kitchen	DO	DO	DO	Ceramic Tiles from Floor Level to 0.6M Above Kitchen Platform
	VIP Room & Lounge	DO	DO	DO	POP Cornice &Moulding shall be Provided for Ceiling
	Attached Toilet of VIP Room	Vitrified Tiles (Antiskid) 0.6x0.6M	Ceramic Tiles 0.3x0.45M (Minimum size)up to Ceiling	DO	
	Dormitory	22mm Thk. Terrazzo Tiles Light shade	Plastered & Painted OBD Over 2mm POP Finish	DO	
	Dormitory Toilet/Bath	Antiskid Ceramic Glazed 1st Quality Floor Tiles-0.3x0.3M	Ceramic Tiles 0.2x0.3M up to 2.1M	DO	Area Above 2.1M Plaster & Painted OBD over 2MM POP

					Finish
	Staircase	18mm Thk. Udaipur Green Marble Stone	Plastered & Painted OBD Over 2mm POP Finish	DO	SS Hand Railing as per Drawing
	Bed Rooms	Polished Vitrified Tiles 0.6mx0.6m	Plastered & Painted with Plastic Emulsion Paint Over 2mm POP Finish	DO	
	Attached Toilets	Antiskid Ceramic Glazed 1st Quality Floor Tiles-0.3x0.3M	Ceramic Tiles 0.2x0.3M up to 2.1M	DO	Area Above 2.1M Plaster & Painted OBD over 2MM Thk. POP Finish
	Care Taker Room	Vitrified Tiles With Light Shade	Plastered & Painted OBD Over 2mm POP Finish	DO	
	Common Toilet	Antiskid Ceramic Glazed 1st Quality Floor Tiles-0.3x0.3M	Ceramic Tiles 0.2x0.3M up to 2.1M	DO	Area Above 2.1M Plaster & Painted OBD over 2MM Thk. POP Finish
	Store	Vitrified Tiles With Light Shade	Plastered & Painted OBD	DO	
	Balconies	Antiskid Vitrified Tiles Light Shade	Plastered & Painted with Exterior Paint	DO	
	Terrace	Brick Bat Coba Water Proofing	Plastered & Painted with Exterior Paint		

23.0 Boundary wall, Main Gate, Security Room and septic tank and soak pit

23.1 Boundary Wall :

RCC framed with brick masonry/concrete block/stone masonry in fill between columns shall be provided along periphery of substation. The brief description of boundary wall is given below:

(a) Height of boundary wall (Masonary portion) above ground = 2.5 m
(b) 0.5 m Heigh of Y shaped angle supports (50x50x6 mm) above each column with about 0.5 m deep grouted in column shall be provided as grill on the boundary wall
(c) C/c distance of RCC Column (230 X 230 mm size) = 2.5 m

(d) 8 rows of galvanised barbed wire with concertina coil a top of boundary wall shall be provided. 4 rows of barbed wire on each arm of Y-shaped angle is to be provided.
(e) Grade of Concrete for RCC works = M25
(f) Mix of masonry works = 1 Cement: 6 Sand
(g) 12 mm thick Cement sand plaster (1 cement: 6 Sand) over exposed portion of boundary wallalong with 50mm thick PCC(1:2:4) coping on the top of wall.
(h) Two coats of oil bound distemper with one coat of cement primer of approved make shall be applied over exposed portion of boundary wall.
(i) A RCC plinth beam (230 X 300 mm deep) shall be provided at ground level. A lintel beam of 230 X 230 mm shall be provided over gratings.
(j) Suitable steel grating made of 20 mm square bars shall be provided at suitable locations preferably @ 100 m to allow the flow of surface water.
(k) Suitable foundation of about 1.5 depth shall be provided for each RCC column. 75 mm thick PCC (1:4:8) layer shall be provided below all RCC works.
(l) All steel works shall be provided with two coats of synthetic enamel paint over a coat of steel primer of approved make.
(m) Twin columns with 25 mm expansion gap at every 45 meter length shall be provided.
(n) Suitable design of boundary wall shall be developed by the contractor.

The boundary wall shall be measured and paid on running meter length basis.

23.2 Main Gate

A steel gate of 2.1 m high and 6 m wide along with 1.5 m wide man gate shall be provided at entry location of substation. The gate shall be supported on steel columns. The steel support columns shall be encased with suitable RCC foundations. Suitable wheel mounting arrangement shall be provided at the bottom of gate for smooth opening of gate. All steel works shall be provided with two coats of synthetic enamel paint over a coat of steel primer of approved make.

The item shall be measured and paid on Lump sum basis.

23.3 Security Room:

A RCC framed room of size 3 m X 3m and 3 m high with 1.5 m wide veranda shall be provided near gate.An attached toilet of 1.5 m x 1.5 m size shall be provided. Suitable septic tank and soak pit for 10 users with cleaning interval of 3 years shall also be provided. A RCC platform (600 mm wide) at window sill level along with wardrobe shall be provided. All sanitary works and a PVC water tank of 1000litre capacity shall also be provided. All finish details shall match with other buildings mentioned elsewhere in the technical specification.

The item shall be measured and paid on square meter area basis.

24.0 MODE OF MEASUREMENT

24.1 Geotechnical investigation

This shall include carrying out field tests, laboratory tests, compilation of results and preparation of soil report with recommendations for type of foundations shallow or pile type, suitability of soil for construction of substation etc. The geotechnical investigation work shall be measured on lump sum basis.

24.2 Contour survey and site leveling.

The Contour survey work shall not be measured and paid separately and shall be deemed to be included in the item of site leveling work.
Measurement of Earth work in all kind of soil including soft/disintegrated rock in the item of cutting and filling and item of earth work in the filling with borrowed earth shall be made in Cubic meters. No void deduction for 95% compaction.

24.3 Earthwork

This shall include excavation in all kinds of soil including rock, all leads and lifts including back filling with suitable earth, compacting, dewatering (if required) and disposal of surplus earth or rock to a suitable location within a lead up to 2 km. The surplus earth if disposed within substation boundary shall be spread in uniform layers each compacted with two passes of suitable compacting equipment. The quantity of excavation for foundations of towers, equipment support structures, all transformers/Reactors, DG Set, firewall, cable trenches, fire fighting water tank, buildings and underground water tanks, covered car parking, External lighting poles, control cubicles, marshalling box shall only be measured. The quantity of excavation for roads, rail cum road, drains, culverts, rainwater harvesting, septic tank, soak pit, external water supply system, site surfacing, chain link fencing (including gate) shall not be measured separately and shall be deemed to be included in the composite rates quoted by the bidder for the respective works. All other excavation required for the completion of the work including plinth protection, flooring, sewerage system, manholes, pipes, earth mat etc. shall also not be paid for. The measurement of excavation of all concrete works shall be made considering dimension of the pit leaving 150mm gap around the base pad (lean concrete) or actually excavated pit, whichever is less. The quantity shall be measured in cubic metres.

24.4 PCC

Providing and laying Plain Cement Concrete of all types and at all locations including all leads and lifts. The quantity shall be measured in cubic meters as per lines and levels indicated in the drawings.

24.4.1 PCC 1:2:4 (1 cement : 2 sand : 4 coarse aggregate 20 mm nominal size) shall be measured in flooring of buildings, plinth protection, fencing, transformer/reactor foundation, rail track, drain, culverts, septic tank, chain link fencing, fencing gate ,external lighting poles etc. as indicated in the approved drawings.

24.4.2 PCC 1:4:8 (1 cement : 4 coarse sand : 8 stone aggregate, 40mm nominal size) shall be measured below all foundations of towers, equipment support structures, buildings, fire fighting water tanks, covered car parking, cable trench, roads, under flooring, rail-cum-road, transformer foundation, reactor foundation, drain, cable trench crossings, culverts, fence, gate etc. as indicated in the approved drawings.

24.4.3 PCC 1:5:10 (1 Cement: 5 sand: 10 Stone aggregate, 40mm nominal size) shall be provided for site surfacing in switchyard, roof water proofing etc.

All other PCC required for the completion of the work including hold fasts of doors/windows/rolling shutters, fixing of plumbing pipes, bedding concrete for sewer lines, embedment of electrical conduits etc. shall not be measured and deemed included in the composite rates quoted by the bidder for respective works. Water proofing compound wherever specified shall be added without any extra cost.

24.5 RCC

Measurement of reinforced cement concrete at all locations shall be made and shall include all leads, lifts, formwork, grouting of pockets and underpinning, (but shall exclude reinforcement & miscellaneous structural steel like inserts etc.), of M25 design mix (Minimum). This shall also include pre-cast RCC work and addition of water proofing compound wherever required for which no additional payment shall be made. The quantity shall be measured in cubic meters as per lines and levels indicated in the drawings. No deduction shall be made for volume occupied by reinforcement/inserts/sleeves and for openings having cross-sectional area up to 0.1 Sq.M.

24.6 Steel Reinforcement

Reinforcement steel shall be measured in length (actual or theoretical as per drawing whichever is less) including hooks, if any, separately for different diameters as actually used in RCC work, excluding overlaps. From the length so measured, the weight of reinforcement shall be calculated in metric tonnes on the basis of sectional weights as adopted by British Standards/equivalent International standards. Wastage, overlaps, couplings, welded joints, spacer bars, chairs, stays, hangers and annealed steel wire or other methods for binding and placing shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement.

24.7 Stone filling over grating in Transformer/Reactor foundation

Measurement of stone (40mm nominal size) filling over gratings of transformer/reactor foundations shall be made as per theoretical volume of the space to be filled in the transformer foundation as per approved drawings. This shall be measured in Cu.M.

24.8 Miscellaneous structural steel

Measurement for Supply, fabrication, transportation and erection of all miscellaneous structural steel work for rails along with rail fixing details and gratings with supports for transformers/reactors, Cable trenches with covers (Chequered plate covers, cable supports, earthing cleats and edge protection angles etc), all other steel fittings and fixtures, inserts and embedment in concrete of transformer/reactor foundation and cable trenches shall be made as per approved drawings. The unit rate for this item shall be inclusive of cutting, grinding, drilling, bolting, welding, pre- heating of the welded joints, applying a priming coat of steel primer and anti-corrosive bitumastic paint/ synthetic enamel paint in general but with Zinc Phosphate Primer (Two packs) for grating and support for grating in Transformer foundation. (Wherever specified), setting of all types of embedment in concrete, etc. Steel required for foundation bolts, nuts and bolt, doors, windows, ventilators, louvers, rolling shutters, chain link fencing, gratings in drains, soil pipes, plumbing pipes, floor traps, embedment's required for rainwater harvesting, septic tank, soak pit, roof truss and purlins required for fire water tank, etc. shall not be considered for payment and measurements. Quantity shall be measured in metric tonnes.

24.9 Roads

A). The measurement for the concrete road shall be made on the basis of area in square meter (M2) of top concrete completed surface of the road and shall be deemed to include all items such as excavation, compaction, rolling, watering, WBM, shoulder, etc complete as per approved drawing but excluding concreting and reinforcement which shall be paid separately under respective items of BPS.

B) The measurement of bituminous road shall be made on the basis of area in square meter (M2), of the top bituminous completed surface of the road and shall include all items such as excavation, compaction, rolling, watering, sub base course, WBM, shoulder, premix carpet etc complete as per approved drawing.

C) The measurement of strengthening of existing road (bituminous road) shall be made on the basis of area in square meter (M2), of the top bituminous completed surface of the road including premix carpet etc but excluding item of granular sub base course which shall be paid separately under respective item of BPS.

24.10 Anti-weed Treatment and Stone Spreading

The measurement shall be done for the actual area in square metres of stone

spreading provided in the switchyard .It includes providing and spreading of 100mm thickness of uncrushed/crushed/broken stone of 40mm nominal size as per relevant BS codes/equivalent International standards for the specified area. Application of anti weed treatment including material shall not be measured separately and item would be deemed to be included in the quoted rate of stone spreading in switchyard.

24.11 Chain Link Fencing and gate

The measurement shall be made in running metres of the fence provided as per approved drawing. The rate shall be including the post, fencing, MS Flat, painting, brick work and plaster of toe wall etc. complete but excluding the concrete. The switch yard gate shall be measured in numbers.

24.12 Cable Trenches and Cable trench Crossings

Earthwork, PCC, RCC, reinforcement steel, RCC hume pipes and miscellaneous steel required for construction of Cable Trenches and cable trench crossings shall be measured under respective items of Bid price schedule (BPS) as described in clauses of aforesaid paras. No additional payment for brick work, plaster and PVC pipes used for cable trench crossings and sealing of trench mouth shall be admissible.

24.13 Drains & Culverts

PCC (1:2:4 and 1:4:8) for drains and culverts shall be measured under respective items of Bid price schedule (BPS) as described in clauses of aforesaid paras . All other items like excavation, brick work, plaster and stone pitching except RCC hume pipes required for completion of drains and culverts shall be deemed to be included in the quoted rate of drain. The quantity for each type of drain section shall be measured in running meters. However, RCC hume pipes used in culverts shall be measured under under respective item of Bid price schedule (BPS) as described in clause of hume pipes.

24.14 External Finishing of RCC Framed Buildings/structures:

The item shall be measured per square meter area basis. Contractor has to assess the quantity as per requirement of Control room cum administrative building, Fire Fighting Pump House, fire fighting water tank, switchyard panel room, residential and non residential buildings, covered car parking and quote for the same separately. This shall include following items.

1) External plastering/cement wash : 18mm Cement plaster in two coats under layer 12 mm thick cement plaster 1:5 (1 cement: 5 coarse Sand) finished with a top layer of 6 mm thick cement plaster 1:6 (1 cement: 6 fine Sand) for all buildings and fire fighting water tank .
2) Providing and applying two or more coats of Acrylic smooth exterior paint over an under coat of suitable primer on new cement plaster surfaces of the control room building, auxiliary building, fire fighting pump house building, fire fighting water tank, panel room , residential and non residential buildings and covered car parking. It shall be inclusive of required tools, scaffolding, materials and other painting accessories etc. as per recommendations of manufacturer.

24.15 Hume Pipe

Hume pipe shall be measured diameter-wise and laid as per approved drawings and shall be measured in running meters. The item shall be inclusive of excavation, laying, back filling, jointing etc. but excluding concrete and reinforcement (if any).

24.16 Building

The measurement of all items except excavation, concrete, reinforcement steel of each type of buildings shall be made on area in Square Meter basis. However, the quantity of excavation, concrete, reinforcement shall be measured in respective items of BPS and described in above paras. The structural steel used for cable tray support, earthing cleat, chequered plates for internal cable trenches of building and panel room wherever applicable shall be measured and paid under miscellaneous steel item of BPS and described above paras. The structural steel and foundation bolts for fixing equipments with foundations/raft within buildings shall not be measured separately which shall be deemed to be included in the quoted rates per square meter of buildings. External Finishing shall be measured and paid in respective items of BPS and described in above paras. The rest of the entire work required to complete the building in all respect as per drawings prepared by contractor and approved by NEA/Consultant shall be deemed to be included in this item rate per square meter area basis.

24.17 Rain Water Harvesting

This is a lump sum item. The contractor shall be required to complete the work in all respect as per drawings prepared by contractor and approved by NEA/Consultant. All the items including excavation, miscellaneous steel, brick work, fillings of boulders, gravel, sand, pipes etc. shall be deemed to be included in this lump sum rate. However, the concrete (all types) and the reinforcement shall be measured and paid under respective item of BPS and described in above paras.

24.18 Rail cum Road

The measurement for the rail cum road shall be made in square metres of top concrete completed surface of the rail cum road and shall include all items such as excavation, compaction, rolling, watering, WBM etc. complete as per approved drawing but excluding concrete, reinforcement, structural steel and rails with rail fixing details which shall be measured separately under respective item of BPS and described in above paras.

24.19 Septic Tank and Soak Pit

This is a lump sum item. The contractor shall be required to complete the work in all respect as per drawings furnished by the contractor and approved by NEA/Consultant. All the items including excavation, masonry work, all types of fillings, all types of pipes including plumbing and vent pipes, all type of fittings etc. shall be deemed to be included in this lump sum rate. However, the concrete (all types) and the reinforcement shall be measured and paid under the respective item mentioned above.

24.20 Fire Water Tank

This is a lump sum item. The contractor shall be required to complete the work in all respect as per approved drawings. The items including brick work if any, and miscellaneous steel including steel embedment Rungs, roof truss, corrugated AC Sheet roofing, door, pipe sleeves, internal finish, etc. shall be deemed to be included in this lump sum cost. However, the items like excavation, concrete (all types), reinforcement steel, external finish shall be measured and paid under the respective item of BPS and described in above paras.

24.21 External water supply from Bore-well/ other source of water supply arrangement to Fire water tank, Control Room building, Residential and non residential buildings

The external water supply from Bore-well shall be measured diameter-wise in running meters. It shall include all the items such as excavation, piping, pipe fittings, painting, brickwork, sand filling, concrete, valves, chambers cutting chases in walls, openings in RCC and repairs, etc. required to complete the job.

24.22 External Sewage System of Control Room Building and other Buildings of Township.

It shall be measured diameter wise in running meters. It shall include all the items such as excavation, piping, pipe fittings, manholes, gali trap, gali chamber casing in concrete and repairs etc required to complete the job. Any modification in the existing sewage system, if required, shall be done by the Contractor without any extra cost implicated to NEA/Consultant.

25.0 MISCELLANEOUS GENERAL REQUIREMENTS

25.1 Dense concrete with controlled water cement ratio as per BS-code shall be used for all underground concrete structures such as pump-house, tanks, water retaining structures, cable and pipe trenches etc. for achieving water-tightness.

25.2 All joints including construction and expansion joints for the water retaining structures shall be made water tight by using PVC ribbed water stops with central bulb. However, kicker type (externally placed) PVC water stops shall be used for the base slab and in other areas where it is required to facilitate concreting. The minimum thickness of PVC water stops shall be 5 mm and minimum width shall be 230 mm.

25.3 All steel sections and fabricated structures which are required to be transported on sea shall be provided with anti corrosive paint to take care of sea worthiness.

25.4 All mild steel parts used in the water retaining structures shall be hot-double dip galvanised. The minimum coating of the zinc shall be 750 gm/sq. m. for galvanised structures and shall comply with relevant BS. Galvanizing shall be checked and tested in accordance with relevant BS. The galvanizing shall be followed by the application of an etching primer and dipping in black bitumen in accordance with BS: 3416.

25.5 A screed concrete layer not less than 100 mm thick and of grade not weaker than M10 conforming to relevant BS shall be provided below all water retaining structures. A sliding layer of bitumen paper or craft paper shall be provided over the screed layer to destroy the bond between the screed and the base slab concrete of the water retaining structures.

25.6 Bricks having minimum 75 kg/cm2 compressive strength can only be used for masonry work. Contractor shall ascertain himself at site regarding the availability of bricks of minimum 75 kg/cm2 compressive strength before submitting his offer. The contractor may use concrete blocks of equivalent compressive strength in place of brick work.

25.7 Doors and windows on external walls of the buildings (other than areas provided, with insulated metal claddings) shall be provided with RCC sun-shade over the openings with 300 mm projection on either side of the openings. Projection of sunshade from the wall shall be minimum 450 mm over window openings and 750 mm over door openings.

25.8 All stairs shall have maximum riser height of 150 mm and a minimum tread width of 300 mm. Minimum width of stairs shall be 1500 mm. Service ladder shall be provided for access to all roofs. RCC fire escape staircase if required as per local bye laws, shall be provided in control buildings.

25.9 Angles 50x50x6 mm (minimum) with lugs shall be provided for edge protection all round cut outs/openings in floor slab, edges of drains supporting grating covers, edges of RCC cable/pipe trenches supporting covers, edges of manholes supporting covers, supporting edges of manhole precast cover and any other place where breakage of corners of concrete is expected.

25.10 Anti termite chemical treatment for buildings shall be given to all column pits, wall trenches, foundations, filling below the floors etc. as per relevant International/BS .

25.11 Hand-railing minimum 900mm high shall be provided around all floor/roof openings, projections/balconies, walk ways, platforms, steel stairs etc. All handrails and ladder pipes shall be 32 mm nominal bore MS pipes (medium class) and shall be galvanised (medium-class as per relevant BS). All rungs for ladder shall also be galvanised as per relevant BS.

For RCC stairs, hand railing with 20 mm square MS bars, balustrades with suitable MS flats & aluminium handrails shall be provided.

25.12 For all civil works covered under this specification, design Mix of Minimum M25 grade as per relevant International /BS shall be used. Reinforcement steel shall be of minimum Fe 500 grade.

The material specification, workmanship and acceptance criteria shall be as per relevant clauses of applicable International/BS standard.

25.13 Items/components of buildings not explicitly covered in the specification and BPS but required for completion of the project shall be deemed to be included in the scope.

25.14 Requirement of sulphate resistant cement (SRC) for sub structural works shall be decided in accordance with the International/BS Standards based on the findings of the detailed soil investigation to be carried out by the Bidder.

25.15 Foundation system adopted by Bidder shall ensure that relative settlement and other criteria shall be as per provision in relevant BS and other International Standards.

25.16 All water retaining structures designed as uncracked section shall also be tested for water tightness at full water level in accordance with relevant international/ BS standards.

25.17 Construction joints shall be as per International/BS standard..

25.18 All underground concrete structures like basements, pumps houses, water retaining structures etc. shall have plasticizer cum water proofing cement additive conforming to relevant BS. The concrete surface of these structures in contact with earth shall also be provided with two coat of bituminous painting for water/damp proofing.

In case of water leakage in the above structures, The Method shall be applied as per relevant international standard/BS standard for repairing the leakage.

25.19 All building/construction materials shall conform to the best quality specified in relevant International /BS standard.

26.0 INTERFACING

The proper coordination & execution of all interfacing civil works activities like fixing of conduits in roofs/walls/floors, fixing of foundation bolts, fixing of lighting fixtures, fixing of supports/embedment's, provision of cut outs etc. shall be the sole responsibility of

the Contractor. He shall plan all such activities in advance and execute in such a manner that interfacing activities do not become bottlenecks and dismantling, breakage etc. is reduced to minimum.

27.0 STATUTORY RULES

27.1 Contractor shall comply with all the applicable statutory rules pertaining to factories act (as applicable for the State). Fire Safety Rules of Tariff Advisory- Committee and Water and sewerage Act for pollution control etc.

27.2 Provisions for fire proof doors, no. of staircases, fire escape stairs ,fire separation wall, plastering on structural members (in fire prone areas) etc. shall be made according to the recommendations of Local Advisory Committee.

27.3 Statutory clearance and norms of Local Pollution Control Board shall be followed as per Water Act for effluent quality from plant.

28.0 FIELD QUALITY PLAN

All tests as required in accordance to BS codes or equivalent International standards have to be carried out. The contractor shall prepare field quality plan for civil works as per relevant /BS codes/equivalent International Standards during detailed engineering stage and submit to NEA/Consultant for approval within ONE month after award of work.

29.0 BRITISH STANDARD CODES

Major British standard Codes for civil work have been given in the following list. This list is illustrative but not exhaustive. However, for design and engineering relevant BS codes or equivalent International standards shall be referred by the contractor. Relevant portion of BS codes or equivalent international standards referred by the contractor for the design shall be made available to NEA/Consultant if necessary during detailed engineering stage.

Sr. No.	Standard No.	Title	Year
1	BS 41	Structural steel sections. Specification for hot-rolled sections	2005
2	BS 13771	Methods of test for soils for civil engineering purposes. General requirements and sample preparation	1990
3	BS 4449	Steel for the reinforcement of concrete. Weldable reinforcing steel. Bar, coil and decoiled product. Specification (with A2:2009)	2005
4	BS 4482	Steel fabric for the reinforcement of concrete. Specification	2005
5	BS 4483	Steel fabric for the reinforcement of concrete. Specification	2005
6	BS EN 102102	Hot finished structural hollow sections of non-alloy and fine grain steels. Tolerances, dimensions and sectional properties	2006
7	BS EN 100561	Specification for structural steel equal and unequal angles. Dimensions	1999
8	BS EN ISO 800001	Quantities and units. General	2013
9	BS 5930	Code of practice for site investigations (with A2:2010)	1999
10	BS EN 1993-11	Eurocode 3. Design of steel structures. General rules and rules for buildings	2005

11	NA to BS EN 199311	UK National Annex to Eurocode 3. Design of steel structures. General rules and rules for buildings	2008
12	BS EN 1993-15	Eurocode 3. Design of steel structures. Plated structural elements	2006
13	NA to BS EN 199315	UK National Annex to Eurocode 3. Design of steel structures. Plated structural elements	2008
14	BS EN 1993-18	Eurocode 3. Design of steel structures. Design of joints	2005
15	NA to BS EN 199318	UK National Annex to Eurocode 3. Design of steel structures. Design of joints	2008
16	BS 60732	Precast concrete masonry units. Guide for specifying precast concrete masonry units	2008
17	BS 7668	Weldable structural steels. Hot finished structural hollow sections in weather resistant steels. Specification	2004
18	BS EN 1997-1	Eurocode 7. Geotechnical design. General rules	2004
19	NA to BS EN 19971	UK National Annex to Eurocode 7. Geotechnical design. General rules	2007
20	BS EN 1992-3	Eurocode 2. Design of concrete structures. Liquid retaining and containing structures	2006
21	BS EN 1992-11	Eurocode 2. Design of concrete structures. General rules and rules for buildings	2004
22	NA to BS EN 199211	UK National Annex to Eurocode 2. Design of concrete structures. General rules and rules for buildings	2005
23	BS 75334	Pavements constructed with clay, natural stone or concrete pavers. Code of practice for the construction of pavements of precast concrete flags or natural stone slabs	2006
24	BS EN 1971	Cement. Composition, specifications and conformity criteria for common cements	2011
25	BS 743	Specification for materials for damp proof courses	1970
26	BS 8122	Testing aggregates. Methods for determination of density	1995
27	BS 952-1	Glass for glazing. Classification	1995
28	BS 952-2	Glass for glazing. Terminology for work on glass	1980
29	BS EN 12620	Aggregates for concrete	2013
30	BS 1125	Specification for WC flushing cisterns (including dual flush cisterns and flush pipes)	1987
31	BS 1188	Specification for ceramic wash basins and pedestals	1974
32	BS 1199 and 1200	Specifications for building sands from natural sources	1976
33	BS EN 13310	Kitchen sinks. Functional requirements and test methods	2003
34	BS 1245	Pedestrian doorsets and door frames made from steel sheet. Specification	2012
35	BS 1254	Specification for WC seats (plastics)	1981
36	BS 1370	Specification for low heat Portland cement	1979
37	BS EN 1008	Mixing water for concrete. Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete	2002
38	BS 3505	Specification for unplasticized polyvinyl chloride (PVC-U) pressure pipes for cold potable water	1986
39	BS EN 15743	Supersulfated cement. Composition, specifications and conformity criteria	2010

40	BS EN ISO 3766	Construction drawings. Simplified representation of concrete reinforcement	2003
41	BS 8666	Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete. Specification	2005
42	BS 4514	Unplasticized PVC soil and ventilating pipes of 82.4 mm minimum mean outside diameter, and fittings and accessories of 82.4 mm and of other sizes. Specification	2001
43	BS 4551	Mortar. Methods of test for mortar and screed. Chemical analysis and physical testing (with A2:2013)	2005
44	BS EN 122001	Plastics rainwater piping systems for above ground external use. Unplasticized poly (vinyl chloride) (PVC-U). Specifications for pipes, fittings and the system	2000
45	BS EN 1462	Brackets for eaves gutters. Requirements and testing	2004
46	BS EN 607	Eaves gutters and fittings made of PVC-U. Definitions, requirements and testing	2004
47	BS 6262	Code of practice for glazing for buildings	1982
48	BS EN 14411	Ceramic tiles. Definitions, classification, characteristics, evaluation of conformity and marking	2012
49	BS 6510	Steel framed windows and glazed doors. Specification	2010
50	BS EN 636	Plywood. Specifications	2012
51	NA to BS EN 19923	UK National Annex to Eurocode 2. Design of concrete structures. Liquid retaining and containment structures	2007
52	BS EN 1339	Concrete paving flags. Requirements and test methods	2003
53	BS EN 1340	Concrete kerb units. Requirements and test methods	2003

SECTION-14.2

PILE FOUNDATION

CONTENTS

SECTION-14.2
GENERAL INFORMATION & SCOPE

CONTENTS

SECTION-14.2 (Part-I)
GENERAL INFORMATION & SCOPE

1 GENERAL

This section covers the specification for pile foundation work envisaged substation Pile foundations are envisaged for locations such as Control Room Building, GIS hall etc. or where ever required

2 SCOPE

2.1 The work to e performed under this specification consists of boring in all kinds of soil including weathered rock, fissured rock, hard rock, shale etc., providing and installation of cast-in-situ RCC vertical bored piles of diameter as per provision in BoQ, providing all labour, materials, supervision, dewatering, scaffolding, platforms, boring and construction equipment & machineries, tools, tackles and plants, supplies, power, fuel, transportation on land and water, all incidental items not shown or specified but reasonably implied or necessary for successful and timely completion of work including Contractor's supervision in strict accordance with IS Codes, drawings and specifications. The nature of work shall generally involve construction/installation of cast-in-situ RCC vertical bored piles of specified diameter, pile caps, pedestals, tie beam (if required) etc. as per the Purchaser's construction drawings and also co-ordination with the structures built above the foundation.

2.2 The bidder shall furnish in their bid complete data regarding the method of installation of the pile foundations, complete list of equipment, tools and tackles, rigs, men, materials to be deployed for the work etc.

2.3 The Bidder's offer should be based on the mobilization of at least one no. piling rig for each tower location together with all associated working gangs, tool & tackles etc. (including at least one no. of Rotary Hydraulic drilling rig capable of boring piles up-to 40m depth below existing Ground Level with necessary tools/accessories for boring) However, if extra rigs are required to be deployed by the Contractor to match with the project construction schedule, the same shall be deployed without any additional cost to the Purchaser. The contractor has to execute the complete job as per soil strata actually encountered at the time of construction.

2.4 The Contractor shall be responsible for the soundness of the above pile foundations installed / constructed by them.

2.5 After completion of installation / construction of piles, pile integrity test shall be conducted for each pile by the contractor, in presence of Purchaser's representative, to establish its soundness. The procedure for conducting of pile integrity test is given briefly at Part – IV of this Specification. The tentative quantity of tests to be carried out are given in BPS. Bidder has to quote the price accordingly. Initial load test and routine test shall be carried out as per relevant British standard codes/ equivalent international standards.

2.6 The setting of stub/fixing of foundation anchor bolts (as indicated in the drawing) shall be the responsibility of the Contractor.

2.7 The Bidder shall quote based on the provisional Bill Of Quantities (BOQ) furnished in the Bid Proposal Sheet (B.P.S). No deviation in this respect will be acceptable and any bid quoted based on different Bill of Quantities shall be liable for rejection. However, the payment will be made as per actual quantity executed as per Purchaser/Purchaser's design & drawing based on the unit rates for items quoted.

3 SUB-SOIL DATA

3.1 The detailed soil investigation for the locations where pile foundations are envisaged shall be carried out by the Contractor. The contractor has to execute the complete job as per the soil strata actually encountered at the time of construction which may have some variations of reasonable nature from the soil investigation report. Any extra claim whatsoever on account of such variations shall not be entertained.

4 DESIGN AND DRAWINGS

4.1 Purchaser shall develop the pile foundation design based on the soil investigation report. The construction drawings required for execution of pile foundations shall be given to the contractor as per site requirement during execution stage.

5 TABLE OF COMPLIANCE

Bidder shall use one copy of “Technical Specifications“ to indicate compliance status. Within the right hand margin, Bidder shall indicate compliance status to each paragraph along with a cross-reference to its proposal and an index key for any explanation or comment.
In addition, The Bidder shall annotate the Table of contents of the above stated volume to provide a high level summary of compliance status, In both cases, the following symbols, and no others, shall be used:

C- Bid complies with all requirements in the adjacent paragraph

A-Bid is not compliant with the requirements in the adjacent paragraph, but a functional alternative is proposed.
X- Bid takes exception to the requirements of the adjacent paragraph and no functional alternative is proposed.
Only one symbol shall be assigned to a paragraph and shall indicate the worst case level of compliance for that paragraph. The annotation may be hand written.

Bidder shall underline, on the compliance copy, all requirements to which exceptions have been taken (X) or to which alternatives have been proposed (A).

Each alternative shall be clearly and explicitly described. Such descriptions shall use the same paragraph numbering as the bid document sections addressed by the alternatives. All alternative descriptions shall be in one contiguous section of the Bidder’s proposal, preferably in the same volume, and titled “Alternatives”. A separate section titled “Exceptions” should be provided containing any discussion or explanation Bidder chooses to provide concerning exceptions taken.

Alternatives which do not substantially comply with the intent of the bid documents will be considered exceptions.

The Purchaser will assess the merits of each alternative and exception and will be the sole judge as to their acceptance.

SECTION –14.2 (Part-II)
BORED CAST-IN-SITU PILE FOUNDATION

CONTENTS

SECTION –14.2 (Part-II)
BORED CAST-IN-SITU PILE FOUNDATION

CONSTRUCTION OF BOARD CAST IN-SITU-PILE FOUNDATION

5.1 General Requirement

5.1.1 The specification covers the technical requirements for piling work, general description of work, quality and workmanship. In every case, work shall be carried out to the satisfaction of the Employer in accordance with the Technical Specifications and conform to location, lines, grades and cross sections shown on the construction drawing or as directed by the Employer. The specifications are not, however, intended to cover all the minute details and the work shall be executed according to the relevant British Standard Codes or equivalent International standard. In absence of the Codes, work shall be executed according to the best prevailing local Public Works Department practice or to the recommendations of the relevant International Standards or to the instructions of the Employer. This specification shall have precedence in case anything contrary to this is stated anywhere in this Bid Document. In case of conflict between the Specification and Codes, the former shall prevail.

5.1.2 The work shall include mobilization of all necessary equipments, providing necessary engineering supervision through qualified and technical personnel, skilled and unskilled labour, etc. as required to carry out the complete piling work. The minimum capacity of some key equipments are listed below. However, bidder has to furnish information regarding the equipments they intend to deploy for the project as per proforma stipulated in the relevant schedules of the BPS.

Sl.No.	Description	Capacity
1.	Tripod height	6m. to 10m. (clear drop)
2.	Rig (winch) capacity	3 T to 5T
3.	Weight of chisel	2T to 3T
4.	Mud pump capacity	15 HP to 25 HP
5.	Dia. of outlet pipe	2.5 inch for bentonite
6.	Rotary drilling rig	Minimum torque 12T (Hydraulic) alongwith all accessories

Note: Bidder may have to provide higher capacity equipments than mentioned above, as per the actual requirement for the execution of the job, without any additional financial implication to EMPLOYER.

6 Layout and Levels

6.1 Layout and levels of structures etc. shall be made by the Contractor, at his own cost, from the general grid of the plot and the bench marks given by the Employer. The Contractor shall make his own arrangements, at his own cost, for locating the co-ordinates and position of piles as per approved drawings and for determining the Reduced Level (R.L.) of the locations with respect to the single bench mark indicated by the Employer. Two established reference lines in mutually perpendicular direction shall be indicated to the Contractor. The Contractor shall provide at site all the required survey instruments, materials and men to Employer for verification of the detailed layout and correctness of the layout and levels to the satisfaction of the Employer so that the work can be carried out accurately according to specifications and approved drawings. The contractor shall be solely responsible for the correctness of layout and levels.

7 Site Preparation

This section of the specification covers site preparation of the areas as indicated in the drawings.
The area shall be stripped to remove roots of grass, rubbish and slush, shrubs or other organic materials. Spoiled materials shall be burnt or removed to approved disposal areas on or near the job site as directed by the Employer.

8 Properties of Construction Materials

This clause specifies the properties of common building materials unless otherwise mentioned in the drawings or schedule of items.

All materials viz., cement, steel, aggregates, water etc. which are to be used for pile construction are detailed below. However, aggregates more than 20mm shall not be used, except for lean concrete.

8.1 Coarse aggregates/Stone

8.1.1 All coarse aggregates shall be as per IS:383 consisting of hard, strong, compact grained and durable pieces of crushed stone having uniform in texture and colour and free from decay, flaws, veins, cracks and sand holes. Coarse aggregates should be of angular shape & rectangular surface and shall be free from organic or clay coatings and other impurities like disintegrated stones, soft flaky particles, adherent coatings, clinkers, slag, mica and any other materials liable to affect the strength, durability or appearance of concrete. The surface of a freshly broken stone shall be bright, clean, and free from any dull, chalky or earthy appearance. Coarse aggregates with round surface shall not be used. ~~A~~ coarse aggregates shall not absorb more than 5% of its weight of water after 24 hours immersion. Samples shall be submitted by the Contractor and approved samples shall be retained by the Employer for comparison of bulk supply.

8.1.2 Sieving and washing of aggregates by approved method shall be carried out wherever required.

8.1.3 Grading of coarse aggregate shall generally conform to IS:383 and shall be such as to produce a dense concrete of the specified proportions and strength and of consistency that will work readily into position without segregation.

8.1.4 The maximum size of aggregate shall be as follows unless specified otherwise:

i) Reinforced concrete with very narrow space - 10mm.
ii) Reinforced concrete & Plain Concrete - 20mm.
iii) Lean Concrete 1:3:6 or 1:4:8-40mm.

8.2 Cement

Cement used shall generally be ordinary Portland Cement conforming to the latest Indian Standard Code IS:8112 or IS:12269. Alternatively, other varieties of cement other than ordinary Portland Cement such as Portland Pozzolana Cement conforming to IS;1489 or Portland Slag Cement conforming to IS:455 can also be used. The Contractor shall submit the manufacturer's certificate, for each consignment of cement procured, to the Employer. However Employer reserves the right to direct the Contractor to conduct tests for each batch/lot of cement used by the Contractor and Contractor will conduct those tests free of cost at the laboratory so directed by the Employer. The Contractor shall also have no claim towards suspension of work due to time taken in conducting tests in the laboratory. Changing of brand or type of cement within the same structure shall not be permitted without the prior approval of the Employer. Sulphate Resistant Cement shall be used if Sulphate content is more than the limits specified in IS:456, as per Geotechnical investigation report and as

mentioned in the construction drawing. No additional payment shall be made for using Sulphate Resistant Cement.

8.3 Sand

Sand shall be hard, durable, clean and free from any adherent coatings or organic matter and shall not contain clay balls or pellets. The sand shall be free from impurities such as iron pyrites, alkalis, salts, coal, mica, shale or other laminated materials, in such forms or quantities as to affect adversely the hardening, strength, durability or appearance of concrete or to cause corrosions to any metal in contact with such concrete. In no case the cumulative percentage of impurities in sand shall be more than 5% by weight. All sand shall be properly graded. Unless otherwise directed by the Employer all sand shall pass through IS Sieve no. 2.36mm. Sand for concrete shall conform to IS:383 .

8.4 Water

Water shall be clean, fresh and free from organic matters, acids or soluble salts and other deleterious substances which may cause corrosion, discoloration, efflorescence etc. Potable water is generally considered fit for use. Water to be used shall comply with the requirements of IS:456 . Average 28 days compressive strength of at least three 15 cm. cubes of concrete prepared with proposed water shall not be less than 90% of average strength of three similar cubes prepared with distilled water. PH of water shall generally be not less than 6.

8.5 Reinforcement

Reinforcement steel shall be clean and free from loose mill scales, dust, loose rust, oil and grease or other coatings which may impair proper bond. Reinforcement shall conform to IS:1786 for deform and cold twisted bars (Fe 500). If mentioned in the BPS, epoxy coated reinforcement shall conform to IS:13620. Thermo Mechanically Treated (TMT) bars (equivalent grade) in place of cold twisted bars are also accepted. Hard drawn steel wire shall conform to IS:432. Hard drawn steel wire fabric shall conform to IS:1566. All steel bars including and above 6mm diameter shall be of tested for quality. Substitution of reinforcement, other than those mentioned above, shall not be permitted without the prior approval of the Employer. Contractor shall supply, fabricate and place reinforcement to shapes and dimensions as indicated or as required to carry out the intent of approved foundation drawings and Specifications. Spacers, chairs, stays, hangers and annealed steel wire for bending etc. as may be necessary, should be used for proper completion of foundation job. Spacers or chairs should be placed at a maximum spacing of 1 m and closer spacing shall be provided wherever necessary.

In area near nala or where subsoil strata is attacking in nature Epoxy coated reinforcement and ready mix concrete shall be used. Such area may involve continuous dewatering also for casting of foundation. Portland Pozzolona cement or Slag cement shall be used for such locations. For concreting under water , Slump of concrete shall be 100 -150 mm recorded by suitable method.

9 Storage & Handling of construction Materials

All materials shall be stored by the Contractor in a manner aiding convenient access for identification and inspection at all times. The storage arrangements shall be subject to the approval of the Employer. Storage of materials shall be as described in IS:4082 .

All materials shall be so stored as to prevent deterioration or intrusion of foreign matter and to ensure the preservation of their quality and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Employer shall not be used for concrete, and shall be removed from site immediately, failing which, the Employer will get the materials removed and the cost thereof shall be recovered from

contract price. The Contractor shall maintain up to date accounts of receipt, issue and balance (stock wise) of all materials.

9.1 Cement

The cement shall be stored in dry enclosed shed, well away from the walls and insulated from the floor to avoid contact with moisture. The cement shall be stacked in easily countable stacks to facilitate removal of first in first out basis.

The cement bags shall be gently kept on the floor to avoid leakage of cement from the bags. Sub-standard or partially set cement shall be immediately removed from the site as soon as it is detected. Cement stored for period beyond 90 days shall be tested before use.

9.2 Coarse Aggregates and Sand

All coarse aggregates & sand shall be stored on brick soling or an equivalent platform so that they do not come in contact with dirt, clay, grass or any other injurious substance at any stage. Aggregate of different sizes shall be kept in separate and easily measurable stacks. If so desired by the Employer, aggregates from different sources shall be stacked separately with proper care to prevent intermixing.

9.3 Reinforcement

Reinforcement steel shall be stored consignment wise and size wise, off the ground and under cover. It shall be protected from rusting, oil grease and distortions. If directed by the Employer, the reinforcement steel may have to be coated with cement wash before stacking, to prevent scale and rust at no extra cost to the Employer. The stacks shall be easily measurable. Only steel needed for immediate use shall be removed from storage. Fabricated reinforcement shall be carefully stored to prevent damage, distortion, corrosion & deterioration.

10 Cement Concrete

10.1 General

10.1.1 This section of the specification deals with cement concrete, plain or reinforced, and covers the requirement for concrete mix design, strength and quality, pouring at all levels, forming, protection, curing finishing, admixtures, inserts and other miscellaneous works.

10.1.2 The provisions of IS:456 shall be complied with, unless permitted otherwise. Any other Indian Standard Code shall form the part of the specification to the extent it has been referred to or applicable within this specification.

10.1.3 The Contractor shall furnish all labour, material and equipment to form, place and finish all structural concrete, concrete works and miscellaneous items complete, as described herein.

10.2 Admixtures

10.2.1 The admixtures in concrete for promoting workability, improving strength or for any other purpose, shall be used only after the written permission from the Employer. The Admixtures shall conform to IS:9103.

10.2.2 Admixtures should not impair durability of concrete nor combined with the constituent to form harmful compounds nor increase the risk of corrosion of reinforcement.

10.2.3 Addition of admixtures should not reduce the specified strength of concrete in any case. The workability, compressive strength and the slump loss of concrete with and without the use of admixtures shall be established during the trial mixes before use of admixtures.

10.2.4 The chloride content of admixtures shall be independently tested for each batch before acceptance.

10.2.5 If two or more admixtures are used simultaneously in the same concrete mix, data shall be provided to asses their interaction and to ensure their compatibility.

10.2.6 In case admixtures are used in the concrete for any structure, fresh mix design be done considering the admixture with the specific approval from Employer. No extra payment shall be made to the Contractor on this account.

10.3 Grades of Concrete

10.3.1 The minimum grade of concrete to be used for piling shall be M-25 with minimum cement content 400 kg/m^3 and maximum water cement ratio of 0.5. Concrete shall conform to the controlled design mix as specified in IS:456 . In addition, nominal mixes of 1:3:6 and 1:4:8 (with aggregates of nominal size 40mm maximum, by weight converted to equivalent volume shall also be used as per field quality plan. The concrete in aggressive surroundings due to presence of Sulphate, etc., shall confirm to IS:456. The slump of concrete shall be maintained between 150 to 200 mm.

10.3.2 The Contractor shall carry out concrete mix design in accordance with IS:10262 and submit mix design calculations and get them approved from the Employer well in advance of installation of pile foundations. The Contractor shall carry out adequate number of tests in accordance with IS:456 to ensure concrete of the minimum specified strength at requisite workability(i.e. slump).

10.4 Workmanship

All workmanship shall be according to the current Industry standard and best practices.

Before starting a pour the Contractor shall obtain the approval of the Employer in a “Pour Card” maintained for this purpose. He shall obtain complete instructions about the material and proportions to be used, Slump / workability, Quantity of water per unit weight of cement, number of test cubes to be taken, type of finishing to be done, any admixture to be added, any limitation on size of pour and stopping of concrete in case of premature stopping of pours.

10.5 Mixing of Concrete

10.5.1 All design mix concrete shall be mixed in mechanically operated mixer of an approved size and type capable of ensuring a uniform distribution on the materials through the mass. However, contractor can also use central batching plant situated within the area allocated for the Contractor’s particular use.

10.5.2 The proportions of sand, coarse aggregate, cement and water shall be as determined by the mix design. However, in case of nominal mix concrete (for lean concrete only) the proportions of ~~fine~~ sand, ~~and~~ coarse aggregate, cement and water shall be fixed. The proportions, as determined for design mix concrete and shall always be approved by the Employer. The quantities of the cement, sand and coarse aggregates shall be determined by weight. However, for a faster progress at site, quantities of the cement, sand and coarse aggregates can be converted to equivalent volume. The water shall be measured accurately after giving proper allowance for surface water present in the aggregate for which regular check shall be made by the Contractor.

10.5.3 The water shall not be added to the mix until all the cement and aggregates consisting the batch are already in the drum and dry mixed for at least one minute. Mixing of each batch shall be continued until there is a uniformity in colour and consistency but in no case shall mixing be done for less than two (2) minutes and at least forty (40) revolutions after all the materials and water are in the drum. When absorbent aggregates are used or when the mix is very dry, the mixing time shall be extended as may be directed by the Employer. Mixers shall not be loaded above their rated capacity as it prevents thorough mixing. If there is segregation after unloading from the mixer the concrete should be remixed.

10.5.4 The entire contents of the drum shall be discharged before the ingredients for the next batch are fed into the drum. No partly set or remixed or excessively wet concrete shall be used and it shall be immediately removed from site. Each time the work stops, the mixer shall be thoroughly cleaned and when the next mixing commences, the first batch shall have 10% additional cement at no extra cost to the Employer to allow for loss in the drum.

Conveying Concrete

Concrete shall be handled and conveyed from the place of mixing to the place of final laying as rapidly as practicable, by approved means, before the initial setting of the cement starts. Concrete should be conveyed in such a way as will prevent segregation of Concrete which may occur during transportation of concrete. In case of any such segregation during transport, the concrete shall be re-mixed. During very hot or cold weather, if directed by the Employer, concrete shall be transported in deep containers, having mortar leak proof, which will reduce the rate of water loss by evaporation and loss of heat. Conveying equipment for concrete shall be well maintained and thoroughly cleaned before commencement of concrete mixing. Such equipment shall be kept free from set concrete.

10.6 Placing of Concrete

a) Formwork and placement of reinforcement shall be approved in writing by the Employer before concrete is placed. The forms shall be well wetted and oil shavings, dirt and water that may have collected at the bottom shall be removed before concrete is placed. Concrete shall be deposited in its final position without segregation, re-handling or flowing. The interval between adding the water to the dry materials in the mixer and the completion of the final placing inclusive of compaction of the concrete shall be well within the initial setting time for the particular cement in use or as directed by the Employer. As far as possible, concrete shall be placed in the formwork by means approved by the Employer and shall not be dropped from a height or handled in a manner which may cause segregation. Any drop over 1800 mm shall have to be approved by the Employer. Once the concrete is deposited in its final position, it shall not be disturbed. Care should be taken to avoid displacement of reinforcement or movement of formwork.

b) The placing of concrete shall be a continuous operation with no interruption in excess of 30 minutes between the placing of continuous portions of concrete.

c) After the concrete has been placed it shall be spread and thoroughly compacted by approved mechanical vibration to a maximum subsidence without segregation and thoroughly worked around reinforcement or other embedded fixtures into the correct form and shape. Vibrators shall not be used for pushing and shoveling concrete into adjoining areas. Vibrators must be operated by experienced men and over-vibration shall not be permitted. Head tamping in some case may be allowed subject to the approval of the Employer. Care must be taken to ensure that the inserts, fixtures, reinforcement and form work are not displaced or disturbed during placing of concrete. No concrete shall be placed in open while it rains. If there has been any sign of washing of cement and sand, the concrete shall be entirely removed immediately.

Suitable precautions shall be taken in advance to guard against rains before leaving the fresh concrete unattended. No accumulation of water shall be permitted on or around freshly laid concrete. Tie beams, pile caps, footings shall be poured in one operation normally, in special circumstances with the approval of the Employer these can be poured in horizontal layers not exceeding 500 mm in depth. When poured in layers, it must be ensured that the under layer, is not already hardened. Blending of under layer if any, shall be effectively removed.

d) Wherever vibration has to be applied externally the design of formwork and the disposition of vibrators shall receive special consideration to ensure efficient compaction and to avoid surface blemishes.

10.7 Inserts

All anchors, anchor bolts, insert, stubs, etc. and any other items those are required to be embedded in the concrete shall be placed in correct position before pouring. Extra care shall be taken during pouring operation to maintain their position as indicated in the drawings. These inserts shall be welded to the nearest reinforcement to keep them in position and all such welding shall be deemed to be included in the unit rate quoted and no extra payment shall be made on this account.

10.8 Blockouts

Blockouts in concrete as indicated in the drawing or as directed by the Employer shall be provided wherever required. No extra payment shall be made to the Contractor on this account.

10.9 Repairs and Finishes of Concrete

All concrete surfaces shall have even and clean finish, free from honeycombs, air bubbles, fins or other blemishes. The formwork joints marks for concrete work exposed to view shall be rubbed with carborandum stone and defects patched up with a paste of 1 part sand and 1 part cement and cured. The finish shall be made to the satisfaction of the Employer.

The unit rate of concrete work shall be inclusive of the cost of cleaning and finishing exposed surface as mentioned above.

11 Reinforcement Steel

This section of the specification shall cover providing reinforcement steel and its cleaning, bending, binding, placing with arrangements for chairs, supports and suitable covers for all reinforced concrete works, below and above ground level as per drawings and specifications.

11.1 General Requirements

11.1.1 Reinforcement steel of same type & grade shall be used for structural reinforcement work as detailed in the drawing released by the Employer. No work shall be commenced without proper verification with the bar-bending schedule provided in the drawing .

11.1.2 Contractor shall supply, fabricate and place reinforcement to shapes and dimensions as indicated on the drawings and as per specifications. The reinforcement shall be either plain or deformed steel bars or welded wire fabric conforming to relevant IS specifications.

11.1.3 Any adjustment in reinforcement to suit field conditions and construction joints other than shown on drawings shall be subjected to the approval of Employer.

11.2 Bending

11.2.1 Unless otherwise specified, reinforcement steel shall be bent in accordance with procedure specified in IS:2502. Bends and shapes shall comply strictly with the dimensions in the approved Bar Bending Schedule. Contractor shall be entirely responsible for its correctness. Bars correctly bend shall only be used.

11.2.2 No reinforcement shall be bent when in position in the work without approval of the Employer, whether or not it is partially embedded in concrete. Bars shall not be straightened in a manner that will injure the material. Rebending can be done only if approved by the Employer. Reinforcement bars shall be bent by machine or other approved means producing a gradual and even motion. All the bars shall be cold bent unless otherwise approved.

11.3 Placing in position

11.3.1 All reinforcement shall be accurately fixed and maintained in position as shown on the drawings by ~~such~~ approved means as mild steel chairs, and/or concrete spacer blocks. Bars intended to be in contact, at crossing points, shall be securely bond together at all such points by two number No.20G annealed soft-iron wire.

Binders shall tightly embrace the bars with which they are intended to be in contact and shall be securely held. The vertical distance between successive layers of bars shall be maintained by provision of mild steel spacer bars. They should be so spaced that the main bars do not sag preceptibly between adjacent spacers.

11.3.2 The placing of reinforcements shall be completed well in advance of concrete pouring. Immediately before pouring, the reinforcement shall be checked by the Employer for accuracy of placement and cleanliness and necessary correction as directed by him shall be carried out. The cover for concrete over the reinforcements shall be as shown on the approved drawings unless otherwise directed by the Employer. Care should be taken to ensure that projecting ends of ties and other embedded metal do not encroach into the concrete cover. Where concrete blocks are used for ensuring the cover and positioning reinforcement, they shall be made of mortar 1:2 (one part cement: two parts sand) by volume and cured for at least (7) days. The sizes and locations of the concrete blocks shall be approved by the Employer.

11.3.3 Longitudinal reinforcement in pile shall be high yield strength cold twisted deformed steel bars conforming to IS:1786. Thermo mechanically Treated (TMT) bars (equivalent grade) in place of Cold twisted deformed steel bars are also accepted. Lateral reinforcement in pile shall be of tor steel conforming to IS:432 Part-I.

11.3.4 The longitudinal reinforcement shall project 52 times its diameter above cut-off level unless otherwise indicated in the drawing.

11.3.5 The minimum diameter of the links or spirals bar shall be 8mm and the spacing of the links or spiral shall not be less than 150mm and in no case more than 250mm. The laterals shall be tied to the longitudinal reinforcement to maintain its shape and spacing.

11.3.6 Reinforcement cage shall be sufficiently rigid to withstand handling and installation without any deformation and damage. As far as possible number of joints (laps) in longitudinal reinforcement shall be minimum. In case the reinforcement cage is made up of more than one segment, these shall preferably be assembled before lowering into casing tube/pile bore by providing necessary laps as per IS:456.

11.3.7 The minimum clear distance between the two adjacent main reinforcement bars shall normally be 100mm for the full depth of cage, unless otherwise specified.

11.3.8 The laps in the reinforcement shall be such that the full strength of the bar is effective across the joint and the reinforcement cage is of sound construction. Laps and anchorage lengths of reinforcing bars shall be in accordance with IS:456, unless otherwise specified. If the bars in a lap are not of the same diameter, the smaller will guide the lap length.

11.3.9 Laps shall be staggered as far as practicable and as directed by the Employer. Not more than 50% bars shall be lapped at a particular section. Lap joints shall be staggered by at least 1.3 times the lapped length (Center to Center).

11.3.10 Proper cover and central placement of the reinforcement cage in the pile bore shall be ensured by use of suitable concrete spacers or rollers, as required, without any additional cost to the Employer.

11.3.11 Minimum clear cover to the reinforcement shall be 75mm unless otherwise mentioned.

11.3.12 Unless otherwise specified by the Employer reinforcement shall be placed within the following tolerance as specified in IS:456:2000.

a) For effective depth 200mm or less +10mm.

b) For effective depth more than 200mm +15mm.

The cover shall in no case be reduced by more than one-third of specified cover or 5mm whichever is less.

11.3.13 Welding of reinforcement bars shall be avoided. However, welding may be done in specific case subject to prior permission from the Employer.

12 Construction of Pile Cap, Pedestal, Tie Beam etc.

The Contractor shall deploy all labour, equipment, tools & tackles and materials required for complete execution of the work in accordance with the drawings and as described herein.

12.1 Excavation

12.1.1 The Contractor shall control the grading in the vicinity of all excavation so that the surface of the ground will be properly slopped or diked to prevent surface water from running into the excavated areas during construction.

12.1.2 Excavation shall include the removal of all materials required to execute the work properly and shall be made with sufficient clearance to permit the placing, inspection and setting of forms and completion of all works for which the excavation was done.

12.1.3 Side and bottoms of excavation shall be cut sharp and true, undercutting shall not be permitted. Each side of excavation shall be used in lieu of formwork for placement of concrete unless authorised, in special cases, by the Employer, where limitation of space for larger excavation necessitate such decision.

12.1.4 When machines are used for excavation, the last 300mm before reaching the required level shall be excavated by hand or by such equipment that will leave the soil at the required final level, in its natural conditions.

12.1.5 Suitability for bearing of the bottoms of excavations shall be determined by the Employer.

12.1.6 The bottom of excavation shall be trimmed to the required level and when carried below such levels, by error, shall be brought to level by filling with lean concrete 1:4:8 mix, with aggregate of 40mm maximum nominal size at no additional cost to the Employer.

12.1.7 The Contractor shall be responsible for assumptions and conclusions regarding the nature of materials to be excavated and the difficulty of making and maintaining the required excavations and performing the work required as shown on the drawing and in accordance with these specifications. The Contractor shall be responsible for any damage to any part of the work and property caused by collapse of sides of excavations. Materials may be salvaged, if it can be done with safety for the work and structure, as approved by the Employer.

However, no extra claim shall be entertained for materials not salvaged or any other damage to Contractor's property as a result of the collapse. He shall not be entitled to any claim for redoing the excavation as a result of the same.

12.1.8 Excavations for foundations specified shall be carried out at least 75mm or as specified in relevant drawings below the bottom of structural concrete and then be brought to the required level by placing lean concrete of 1:4:8 mix or as specified in drawings with aggregate of 40mm maximum nominal size.

12.1.9 When excavation requires coffer dams, sheet piling, bracing, sheeting, shoring, draining, dewatering etc. the Contractor shall have to provide the same as required and the cost there of shall be included in the unit rate quoted for the item of excavation and contractor shall submit necessary drawings showing arrangement and details of proposed installation and shall not proceed until he has received approval from the Employer.

12.1.10 The Contractor shall have to constantly pump out the water collected in pits due to rain water, springs, seepage etc. and maintain dry working conditions at no extra cost to the Employer.

12.1.11 For the purpose of excavation in earthwork, all types of soil including kankar, morum, shingle and boulders up to 150mm size are included and no separate payment shall be made for different type of soils encountered.

12.2 Form work

12.2.1 General

12.2.1.1 If it is so desired by the Employer, the Contractor shall prepare, before commencement of the actual work, design and drawings for form work and centering and get them approved by the Employer. The form work shall conform to the shape, alignment and dimensions as shown in the drawings.

Form work shall be composed of steel and/or best quality shuttering wood of non- absorbent type or plywood. Timber shall be free from significant knots and shall be of medium grain as far as possible and hard woods shall be used as caps and wedges under or over posts. Plywood or equivalent shall be used where specified to obtain smooth surfaces for exposed concrete work. Struts shall generally be mild steel tubes, and strong sal ballis of 150mm in diameter or above. Bamboos, small diameter ballis, etc. shall not be used unless approved by the Employer in specified cases.

Supports or props should not be supported on an unpropped lower suspended floor or beam unless calculations are submitted to the Employer to confirm the strength of the lower floor or beam and no propping shall be taken out until the Employer approval has been given.

12.2.1.2 The form work shall be true and rigid and thoroughly braced both horizontally and diagonally. The forms shall be sufficiently strong to carry without undue deformation, the dead weight of the concrete as well as working load. Where the concrete is vibrated, the formwork shall be strong enough to withstand the effects of vibration, without appreciable deflection, bulging,

distortion or loosening off its components. The joints in the formwork shall be sufficiently tight to prevent any leakage of mortar. The formwork shall be such as to ensure a smooth uniform surface free from honeycombs, air bubbles, bulges, fins and other blemishes. Any blemish or defect found on the surface of the concrete must be brought to the notice of Employer immediately and rectified free of charge as directed by him. To achieve the desired rigidity, the bolts, space blocks, the wires and clamps as approved by the Employer shall be used but they must in no way impair the strength of concrete or leave stains or marks on the finished surface, where there are chances of these fixtures being embedded, only mild steel or concrete of adequate strength shall be used. Bolts passing completely through liquid retaining walls/slabs for the purpose of securing and aligning the formwork should not be used.

12.2.1.3 Temporary openings for cleaning, inspection and for pouring concrete may be provided at the base of vertical forms and as may be directed by the Employer. The temporary openings shall be so formed that they can be conveniently closed when required and must not leave any mark on the concrete.

12.2.2 **Cleaning and Treatment of Forms**

12.2.2.1 All forms shall be thoroughly cleaned of old concrete wood shavings, saw dust, dirt and dust sticking to them before they are fixed in position. All rubbish loose concrete, chippings, shavings, saw dust etc. shall be scrupulously removed from the interior of the forms before the concrete is poured. Along with wire brushes, brooms, etc. compressed air jet and/or water jet shall be kept handy for cleaning, if directed by the Employer.

12.2.2.2 Before shuttering is placed in position the form surface in contact with concrete shall be treated with approved non-standing oil or composition of other material approved by the Employer. Care shall be taken that the oil or composition does not come in contact with reinforcing steel or existing concrete surface. They shall not be allowed to accumulate at the bottom of the shuttering.

12.2.2.3 If formwork for pedestal/chimney is erected for the full height of the section, as placing of concrete proceeds, wedges, spacer bolts, clamps or other suitable means shall be provided to allow accurate adjustment of the formwork and to allow it to be removed gradually without jarring the concrete.

12.2.3 **Removal of Forms**

12.2.3.1 The Contractor shall begin the removal of formwork only after approval of Employer. He shall place on record the date on which the concrete is placed in different parts of the work and the date of the removal of formwork there from. This record shall be checked and countersigned by the Employer. The Contractor shall be responsible for the safe removal of formwork but the Employer may delay the time of removal if he considers it necessary. Any work showing signs of damage through premature removal of formwork or loading shall be entirely reconstructed without any extra cost to Employer.

12.2.3.2 Forms for various types of structural components shall not be removed before the minimum periods specified below which shall also be subject to the approval of the Employer.

12.2.3.3 No supporting forms shall be removed suddenly in such manner as to create shock loading. Forms for sides shall not be removed before 2 days. Bottom forms shall not be removed before 28 days unless this period is reduced with specified concurrence of the Employer.

12.2.3.4 However, in any case, formwork shall not be struck until the concrete has reached a strength at least twice the stress to which the concrete may be subjected to, at the time of removal of forms.

12.2.4 **Re-use of Forms**

Before re-use, all forms shall be thoroughly scrapped cleaned and joints, etc. shall be examined, ~~and~~ when necessary repaired and inside surface treated as specified. Formwork shall not be used/re-used, if declared unfit or unserviceable by the Employer.

12.3 Back Filling

12.3.1 General Requirement

12.3.1.1 After completion of foundation footings, pile caps, pedestals, tie beams and other constructions below the elevation of the grades, and prior to back filling, all forms of temporary shoring, timber etc. shall be removed and the excavation cleaned of all trash, debris and perishable materials, back filling shall begin only with the approval of the Employer.

12.3.1.2 The soil to be used for back filling purpose shall be inorganic material and shall be free from any foreign substance which can harm or impair the strength of footing in any manner. In any case the soil to be used for back filling purpose shall have the prior approval of the Employer.

12.3.1.3 The soil to be used for back filling purpose shall be either from the excavated earth or from the borrow pits, as directed by the Employer. The soil may have to be brought from a distance up to 2 km. By the shortest haulage route as approved by the Employer. If directed by the Employer, the excavated earth from the adjoining areas (which is to be disposed off up to a distance of 500 meters by manual labour) shall be used as for back filling purpose.

12.3.1.4 Back filling shall not be dropped directly upon or against any structure where there is danger of displacement or damage.

12.3.1.5 Back filling shall be placed in horizontal layers not to exceed 200mm in thickness. Each layer shall be compacted with proper moisture content and with such equipment as may be required to obtain a density equal to or greater than 95% of maximum dry density as determined by the relevant Indian Standard. The method of compaction shall be subject to the approval of the Employer. Pushing of earth for back filling shall not be adopted under any circumstances.

12.3.1.6 On completion of structures, the earth surrounding them shall be accurately finished to line and grade as shown on the drawings or as per the instruction of the Employer. Finished surface shall be free of irregularities and depressions and shall be within 50mm of the specified level.

12.3.1.7 Any additional quantity of back filling, if required, beyond the excavation payment line shall be done by the contractor at his own expense.

12.4 Construction Joints

a) When the work is to be interrupted, the concrete shall be rebated at the joint to such

shap and size as may be required by the Employer or as shown on the drawings. All vertical construction joints shall be made with stone boards, which are rigidly fixed and slotted to allow for the passage of the reinforcing steel. If desired by the Employer, keys and/or dowel bars shall be provided at the construction joints. Construction joints shall be provided in positions as shown or described on the drawing. Where it is not described, the joints shall be in accordance with the following :

i) In a column, the joint shall be formed about 75mm below the lowest soffit of the beams framing into it.

ii) Concrete in tie beam shall be placed throughout without a joint, but if the provision or a joint is unavoidable, the joint shall be vertical and at the middle of the span.

iii) In forming a joint, concrete shall not be allowed to slope away to thin edge. The locations of construction joints shall be planned by the Contractor well in advance of pouring and have to be approved by the Employer.

b) Before the fresh concrete is placed, the cement skin of the partially hardened concrete shall be thoroughly removed and surface made rough by hacking, sand blasting, water jetting, air jetting or any other method as directed by the Employer. The rough surface shall be thoroughly wetted for about two hours and shall be dried and coated with 1:1 freshly mixed cement sand slurry immediately before placing the new concrete. The new concrete shall be worked against the prepared surface before the slurry sets. Special care shall be taken to see that the first layer of concrete placed after a construction joint is thoroughly rammed against the existing layer. Old joints during pour shall be treated with 1:1 freshly made cement sand slurry only after removing all loose materials.

c) The unit rate of concrete work shall include the cost of construction joints.

12.5 Curing and Protection of Concrete

Newly placed concrete shall be protected by approved means from rain, sun & wind. Concrete placed below ground level shall be protected from falling earth during and after placing. Concrete placed in ground containing deleterious substances shall be kept free from contact with such ground or with water leaking from such ground during placing of concrete and for a period of three days or as otherwise instructed by the Employer after placing of concrete. The ground water around newly poured concrete shall be kept to an approved level by pumping or other approved means of drainage. Adequate steps shall be taken to prevent floatation or flooding. Steps, as approved by the Employer, shall also be taken to protect immature concrete from damage by debris, excessive loading, vibration etc. which may impair the strength or durability of the concrete.

All fresh concrete shall be covered with a layer of Hessian or similar absorbent material and kept constantly wet for a period of seven days or more from the date of placing of concrete as per directions of the Employer. Curing can also be made by ponding. Concrete shall be cured by flooding with water of minimum 25mm depth for the period mentioned above. Step shall also be taken to protect immature concrete from damage debris by excessive loading, vibrations, abrasions, deleterious ground water, mixing with earth or foreign materials, floatation etc. that may impair the strength and durability of the concrete. Approved curing compound can be used with the permission of the Employer. Such compound shall be applied to all exposed surfaces of the concrete as soon as possible after the concrete has set.

13 Pile Installation

Installation of piles shall be carried out as per pile layout drawings, installation criteria, technical specifications and the directions of the Employer.

13.1 Equipment and Accessories

13.1.1 The equipment and accessories for installation of bored cast-in-situ piles shall be selected giving due consideration to the sub soil conditions, ground water conditions and the method of casting, etc. These shall be of standard type and shall have the approval of the Employer.

13.1.2 The capacity of the rig shall be adequate so as to reach the specified founding level.

13.1.3 Provision shall be kept for chiseling within the pile bore, as specified in this specification. Chiseling shall be carried out only with the approval of Employer. The contractor must have the provision of equipment/accessories which can bore in the hard rock strata if required, without any additional cost implication to the Employer.

13.2 Installation Criteria

13.2.1 The Contractor while boring the pile bores, shall constantly collect the bore spoils and these shall be compared with the layer wise soil classifications reported in the bore-log details of the location, reported in the soil investigation report. Should there be any variation between the two soil classification, these shall be immediately reported to the Employer.

13.2.2 Whenever the rock strata is encountered in the pile bore, the Contractor shall immediately report the matter to the Employer and shall take up the work of rock chiseling or any other suitable method only after the certification/approval of the Employer. Since the piles are required to be terminated in the firm/hard strata and as stipulated in the construction drawing the Contractor shall demonstrate such founding strata and seek approval of the Employer before terminating the piles.

13.2.3 The pile should be socketed and founded in good rock only. Whenever rock strata is encountered at any pile bore and the level of good rock (i.e. rock strata is not highly fractured and weathered and core recovery is not less than 80% with RQD 70%) is different than that is given in the Geotechnical Investigation report, in that case to establish the level of good rock, core drilling is necessary to be carried out at least upto 5m depth in rock strata encountered by the contractor without any additional cost implication to EMPLOYER and no time extension will be permitted on this account.

13.2.4 In order to verify the terminating depth, where rock strata is met with, the rock samples obtained from the bore spoils of pile shall also be tested for point load strength index and these shall then be compared/correlated to the values of uniaxial compression strength test shown in the soil investigation report. Accordingly, the termination of piles in the socketing zone shall be done with prior approval of the Employer.

13.3 Control of position and alignment

Piles shall be installed vertically as accurately as possible as per the construction drawing. The permissible limits for deviation with respect to position and inclination/alignment shall conform to IS-2911 (Part I/Sec.2), as reproduced below.

13.3.1 Maximum permissible deviation in alignment is 1.5% . Piles should not deviate more than 75mm or D/10 which ever is less from their positions at the working level. In case of piles deviating beyond these limits, the piles should be replaced or supplemented by one or more additional piles including the revised cap size(as the situation may be) at no additional cost

to the Employer. Any extra claim whatsoever from the contractor on this account shall not be entertained.

13.4 Boring

13.4.1 Boring operations shall be done by rotary or percussion type drilling rigs using Direct Mud Circulation (DMC), Reverse Mud Circulation (RMC) methods or grab method. In soft clays and loose sands bailer method, if used, shall be used with caution to avoid the effect of suction. In cohesive soils, use of water for boring shall be restricted to a minimum, while boring

in cohesion less deposits water level in the bore hole shall be maintained at or slightly above the standing water table.

Boring operations by any of the above methods shall be done using drilling mud. The bidder shall be required to furnish along with their bid, complete details regarding the installation of piles and the method by which they wish to install the piles.

The Contractor shall satisfy himself about the suitability of the method to be adopted for site. If DMC or RMC is used, bentonite slurry shall be pumped through drill rods by means of high pressure pumps. The cutting tools shall have suitable pores for the bentonite slurry to flow out at high pressure. If the Contractor fails to make proper bore for any reason, the Contractor has to modify the boring technique and switchover to other boring methods as approved by the Employer at no extra cost to the Employer.

13.4.2 Working level shall be above the pile cut off level. After the initial boring of about 1.0 to 2.0m temporary guide casing shall be lowered in the pile bore. The diameter of guide casing shall be of such diameter to give the necessary finished diameter of the concrete pile. The center line of guide casing shall be checked before continuing further boring. Guide casing shall be minimum 2.0m length. Additional length of guide casing shall be used depending on the conditions of the strata, ground water level etc. as required by the Employer without any additional cost to the Employer.

13.4.3 Use of drilling mud (Bentonite slurry) for stabilising the sides of the pile bore is necessary wherever subsoil is likely to collapse in the pile bore. Drilling mud to be used shall meet the requirement as given in Annexure-C.

13.4.4 The Bentonite slurry and the cuttings, which are carried to the surface by the rising flow of the slurry shall pass through settling tanks of adequate size to remove the sand and spoils from the slurry before the slurry is re-circulated back to the boring. The Bentonite slurry mixing and re-circulation plant shall be suitably designed and installed.

13.4.5 The Bentonite slurry shall be maintained at 1.5m above the ground water level during boring operations and till the pile is concreted. When DMC or RMC method is used the Bentonite slurry shall be under constant circulation till start of concreting.

13.4.6 The size of cutting tools shall not be less than the diameter of the pile as specified in the drawing and not more than 75mm.

13.5 Chiseling

13.5.1 Chiseling, if required, may be resorted to with the permission of the Employer below the socketing horizon. The chiseling tool or bit shall be of adequate size and weight so as to reach the desired depth.

13.6 Cleaning of Pile bore

9.6.1 After completion the pile bore up to the required depth, the bottom of the pile bore shall be thoroughly cleaned. Cleaning shall ensure that the pile bore is completely free from sludge/bored material, debris of rock/boulder etc. Necessary checks shall be made as given in this Section to confirm the thorough cleaning of the pile bore.

9.6.2 Pile bore shall be cleaned by fresh drilling mud through tremie pipe before start of concreting and after placing reinforcement.

9.6.3 Pile bore spoil along with used drilling mud shall be disposed off from site up to 2 Km. or as directed by the Employer.

13.7 Adjacent Structures

13.7.1 When working near existing structures care shall be taken to avoid any damage to such structures.

13.8 Concreting

13.8.1 Concreting shall not be done until the Employer is satisfied that the bearing strata (soil/rock) met with the termination level of pile, satisfied the installation criteria/approved founding depth.

13.8.2 The time between the completion of boring and placing of concrete shall not exceed 6 hrs. In case the time interval exceed 6 hrs the pile bore shall be abandoned. However, the Employer may allow concreting, provided the Contractor extends the pile bore by 0.5 m beyond the proposed depth, and clean the pile bore properly. The entire cost of all operation and materials for this extra length shall be borne by the Contractor.

13.8.3 Pile bore bottom shall be thoroughly cleaned to make it free from sludge or any foreign matter before and after placing the reinforcement cage.

13.8.4 Proper placement of the reinforcement cage to its full length shall be ensured before concerting.

13.8.5 Entire concreting in pile bores shall be done by tremie method. The operation of tremie concreting shall be governed by IS:2911 Part I/Sec.2. Drilling mud shall be maintained sufficiently above the ground water level.

13.8.6 Concreting operations shall not proceed if the contaminated drilling mud at the bottom of the pile bore posses density more than 1.25 T/Cu.m. or sand content more than 7%. The drilling mud sample shall be collected from the bottom of pile bore. This shall be checked at regular intervals, as decided by the Employer thereafter.

13.8.7 Consistency of the drilling mud suspension shall be controlled throughout concreting operations in order to keep the bore stablised as well as to prevent concrete getting mixed up with the thicker suspension of the mud.

13.8.8 It shall be ensured that volume of concrete poured is at least equal to the theoretically computed volume of pile shaft being cast.

13.8.9 The temporary guide casing shall be entirely withdrawn cautiously, after concreting is done up to the required level. While withdrawing the casing concrete shall not be disturbed.

13.8.10 Tests on concrete cubes shall be carried out as specified in this section of the Specifications.

13.9 Cut-off-level (COL)

13.9.1 Cut-off-level of piles shall be as indicated in approved construction drawings or as directed by the Engineer-in-Charge.

13.9.2 The top of concrete in pile shall be brought above the COL to remove all laitance and weak concrete and to ensure good concrete at COL for proper embedment into pile cap.

13.9.3 When the pile cut off level is less than 1.0 meter below the working level, concrete shall be cast up to the piling platform level to permit overflow of concrete for visual inspection. In case COL of pile is more than 1.0 meter below working level then concrete shall be cast to minimum of one meter above COL.

13.9.4 In the circumstances where COL is below ground water level, the need to maintain a pressure on the unset concrete equal to or greater than water pressure shall be observed and accordingly length of extra concrete above COL shall be determined by the Contractor with prior approval of Employer.

13.10 Sequence of Piling

13.10.1 Each pile shall be identified with a reference number and date wise proper record of construction shall be maintained by the Contractor.

13.10.2 The convenience of installation may be taken into account while scheduling the sequence of piling in a group. This scheduling shall avoid piles being bored close to other recently constructed piles.

13.11 Building up of Piles

13.11.1 If any pile, already cast as per construction drawing, requires any extra casting due to any change in cut off level or the cast pile top level is less than the specified level or for any other reason, then the pile shall be built up by using M-25 grade of concrete with minimum cement content 400kg/m^3, ensuring proper continuity with the existing concrete and to the satisfaction of the Employer. Necessary reinforcement as per design requirement and suitable shuttering shall be provided before casting the concrete. Surrounding soil shall also be built up to the required level by proper compaction to ensure lateral capacity of the pile.

13.12 Breaking off of Piles

13.12.1 If any pile already cast requires breaking due to lowering in cut off level or for any other reason, then the same shall be carried out, (not before seven days of casting of concrete in the piles) without affecting the quality of existing pile such as loosening, cracking etc. to the satisfaction of the Employer. No extra payment shall be made on this account.

13.13 Preparation of Pile head

13.13.1 The soil surrounding the piles shall be excavated up to the bottom of the lean concrete below the pile cap with provision for working space sufficient enough to place shuttering, reinforcement, concreting and any other related operations.

13.13.2 The exposed part of concrete above the COL, shall be removed/chipped off and made square at COL not before seven days of casting of pile.

13.13.3 The projected reinforcement above COL shall be properly cleaned and bent to the required shape and level to be anchored into the pile cap as shown in the drawing.

13.13.4 The pile top shall be embedded into the pile cap by minimum 50mm or clear cover to reinforcement, whichever is higher.

13.13.5 All loose material on the top of pile head after chipping to the desired level shall be removed and disposed off up to a lead of 2km or as directed by the Employer.

13.14 Rejection and Replacement of Defective Piles

13.14.1 The Employer reserve the right to reject any pile which in his opinion is defective with reference to technical specification & construction drawings on account of load capacity, structural integrity, position, alignment, concrete quality etc. Piles that are judged defective shall be pulled out or left in place as decided by the Employer without affecting the performance of adjacent piles. The Contractor shall install additional piles to substitute the defective piles as per the directions of the Employer at no extra cost to the Employer.

13.14.2 During execution of pile foundation work, if the bore holes need to be abandoned due to any reason and pile position to be shifted or realigned, other than for any design requirement by the Employer, fresh bore holes are to be executed at a suitable new position, which may vary from 2D to 3D (where, D is diameter of pile) as decided by the Employer, which may demand for resizing of pile cap including possible increase in reinforcement quantity due to resizing of pile cap. In all such cases the abandoned bore holes are to be filled up with plain cement concrete (1:3:6) so that no cavity remain in the bore hole of the abandoned pile. Any extra claim whatsoever from the contractor on account of abandoned bore hole, filling up of abandoned bore hole with concrete and any extra cost due to resizing of pile cap including increase in reinforcement quantity shall not be entertained by the Employer & the same have to be born by the contractor.

13.15 CRITERIA FOR TERMINATING THE PILES

13.15.1 **The piles can be terminated at a depth based on design developed by the Employer, where loads on the piles can be transmitted to the soil in a proper manner or the depth where specified `N' value is achieved, whichever occurs later. However, in no case piles should be terminated at a higher level than that indicated in the construction drawing.**

13.15.2 Standard penetration test (SPT) shall be carried out starting from 1.0 M above the specified pile termination depth and there after @ 1m. up to the pile termination depth.

13.15.3 The Standard Penetration Test (SPT) shall be carried out based on the following test procedures:

The test shall be conducted by driving a standard split spoon sampler in the borehole by means of a 650 N hammer having a free fall of 0.75 M. The sampler shall be driven for 450 mm using the hammer and the number of blows shall be recorded for every 150mm penetration. The number of blows for the last 300 mm drive shall be reported as N value. The test shall be discontinued when the blow count is equal to 100 or the penetration is less than 25mm for 50 blows, whichever is earlier.

At the location where the test discontinued, the penetration and the number of blows shall be reported. Sufficient quantity of disturbed sample shall be collected from the split spoon sampler for identification/classification of soil. The sample shall be visually classified and recorded at the site.

The specification for the equipments and other accessories, procedure for conducting the test and collection of the disturbed soil sample shall conform to IS:2131.

13.16 Recording of Piling Data

13.16.1 The Contractor shall record all the information during installation of piles. Typical data sheet for recording pile data as shown in Appendix D of IS:2911 Part I/Sec.2 shall be maintained by the contractor. The pile data shall also include all the details as in Annexure-D. On completion of each pile installation, pile record in triplicate shall be submitted to Employer within two days of completion of concreting of the pile.

13.17 Check for Pile bore

13.17.1 On completion of boring and cleaning the bottom of each pile bore shall be checked by the methods as approved by the Employer, to ensure that it is free from pile bore spoil/debris and any other loose material, before concreting. Concreting shall be done only after the approval of the Employer.

13.17.2 For sampling of drilling mud from the pile bore the following method or any other suitable method shall be adopted.

A solid cone shall be lowered by a string to the bottom of pile bore. A sampler tube closed at top with a central hole (hollow cylinder) is lowered over the cone, then a top cover shall be lowered over the cylinder. Care shall be taken for proper fittings of assembly to minimise the leakage while lifting the cone assembly to the ground surface. The slurry collected in the sampler tube shall be tested for density and sand content.

13.18 Properties of drilling mud

13.18.1 Properties of drilling mud shall be checked as per requirements indicated in Annexure 'C' prior to the commencement of piling work and thereafter at least once in a week or as found necessary by the Employer, one sample consisting of 3 specimens shall be tested.

13.18.2 Density and sand content of the drilling mud shall be checked in each pile.

14 Erection of Steel Embedded Parts

14.1 This covers the technical requirements for the supply and fabrication and/or erection of all embedded steel parts by the Contractor. The extent and type of embedded steel parts to be erected shall be as per detailed drawings.

14.2 The supply of embedded steel parts like ladders, steel pieces set in concrete inserts, dowel bars required for construction joints etc. are in the scope of the Contractor. However, supply of anchor bolts/stubs, as the case may be, will be supplied by tower contractor.

14.3 Embedded steel parts shall include items such as foundation anchor bolts, stubs, ladders, steel pieces set in concrete inserts, dowel bars for concrete work, etc. shown on the drawing or as required by the Employer. Material shall also include setting in forms for connecting in place and grouting as required. The grouting operations, if required, shall be performed as per the direction of Employer.

14.4 The Contractor shall erect all embedded steel parts in accordance with the drawings and these specification including setting materials in concrete or grouting pieces in place, furnishing all labour, materials, scaffolding, tools and services necessary for and incidental to the work to its transporting, unloading, storing, handling and erection. Contractor shall furnish welding rods and arrange for field welding as required in accordance with IS : 816.

14.5 Exposed surface of embedded material are to be painted with one coat of approved anticorrosive and/or bituminous paint without any extra cost to the Employer. The threads of holding down bolts shall be greased and protected with water proof tape.

15 Installation

15.1 During erection, the Contractor shall provide necessary temporary bracing or supports to ensure proper installation of the materials. All materials shall be erected in the true locations as shown in the drawings, plumb and level. Extreme care shall be taken to ensure that the threads of holding down bolts and comparable items are protected from damage.

15.2 Groups of holding down bolts shall be set in such a manner that the tolerance of whole group is not more than 3mm from its true position in plan at the top of the bolt and not more than 3mm from the required level. The top ends of all bolt shanks shall be in one plane to the tolerance stated above.

Holding down bolt assemblies shall be set vertically to a tolerance of not more than 1:500.

16 Protection Against Damage in Transit

16.1 All steel work shall be efficiently and sufficiently protected against damage in transit to site from any cause whatsoever. All protecting plates or bars and all ends of members at joints shall be stiffened, all straight bars and plates shall be bundled, all screwed ends and machined surface shall be suitably packed and all bolts, nuts, washers and small loose parts shall be packed separately in cases so as to prevent damage or distortion during transit. Should there be any distortion of fabricated members, the Contractor shall immediately report the matter to the Employer. Distorted reinforcement bars or plates received from stores or distorted during transport from stores to the fabrication yard shall not be used in fabrication unless the distortions are minor which in the opinion of the Employer can be removed by acceptable methods. The cost of all such straightening shall be borne by the Contractor within his unit rates.

These distortions shall be rectified by the Contractor by cold bending. If heating is necessary to rectify the defects, the details of the procedure shall be intimated to the Employer whose approval shall be taken before such rectification. The temperature of heat treatment shall not exceed the limits beyond which the original properties of steel are likely to be impaired.

17 Foundations Bolts

17.1 The foundation bolts / stubs, as required, for the tower structures shall be supplied by the respective tower contractor. These shall be embedded in concrete while the foundation is cast. The Contractor shall ensure the proper alignment of these bolts to match the holes in the base plate and also co-ordinate with the respective tower contractor for its correctness. The final adjustment of these bolts and their grouting are included in the scope of this contract. Grouting of block outs and the gap between the base plate and top of concrete shall be done by the Contractor after finalisation of alignments. The unit rate of concreting shall include the cost of above adjustments, grouting, and skins etc. required for this purpose.

17.2 The Contractor shall be responsible for the correct alignment and levelling of all steel work on site to ensure that the towers are in plumb.

17.3 Before erection of towers, by tower contractor, on the foundations the top surface of base concrete shall be thoroughly cleaned with wire brushes and by chipping to remove all laitance and loose materials and shall be chipped with a chisel to ensure proper bond between the grout and the foundation concrete. The piling Contractor shall also be responsible for bringing

down the top of concrete to the desired level by chipping. In case the foundation as cast is lower than the desired level, the Contractor shall make up the difference by providing additional pack plates without extra cost for any such work or material. No steel structures shall be erected on their foundations unless such foundations have been certified fit for erection by the Employer. Adequate number of air release holes and inspection holes shall be provided in the base plate.

18 Stability of Structure

14.1 The Contractor shall be responsible for the stability of the structure at all stages of its erection at site and shall take all necessary measures by the additions of temporary bracings and guying to ensure adequate resistance to wind and also to loads due to erection equipment and their operations. Guying and bracing shall be done for erection equipment and their operations. Guying and bracing shall be done in such a way that it does not interface with the movement or working of other agencies working in the area. For the purpose of guying, the Contractor shall not use other structures in the vicinity which are likely to be damaged by the guy.

Such temporary bracings shall neither be included in the measurement nor extra rate shall be payable. Such temporary bracings used shall be the property of the Contractor and may be removed by him at the end of the job from the site of work.

19 Grouting and under Pinning

19.1 General requirement

19.1.1 Furnishing of all labour materials and equipment and performance of all operations necessary to complete the work of grouting of block outs and foundation bolt holes and under pinning of base plates is in the scope of the Contractor. The cost of the above shall be included in the unit concreting rate.

19.1.2 Grouting shall be adopted for filling the block outs, pockets below foundation bolt holes. The block out and bolt holes which have to be grouted shall be cleaned thoroughly by use of compressed air immediately before taking up the grouting operations.

19.1.3 Cement and aluminium powder or anti-shrinkage admixture of approved quality shall be first blended thoroughly in the required proportions as per manufacturer's specification. The mix of grouting shall contain one part of cement and two parts of coarse sand. Admixture should be according to IS:9103.

19.1.4 15.1.4The quantity of aluminum powder shall usually be of the order of 0.005% by weight of cement. Any grout which has been mixed for a period longer than half an hour shall not be used on the work. Immediately after preparation the grout shall be poured into the block outs, pockets and foundation bolt holes either from the sides or through the holes provided for this purpose in the base plate, by using special equipment for pressure grouting. It shall be ensured by rodding and by tapping of bolts that the block out is completely filled without leaving any voids. The pouring shall cease as soon as each hole is filled and any excess grout found on the surface of the concrete foundation shall be completely removed and the surface dried.

19.1.5 Under pinning ~~it~~ shall be resorted to for filling the space between the underside of base plate and the top of foundation concrete. After grouting has been completed as specified above, space between the top surface of the foundation concrete and the underside of the base plate shall be filled with mortar or concrete depending upon thickness to be filled as follows :

Less than 40mm	Dry packed cement mortar
Over 40mm	Dry packed fine concrete

Mortar, fine concrete shall be blended with aluminium powder about 0.005% by weight of cement or with anti-shrinkage admixture in a suitable proportion to the cement mortar in accordance with the recommendations of the manufacturer and subject to the approval of the Employer. Mortar shall comprise cement, sand and water in proportion of approx. 1:3:0.4 by weight. Concrete shall comprise cement, sand, 10mm max. sized aggregate and water in proportion of 1:1.25:2:0.4 by weight. In all cases minimum 28 days cube strength should not be less than 25N/mm^2.

Shims provided for the alignment of bases shall be positioned at the edges of the base to permit subsequent removal which shall take place not less than 7 days after the underpinning has been executed. The resulting cavities shall be made good with the same grade of mortar or concrete as has been used for the underpinning of the rest of the base plate.

19.1.6 Cement, sand and aluminium powder or approved anti-shrinkage admixture, shall first be blended thoroughly in the required proportion. The mortar shall then be prepared by mixing with quantity of water which will produce a sufficiently workable mix to enable complete and proper compaction of the mortar.

19.1.7 The mortar shall then be placed below the base plate and rammed in a horizontal direction for each edge until the mortar oozes out through the grout holes provided in the base plate.

19.1.8 When it is clear that the center of base has been properly filled, the mortar outside the base plate shall be briefly rammed to ensure compaction below the edges. Any mortar which has been mixed for a period longer than half an hour, shall not be used in the work.

19.2 Materials

19.2.1 Cement shall conform to the stipulations contained in IS:8112and shall have a fineness (specific surface of cement) not less than 225 sq.m./kg when tested for fineness by Blaine's air permeability method as per IS:4031.

19.2.2 Sand shall conform to the stipulations contained in IS:383.

19.2.3 Water shall be clean and fresh and shall be of potable quality.

19.2.4 Aluminium powder or anti-shrinkage admixture like 'Groutex' CRS-NS grout or its equivalent shall be of standard brand from reputed manufacturer and shall be approved by the Employer prior to its use for work.

19.3 CURING

The work shall be cured for a period of 7 days commencing 24 hours after the completion of the grouting and under pinning operations. The curing shall be done by covering the surfaces with wet gunny bags.

20 Bar Grips

20.1 This covers the technical requirement for furnishing and installation of bar grips complete including all labour materials, equipment, staging, etc.

20.2 The Contractor shall furnish and install the bar grips for various diameter of deformed bars as indicated in drawings and as required by these specifications. The bar grip splicing system shall be of approved manufacturer and of the best quality available subject to approval of the Employer.

21 Splicing

a) The reinforcement bars are to be joined without any gap and the sleeve placed in position.

b) Pressure is applied by means of a hydraulic press which swages the sleeve down on the bar ends in a series of bites which are applied at high pressure.

c) The job can also be done in two stages. The 1st stage is to press the half sleeve on the loose bar at the reinforcement yard. The 2nd stage work is to be done at the actual site after the loose bar is inserted through the unpresented end of the sleeve and pressed insitu.

21.1 The joints shall be staggered as far as possible. Necessary staging arrangements are to be made by the Contractor.

21.2 It may be necessary to fix the sleeve to the reinforcement bars at one end in the open yard for the facility of working. All these working details are to be furnished earlier subject to the approval of the Employer.

21.3 The length of the sleeve should be adequate, that it is safe under the pull out loading conditions.

21.4 One percent representative samples of each dia, bars shall be sent for laboratory testing at the cost of the Contractor to check the efficiency of the joints under ideal condition. These samples of sleeves will be sent in the Laboratory for pull out tests.

21.5 All bar grips installation shall be subject to inspection and approval by the Employer before concreting operation are performed. In case of any defect or joint being not up to mark, the same shall be replaced by the Contractor at no extra cost.

22 MS Liner

MS liner shall be provided wherever included in the construction drawings released by the Employer and/or otherwise required by the Employer. For MS liner the technical specifications stipulated at Part-V shall apply.

SECTION – 14.2 (Part-III)
RATES & MEASUREMENT

CONTENTS

SECTION – 14.2 (Part-III)
RATES & MEASUREMENT

1 Excavation

1.1 The unit rate for excavation shall be quoted by the Bidder in the respective schedule of BPS. The unit rate quoted shall hold good for excavation (other than boring) for all depth and size in all types of soil including sheet piling, sheeting, shoring, bracing, draining, dewatering, cofferdams etc. as required for successful completion of job. The excavation shall be carried out in accordance with stipulations in Part-II of this Specification.

1.2 The unit of measurement shall be in cu.m. The design excavation volume shall be calculated considering dimension of pile cap plus 150mm on all sides of the pile cap and depth as shown in the drawing below the lean concrete level. The payment shall be made based on unit rate quoted, for excavation actually carried out or as per the design excavation volume as calculated above, whichever is less. No extra payment shall be admissible for excavations if required to be carried out in slope to maintain stability of pit.

1.3 The Contractor shall arrange to transport the excavated soil to a distance as directed by Employer and the rates quoted for excavation in Price schedule shall include all lead, lift, carriage etc.

2 Form Work

2.1 Formworks of different types / shapes shall be measured with reference to actual surface area in contact with the concrete and paid on area basis. The unit of measurement will be in sq.m. corrected upto second place of decimal.

2.2 No payments for formwork for construction joints shall be made.

2.3 Opening up to 0.1 sq.m. of boxing left for inserts etc. shall not be considered as if non-existent for the purpose of formwork measurement of surface in which the opening occur. If the cross-sectional area of any openings exceeds 0.1 sq.m., area of such openings shall be measured and deducted from the area payble for the form work.

2.4 No payment shall be made for making the formwork water proof or for supports, scaffolding, centering, approaches, etc.

2.5 No separate payment shall be made for using fillets for rounding of chamfering junctions, corners, etc.

3 Back filling

3.1 The actual volume of backfilling shall be measured in cubic meter rounded off up to 2nd place of decimal and the unit rate wherever applicable shall include all the necessary operations required to complete the work as per drawing & Part-II of this Specifications.

4 Reinforcement Steel

4.1 The unit rate for reinforcement steel shall include supply and placement of reinforcement steel of specific grade, stirrups, annealed wire for binding the reinforcement, chairs, hangers, spacers, welding, tack welding etc. as required to complete the RCC work in pile, pile cap, pedestal/chimney, tie beam (if required) including cleaning, straightening, cutting, bending,

binding etc. The unit rate shall also include placement of reinforcement cage in pile shaft/bore and all other cost for tools, plants, materials, labour, transportation to site by appropriate means as required. The payment of reinforcement steel shall be made based on working drawing. Wastage, overlaps, spacer bars, chairs, stays, hangers, annealed steel wire shall not be measured for the payment and cost of these items shall be deemed to be included in the rates of reinforcement.

4.2 Separator pieces between two or more layers of steel shall not be measured.

4.3 No payment shall be made for supports, spacers, chairs, hangers, etc. of height/length of 300mm and less, required for keeping the steel in position. For supporting horizontal reinforcement at heights, drawings for supports, spacers, chairs, hangers, etc. larger than 300mm, shall be prepared by the Contractor and got it approved from Employer. Payment shall be made for these supports as approved by the Employer, or as actually provided, whichever is less, as per the unit rate quoted for reinforcement.

4.4 No extra payment shall be made for modification of already embedded reinforcement, if required due to faulty fabrication or placement.

4.5 Dowels as required for completion of the work shall be provided by the contractor which will not be separately calculated for payment.

5 Piling work

5.1 The items of works are briefly described in the BPS. The various items in the BPS shall be read in conjunction with the corresponding sections/parts in the Technical Specifications, including amendments, and additions, if any. The unit rate quoted for items shall include all the activities covered in the description of the item (including concrete) as well as all necessary operations described in the specification and any other specific requirements.

5.2 The unit rates wherever applicable shall also include all minor activities which are obviously and fairly intended, though may not have been clearly brought out in the description of items or in these documents, but are essential for the satisfactory completion of the work.

5.3 Unit rates shall also include for all safety measures as required by codal provisions, local regulations, acts, bye-laws, etc. and mobilization of all plant, equipment, scaffolding, materials, skilled and unskilled labour, de-mobilisation after completion of work, supervision, establishing level and coordinates at each location by carrying levels from one established bench mark and distances from one set of grid lines furnished by the Employer.

5.4 Unit rate wherever applicable wherever applicable on per meter length basis for a particular diameter of pile shall remain unchanged irrespective of the actual length/depth of individual piles executed at any location

5.5 Unit rate wherever applicable for pile boring through all kind of soil, including weathered rocks, laterite, shell, hard rock shall be inclusive of cost of boring by approved method, bailing out all the pile bore spoils from the pile bore, keeping the bore hole free from bored material/debris etc. and disposing same along with the drilling mud up to a distance of 2 km., flushing the pile bore by fresh Bentonite before concreting, collection of samples from bottom of pile bore, transporting to laboratory, testing and reporting of results including necessary materials, equipment and manpower.

5.6 Unit rate wherever applicable quoted for pile boring through soil including weathered rocks, laterite, shell, hard rock shall include shifting of plant and equipment from one pile location to another location**,** providing temporary casing as required and removal of the same after completing concreting. The quoted unit rate for boring/installation of pile shall also be inclusive of the empty boring and extra concreting required above the pile cut off level.

5.7 Unit rate wherever applicable for pile boring through soil including weathered rock / laterite shall also include chiseling, if any required, the chiseling through rock in the pile below socketing horizon up to the specified level shall be inclusive of bailing out the pile bore debris/spoils from the pile bore and disposing off the chiseled materials/debris along with the sludge/mud up to 2 kms., flushing the pile bore by fresh betonies before concreting, collection of samples from bottom of the pile bore, transporting to laboratory, testing and reporting of results.

5.8 Unit rate wherever applicable of pile boring shall include concreting in piles by tremie method, cost of preparation of pile head and disposal of debris etc., resulting from breaking off of pile up to COL, up to a distance of 2 km.

5.9 Unit rates wherever applicable shall include for all quality assurance requirements, but not limited to providing for technical inspection, transportation of samples to laboratory, testing samples, maintaining and submitting all test records, etc.

5.10 The rate quoted for boring and installation shall be inclusive of performing point load test on the rock samples obtained from bore spoils during the chiseling operations, and shall be inclusive of transportation to laboratory, testing and reporting of the results.

5.11 Measurement for the item of boring through soil including weathered rock shall be done by linear measurement for the length bored from the pile cut off level or ground level whichever is lower through soil/weathered rock up to termination/founding level as per drawing or actual length achieved of the pile in meters, up to second place of decimal.

6 Pile Integrity Test

The actual quantity of pile integrity test done shall be calculated in nos. and the unit rate wherever applicable quoted shall be include all necessary equipment, manpower, labour, materials, operations etc. required to complete the work as per Part-IV of this Specification. The payment shall only be made after successful completion of the job and submission of complete report for each no. of test.

SECTION –14.2 (Part-IV)
TESTING AND ACCEPTANCE CRITERIA

CONTENT

SECTION –14.2 (Part-IV)
TESTING AND ACCEPTANCE CRITERIA

1 Construction Materials

1.1 Any material considered to be Sub-standard or not meeting the Specifications as described in Section – X, Part-II, of this Specification and as declared/certified accordingly by the Purchaser shall not be used by the Contractor and shall be removed from the site immediately at no extra cost to the Purchaser.

2 Cement Concrete

2.1 Testing

2.1.1 The Contractor shall carry all sampling and testing in accordance with Standard Field Quality Plan (SFQP) as enclosed with this Specification, relevant Indian Standards and this Specification at his own cost in field and in a laboratory approved by the Purchaser. For the tests carried in the laboratory contractor shall the test results to the Purchaser in triplicate within 7(seven**)** days after completion of the test.

2.1.2 Facilities required for sampling and testing materials, concrete, etc. in field and in laboratory shall be provided by the Contractor. Where no specific testing procedure is mentioned the tests shall be carried out as per the prevalent accepted engineering practice to the directions of the Purchaser. Tests shall be done in the presence of the Purchaser or his authorised representative. In case the Purchaser requires additional test, the Contractor shall arrange to get these tests done and submit to the Purchaser the test results in triplicate within three days after completion of any test.

2.1.3 The Contractor shall maintain records of all inspection and testing, which shall be made available to the Purchaser, whenever required.

2.1.4 The testing apparatus/equipment installed in the filed laboratory shall be calibrated / corrected by the qualified person as frequently as possible to give accurate testing results.

2.1.5 Frequency of sampling and testing, etc. and Acceptance Criteria should be as per SFQP. However, Purchaser shall have the full authority to call for tests as frequently as he may deem necessary to satisfy himself that the materials and works comply with the Specifications. The materials shall be tested to meet all the specified requirements before acceptance at manufacturer's premises or at independent government approved laboratory. Tests indicated in the tables of Standard Field Quality Plan are for cross checking at site to ascertain the conformity of the materials to the Specifications.

2.1.6 One sample consisting of six test cubes shall be made from the concrete used in each pile, three to be tested after 7 days and three after 28 days.

2.1.7 In preparation of test cubes/specimens vibrators shall not be used.

2.1.8 Concrete shall be tested for slump at every 1 hour interval.

2.2 Acceptance Criteria for Concrete

a) The acceptance criteria of concrete shall be in accordance with Field Quality Plan (FQP) and as per Section – IV A of this Volume II.

b) Concrete work found unsuitable for acceptances shall have to be dismantled and replacement is to be done as per specification by the Contractor. No payment for the dismantled concrete, the relevant form work and reinforcement, embedded fixtures, etc. wasted in the dismantling shall be made to the Contractor. If any damage is done to the embedded items of adjacent structures, the same shall be made good free of charge by the Contractor, to the satisfaction of Purchaser.

c) The dimensions of concrete as cast, when compared with the drawing, shall be within the tolerances given below. Steps in surface alignment shall not exceed 2mm. No reduction will be permitted in the cover to reinforcement because of a specified negative tolerance in a concrete section.

Structural Element Detail	Permissible Deviation in mm.	
Faces of concrete in foundations and structural members against which backfill is placed	+25	-5
Exposed concrete foundations	+10	-5
Top surfaces of Pedestal/chimney and for concrete to receive grouted plant or structural steel work	+5	-5
Alignment of tie beams, Pedestal/chimney, pile cap	+5	0
Cross sectional dimensions of tie beams, Pedestal/chimney, cap	+5	-5
Level and alignment of holding down bolts	+5	-5
Level of holding down bolt assemblies	+10	-5
Alignment of holding down bolts assemblies	+5	-5
Centers of pockets or holes with greatest lateral dimensions not exceeding 150mm	+5	-5
Centers of pockets or holes with greatest lateral dimension exceeding 150mm.	+10	-5

2.3 Acceptance criteria of Finished Concrete

2.3.1 Finished concrete shall be true to shape, lines, levels plumb and dimensions as shown on drawings.

2.3.2 All embedded fixtures shall be of correct type and in correct position as shown in drawings.

2.3.3 Finished concrete surface shall be free from blemishes like honey-combs, air bubbles, fins, etc.

2.3.4 Exposed concrete surface shall be free from rust stains, grease and mould oil stains etc. and shall have uniform pleasing appearance to the satisfaction of the Purchaser.

2.3.5 The finished concrete shall be of a standard quality and equal to the accepted sample.

3 Reinforcement Steel

Reinforcement shall be checked for cleanliness, proper bending, binding, placing and securing in position with provision for proper cover. The reinforcement should conform to the requirement of Section – X, Part-II of this Specification.

4 Testing for position and alignment

4.1 Each pile shall be checked for its position with respect to specified location. Each pile bore shall be checked for its alignment.

4.2 Permissible limits for deviation shall be as specified under SECTION-X, Part-II of this Specification.

5 Properties of drilling mud

5.1 Properties of drilling mud shall be checked as per requirements indicated in Annexure 'C'. Prior to the commencement of piling work and thereafter at least once in a week or as found necessary by the Purchaser, one sample consisting of 3 specimens shall be tested.

5.2 Density and sand content of the drilling mud shall be checked in each pile.

6 Check for Pile bore

6.1 On completion of boring and cleaning the bottom of each pile bore shall be checked by the methods as approved by the Purchaser, to ensure that it is free from pile bore spoil/debris and any other loose material, before concreting. Concreting shall be done only after the approval of the Purchaser.

6.2 For sampling of drilling mud from the pile bore the following method or any other suitable method shall be adopted.

A solid cone shall be lowered by a string to the bottom of pile bore. A sampler tube closed at top with a central hole (hollow cylinder) is lowered over the cone, then a top cover shall be lowered over the cylinder. Care shall be taken for proper fittings of assembly to minimise the leakage while lifting the cone assembly to the ground surface. The slurry collected in the sampler tube shall be tested for density and sand content.

7 Pile Integrity Test

7.1 Pile Integrity test is used to assess the as-installed pile characteristics as well quality achieved during the construction of pile. The parameters to be evaluated through the Pile Integrity Test (also known as dynamic pile testing) should generally cover True static capacity of the pile at the time of testing, total skin friction and end bearing of the pile, skin friction variation along the length of the pile, compressive and tensile stress, displacement of pile, changes in cross-section if any etc.

7.2 The equipment consists of an electronic control unit, a hand-held instrumented hammer and an accelerometer and computer.

7.3 The pile top is prepared to make a plane surface (by placing a thin cement mortar in an area of 200mm x 200mm) after removal of weak lattiance. The accelerometer is fixed to the top of the pile and the instrumented hammer is struck firmly on the pile top. This generates a wave form that travels down the pile and gets reflected from the bottom as well as from any discontinuities in the pile.

7.4 The results to be stored in a compact control unit and transferred to computer and detail analysis to be carried out.

7.5 The contractor is to submit a detailed report for the data specified in cl. 7.1 above and as required by the Purchaser.

SECTION –14.2 (Part-V)

M.S.LINER

SECTION –14.2 (Part-V)

M.S.LINER

1 Structural steel MS liner for R.C.C Vertical bored piles

1.1 General Requirements

This specification covers general requirements for supply, fabrication, shop painting (if required), and delivery at site mild steel liners of specified diameters and lengths for piles.

M.S. liner shall be provided to piles at locations, as directed by the Purchaser. The extent up to which the MS liners for piles required to be provided shall be as shown in the approved drawings and as per direction and written approval of the Purchaser.

1.2 Drawings

1.2.1 Contractor shall submit calculations and fabrication details for connection/splice/joint for fabrication of liners and get these approved by the Purchaser before starting any fabrication works. The approval of fabrication drawings prepared by the Contractor shall not relieve the Contractor of the responsibility for the liners in place.

Fabrication drawing (drawn to large enough scale) to convey all information clearly shall include the following:

i) Reference of the design drawings based on which fabrication had been prepared. The reference should include and indicate the latest revision of design drawing.

layout, elevations and sections with erection marking of all members.

Quality of Structural Steel, Welding electrodes, and standards to which these conform to.

ii) Detailing of structural joints and shop/field splices.

iii) Details of shop and field joints/connections.

vi) Bill of material indicating size and weight of members/component.

vii) Erection assemblies and sub-assemblies identifying all transportable parts.

viii) Method of erection, special erection instructions, and special precautions to be taken during erection, as required.

1.2.2 Purchaser reserves the right to make changes in the fabrication drawings. Revisions to drawings may be made to reflect more updated requirements. Revisions to drawings and any new drawings made to include additional work by Contractor shall be considered as a part of this specification and the Purchaser shall entertain no extra claim on this account. All revisions in the drawings should be highlighted in the drawing distinctly.

1.2.3 Unless otherwise specified, the drawings and specifications are intended to include everything obviously requisite and necessary for the proper and entire completion of the work and the job shall be carried out accordingly for the completeness as required.

1.2.4 In the case of variations in drawings and specifications, the decision of the Purchaser shall be final. In case Contractor in the execution of his work, find discrepancies in the information furnished by Purchaser, he shall refer such discrepancies to the Purchaser before proceeding with such work.

1.3 Fabrication

1.3.1 General

The fabrication work shall be carried out generally in accordance with IS:800 as well as the stipulation contained in these specifications. All materials shall be completely shop fabricated and finished with proper connection materials for ready assembly in the field. All the workmanship and finish shall be of the best quality and shall conform to the best approved method of fabrication. All materials shall be finished straight and shall be machined true and square where so specified. All edges shall be free of burrs, shearing and chipping shall be neatly and accurately done. Material at the shop shall be kept clean and protected from weather, Checklist format, inspection certificate for fabrication and protocol for handing over of structural steel shall be submitted by the Contractor in the form as agreed to by the Purchaser.

1.4 Straightening

All material shall be straight and free from bends or twists. If necessary, before being worked, the materials shall be straightened, unless otherwise required/specified. In case plates are distorted or twisted, straightening or flattening shall be done by methods that will not injure the plates. Long plates shall be straightened by passing through mangle of leveling rolls. Heating or forging shall not be resorted to without the prior approval of Purchaser in writing.

1.5 Welding

1.5.1 Welding shall be in accordance with IS:816, IS:819, IS:1024, IS:1261, IS:1323, IS:4353 and IS:9595, as appropriate.

1.5.2 For welding of any particular type of joint, Contractor shall give evidence acceptable to the Purchaser of having satisfactorily completed appropriate tests as described in any of the Indian Standards - IS:817,IS:1393,IS:7307 (Part J), as relevant and as per the checklists given in the Annexure to this section of the specification.

1.5.3 The works shall be done as per approved fabrication drawings which would clearly indicate various details of joints to be welded, type of weld, length and size of weld, whether shop or site weld. Symbols for welding on shop drawings shall be according to IS:813. Efforts shall be made to reduce site welding so as to avoid improper welding due to constructional difficulties.

1.5.4 Welding of Structural Steel shall be done by an electric arc process. The procedure to be followed, materials, plant and equipment to be applied shall be subject to the approval of the Purchaser and shall conform generally to relevant acceptable standards viz. IS:816, IS:9595, IS:814, and Indian Standard Hand Book for metal arc welding, and other standard codes of practice internationally accepted.

1.5.5 "Open-Arc-Welding" process employing coated electrodes shall be employed for fabrication of other welded connections and field welding.

1.5.6 Wherever welding is done for assembling the components of liner, the job shall be so positioned that down hand welding is possible. In cases where such positioning of job is not possible other manual welding positions could be resorted to.

1.5.7 Any structural joints shall be welded only by those welders who are qualified for all welding procedures and positions required in such joint that is welded. The entire weld of any liner joint shall be made by one welder.

1.5.8 All welds shall be free from defects like blow holes, slag inclusions, lack of penetration, undercutting, cracks and show uniform Sections, smoothness of Weld metal, feather edge without overlap and freedom from porosity.

1.5.9 Proper edge preparation shall be made for jointing of materials before welding. Suitable edge preparation shall be done for all processes of welding except for square butt welds. Type of edge preparation shall depend on the thickness of parent materials that are to be joined. The edge forms shall be chosen to suit the design, technology and production conditions and shall be subject to the approval of the Purchaser. The edge form of weldments shall be prepared either by machines or by automatic gas cutting with surface rougher of the welding area not exceeding 50sq.mm. All edge cut by flame shall be ground before they are welded.

1.5.10 The electrodes used for welding shall be of suitable type and size depending upon specifications of the parent material, the method of welding, the position of welding and quality of welds desired e.g. normal penetration welds or deep penetration welds.

1.5.11 Where bare electrodes are used these shall correspond to specification of the parent material. The type of flux wire combination for submerged arc welding shall conform to the requirements of F-60 class of AWSA-5-17-69 and IS:3613 (Latest). The electrodes shall be sorted properly and the flux shall be baked before use in an oven in accordance with the manufacturer's requirements as stipulated.

1.5.12 Specific approval of the Purchaser shall be taken by the Contractor for the various electrodes proposed to be used on the work before any welding is started.

1.5.13 Electrodes larger than 5mm diameter shall not be used for root-runs in butt-welds.

1.5.14 Welding plant and accessories shall have capacity adequate for the welding procedure laid down and shall satisfy appropriate standards and be of approved make and quality. All the electrical plant in connection with the welding operation shall be properly and adequately earthed and adequate means of measuring the current shall be provided.

1.5.15 Voltage and current (and polarity if direct current is used) shall be set according to the recommendations of the manufacturer of the electrode being used and suitability to thickness of material, joint form etc.

1.5.16 Prequalified welding procedures recommended by appropriate welding standards and known to provide satisfactory welds shall be followed. For non-standard procedures, qualification tests as prescribed in IS:9595 (latest) shall be made to verify the adequacy of the procedures. A welding procedure shall be prepared by Contractor and submitted to the Purchaser for approval before start of welding. This shall include all details of welding procedures with references to provisions of IS:9595 and IS:4353. Approval of the welding procedure by Purchaser shall not relieve Contractor of his responsibility for correct and sound welding without undue distortion in the finished structure.

1.5.17 No welding shall be done, when the surface of the members is wet, during periods of high wind, unless the welding operator and the work are properly protected.

1.5.18 In joints connected by fillet welds, the minimum sizes of single run fillet welds for first run and minimum full sizes of fillet welds shall conform to requirements of IS:816.

1.6 Pre-Heating Inter-run Temperature and Post Weld Heat Treatment.

i) Welding of mild steel shall not be undertaken when the plate temperature is 0^0 C or below.

ii) Mild steel plates conforming to IS:226 and thicker than 20 mm and plates conforming to IS:2062 and thicker than 25 mm may require preheating of the parent plate prior to welding. In welding materials of unequal thickness the thicker part shall be taken for this purpose.

Minimum Preheat and Interpass Temperature

Thickness of thicker part at point of welding	Other than low hydrogen welding electrodes		Low hydrogen welding electrodes	
	IS:226 IS:8500 steel or IS:2062 steel		IS:8500 steel	IS:226 or steel IS:2062 steel
Up to 20mm incl.	None	Welding by this electrode	None	10 deg.C

iii) Base metal shall be preheated, as required to the temperature given in table above prior to welding or tack welding. When base metal not otherwise required to be preheated is at a temperature below 0 deg. C, it shall be preheated, prior to tack welding or welding. Preheating shall bring the surface of the base metal to the specified preheat temperature and this temperature shall be maintained as minimum inter-pass temperature while welding is in progress.

iv) Pre-heating may be applied by external flame heating equipment, by electric resistance or electric induction process such that uniform heating of the surface extending up to a distance or four times the thickness of the plate on either side of the welding joint is obtained.

v) Thermo-Chalk or other approved methods shall be used for measuring the plate temperature.

1.7 Sequence of Welding

i) The sequence of welding shall be carefully chosen to ensure that the components assembled by welding are free from distortion and large residual stresses are not developed. The distortion should be effectively controlled either by a counter effect of by counter distortion. The direction of welding should be away form the point of restraint and towards the point of maximum freedom.

ii) Each case shall be carefully studied before finally following a particular sequence of welding.

1.7.1 Approval of welding sequence and procedure shall not relieve the Contractor of the responsibility for the correct welding and for minimising the distortion in the finished structure which in no case shall exceed that laid down in Indian Standards.

1.7.2 All welds shall be finished full and made with correct number of runs, the welds being kept free from slag and other inclusions, all adhering slag being removed from exposed faces immediately after such run.

1.7.3 Current shall be appropriate for the type of electrode used. To ensure complete fusion, the weaving procedure should go proper and rate of arc advancement should not be so rapid so as to leave the edges un-melted.

1.7.4 Pudding shall be sufficient to enable the gases to escape from the molten metal before it solidifies.

1.7.5 Non-uniform heating and cooling should be avoided to ensure the excessive stresses are not locked up resulting ultimately in cracks.

1.7.6 The fusion faces shall be carefully aligned. Angle shrinkage shall be controlled by presenting. Correct gap and alignment shall be maintained during the welding operation.

1.7.7 All main butt welds shall have complete penetration and except where it is impracticable they shall be welded from both sides, back surface of the weld being gouged out clean before first run of the weld is given from the back.

1.7.8 Intermittent welds shall not be permitted without the approval of the purchaser. These shall be permitted only when specifically approved in the fabrication drawings.

1.7.9 Inspection of Welds: All Welds shall be inspected for flaws by any of the methods described under Clause “Inspection”. The choice of the method adopted shall be determined by Purchaser.

1.7.10 The Contractor shall carry out tests which establish soundness of welds. In case the tests uncover defective work, the Contractor shall correct such defects at his own cost and prove the soundness of rectified work at his own cost.

1.7.11 The correction of defective welds shall be carried out as directed by Purchaser without damaging the parent metal. When a crack in the weld is removed, magnetic particles inspection or any other equally positive means as prescribed by purchaser shall be used to ensure that the whole of the crack and material up to 25 mm beyond each end of the crack has been removed. Cost of all such test and operations incidental to correction shall be to Contractor’s account.

2 Inspection and Rectification

2.1 Visual Inspection

100 percent of the welds shall be inspected visually for external defects. Dimensions of welds shall be checked. The length and size of weld shall be as per approved fabrication drawing. It may be slightly over sized but should not be under sized. The profile of weld is affected by the position of the joint but it should be uniform. In case of butt and corner welds the profile shall be convey and in case of submerged are fillet weld, it shall be slightly concave. The welds should have regular height and width of beads. The height and spacing or ripples shall be uniform. The joints in the weld run where welding has been recommended shall as far as possible be smooth and should not show any humps or craters in the weld surface. Welds shall be free from the unfilled craters on the surface under cuts slags on the surface visible cracks. Such inspection shall be done after clearing the welds surface with steel wire brushes and chisel to remove the sputter metal, scales, slag, etc. If external defects mentioned above are noticed the work shall be dismantled and redone duly replacing the defective materials including the base members.

2.2 Rectification of Defective Welding Work

Wherever defects like improper penetration, extensive presence of blow holes, undercuts cracking, slag inclusion etc. are noticed by visual inspection/other tests, the welds at such locations shall be removed by gouging process. The joints shall be prepared again by cleaning the burrs and residual matters with wire brushes and grinding, if necessary and re-welded. The gouging as far as possible, be done using gouging electrodes. Flame gouging shall be resorted to only in special cases with specific permission of the Purchaser.

2.3 Acceptance of the Welded Structures

The acceptance of the welded work shall depend upon correct dimensions and alignment, absence of distortion in the structure, satisfactory results from the examination and testing of the joints and the test specimens as per I.S. soundness of the welds and upon general workmanship being good.

2.3.1 Random die penetration tests shall be conducted after welding of M.S. liner plates.

3 ERECTION MARKS

3.1 Before any steel work leaves the Contractor's fabrication shop, it shall be suitably marked in accordance with the approved fabrication drawing and according to an approved marking plan. Copies of all drawing showing such erection marks on the various steel works to be furnished to the purchaser well in advance of the erection.

3.2 The erection marks assigned to various components of the structural steel work shall also contain an erection sequence number indicating the sequence in which the various components are to be erected.

3.3 Erection marks shall be clearly painted on the work, each piece being marked in al least two places. Each piece shall also have its weight marked thereon. In order to help identification, each piece shall bear the erection marks and erection sequence number. Erection marks shall be painted on the structures, during the process of fabrication to facilitate their identification during inspection. Where a number of components are identical and bear the same erection marks, these components shall be further identified by assigning numerals in addition to the common erection mark.

4 Errors

Any error in shop work which prevents proper assembling and fitting of parts in the field, moderate use of drift pins or moderate amount of reaming will be classified by Purchaser as defective workmanship. All charges incurred by Purchaser either directly or indirectly because of workmanship will be deducted from the amount due to Contractor, before payment is made. The amount of such deduction will consist of the sum total of the costs of labour direct or indirect, material, plants, transportation, equipment, rental and overhead expense. In case purchaser chooses to reject the material because of poor workmanship the cost of all handling and returning the material to Contractor, if he so desires, shall entirely be to Contractor's account and in such cases, the cost of handling, transport and delivery to site shall be borne by Contractor.

5 Protection Against Damage in Transit

All steel work shall be efficiently and sufficiently protected against damage in transit to site from any cause whatsoever to prevent damage or distortion during transit. Should there be any distortion of fabricated members the Contractor shall immediately report the matter to the Purchaser. Distorted steel shall not be used in fabrication unless the distortion are minor which in the opinion of the Purchaser can be removed by acceptable methods. These distortions shall be rectified by the Contractor by cold-bending. If heating is necessary to rectify the defects the details of the procedure shall be intimated to the Purchaser whose approval shall be taken before such rectification. The temperature of heat treatment shall not exceed the limits beyond which the original properties of steel are likely to be impaired.

6 Anti Corrosive Treatment for Mild Steel Liners

6.1 After inspection and issue of test and acceptance certificate, all steel surfaces shall be coated with a coat of direct to rust primer i.e. Densotrol or equivalent and thereafter these shall be provided with a final coat of minimuM-250 microns of high built epoxy coal tar, as specified below. The fabricated mild steel liners to be used for the piling work shall be cleaned from grease or any other contaminant, by mechanical/manual cleaning. the primer shall be applied with a brush or spray to develop a dry film thickness or minimum 25 microns. The primer surface shall be left for curing for at least 24 hours before it is coated with the final coat. The final coat shall consist of high built epoxy coal tar with a thickness of minimuM-250 microns. The physical properties of primer and top coat shall be as given below.

6.2 Technical data of Priming material

Binder content	45%
Total Solids	45%
Solvent	55%
Viscosity	16 (Ford Cup No.4)
Density	0.88
Flash point	$+40^0$C
Anti-porosity	80/99 in one and two layers, respectively

Heat-resistance	170/220 continuously & short period strain.
Contact angle	5^{O} (Lorentzon & Westtress)
Covering Capacity	12-20 Sq.m./litre
Layer thickness	12/25 on glossy/coarse surface
Homogeneity	No sediment
Thinning	Normally, no thinner shall be used.
Drying time	Dust-free in 2 hrs, Solid in 4/5 hrs. Between layers from wet-in-wet 2 hrs.for continuous penetration between layers
Lustre	Semi-glossy
Colour	Lightly yellowish
YSAM group	2
Injurious to health	No
Physiological condition	No dangerous gas generation when welding
Application	Airless spray equipment or conventional painting with roll/brush.
Cleaning of equipment	White spirit

6.3 Technical particulars of final coat

System Component A : Base Part Component B : Accelerator Part	Two Components
Colour	Black
Mixing Ratio	1:1 by Weight
% Solid by Weight	More than 95%
Pot Lift (Temp.27^{O}C Relative humidity 65%)	2 hours
Setting Time (At 22^{O}C Relative humidity 65%)	4-5 hours

Fully cured	7 days	
	Density of cured mass	1.35
Flash Pt. of blended product	40^{O}C (104^{O}F)	
Hardness	75 Shore D	
Finish	Semi glossy	
Water absorption after 6 mths.	Negligible	
Covering Capacity	1.5 sq.m./Kg (400 Microns thk.)	
Storage Life	1 year in sealed condition.	

7 Shop Connections

Surfaces to be permanently in contact shall receive a priming coat immediately at the works except where jointed by welding.

SECTION-14.2 (Part-VI)

LIST OF INDIAN STANDARDS

The construction work of pile foundation shall conform to the following Indian Standards, which shall mean latest revisions, amendments/changes adopted and published, unless otherwise specified hereinbefore. Some of the important relevant applicable codes for this section are as follows :

IS : 226	Structural Steel (Standard Quality)
IS : 432	Specification for mild steel and high tensile steel bars and hard drawn steel wire for concrete reinforcement.
IS : 456	Code of practice for plain and reinforcement concrete
IS : 516	Methods of test for strength of concrete
IS : 800	Code of Practice for General Construction in Steel
IS : 813	Scheme of symbols for Welding
IS : 814	Specification for Covered Electrodes for Metal Arc Welding of Structural Steels
IS : 816	Code of Practice for use of Metal Arc Welding for General Construction in Mild Steel.
IS : 817	Code of Practice for Liquid Penetrant Flaw Detection.
IS :1199	Methods of sampling and analysis of concrete.
IS: 1200 Part-I	Method of measurement of Building and civil Engineering work -–earthwork.
IS:1200 Part-23	Method of measurement of Building and civil Engineering work -–Piling
IS : 1786	Cold worked steel high strength deformed bars for concrete reinforcement.
IS : 1838	Performed fillers for expansion joints in concrete non-extruding and resilient type (bitumen impregnated filler).
IS : 2062	Weld able structural steel
IS : 2074	Ready Mixed Paint, air drying, Red Oxide Zinc Chrome, Priming.
IS : 2386 Part-III	Specific gravity, density, voids absorption and bulking.
IS : 2502	Code of Practice for bending and fixing of bars for concrete reinforcement.
IS : 2505	General requirements for concrete vibrators immersion type.
IS : 2506	Screed board concrete vibrators.
IS : 2514	Concrete vibrating tables.
IS : 2911 (Part/Sec. 2)	Code of practice for design and construction of pile foundation-Bored cast-in-situ concrete piles.
IS : 3025	Methods of sampling and test (Physical and chemical) for water used in Industry.
IS : 3350	Methods of tests for routine control for water used in Industry.
IS : 3370	Code of Practice for concrete structure for the storage of liquids.

IS : 3613	Acceptance Tests for Wire Flux Combinations for submerged Arc welding of structural steels.
IS : 3658	Recommended Practice for Radiographic Examination of Fusion Welded Butt Joints in Steel Plates.
IS : 3764	Safety codes for Excavation work.
IS : 4353	Recommendations for Submerged Arc Welding of Mild Steel and Low Alloy Steels.
IS : 4656	Form vibrators for concrete.
IS : 4701	Code of practice for earth work on canals.
IS : 8500	Specification for weldable structural steel (medium and high strength qualities)
IS : 9103	Admixtures for concrete.
IS : 10262	Recommended guidelines for concrete mix design.

ANNEXURE - A

SPECIFICATION OF DRILLING MUD (BENTONITE SLURRY)

1.0 Bentonite suspension used for piling work shall satisfy the following requirements:

a) Liquid limit of Bentonite when tested in accordance with IS:2720 (Part V) shall be more than 300 percent and less than 450 percent.

b) Sand content of the Bentonite powder shall not be greater than 7 percent.

c) Bentonite solution should be made by mixing it with fresh water using pump for circulation. The density of the freshly prepared Bentonite suspension shall be between 1.024 and 1.10 gm/ml depending upon the pile dimensions and type of soil in which the pile is to be met. However, the density of Bentonite suspension after mixing with deleterious materials in the pile bore may be up to a maximum of 1.25 gm/ml.

d) The Marsh viscosity when tested by a Marsh cone shall be between 30 to 60 seconds.

e) The differential free swell shall be more than 540 percent.

f) The pH value of the Bentonite suspension shall be between 9 and 11.5.

ANNEXURE - B

PILE DATA SHEET

1. Reference No. Location (Co-ordinates)_____ area.
2. Sequence of Piling
3. Pile diameter & Type
4. Working level (Platform level)
5. Cut off level (COL)
6. Actual length below COL
7. Pile termination level
8. Top of finished concrete level
9. Date and time of start and completion of boring
10. Depth of Ground water table in the vicinity
11. Type of strata at pile tip
12. Method of boring operation
13. Details of drilling mud as used :

    i) Freshly supplied mud

    liquid limit sand content density marsh viscosity Swelling index pH value

    ii) Contaminated mud density sand content
14. SPT, N values in soil (from the nearest bore hole). UCS value in rock (from the nearest bore hole).
15. Chiseling if any, from....m to.....m.
16. Date and time of start and completion of concreting
17. Method of placing concrete
18. Concrete quantity :

    Actual
    Theoretical
19. Ref. Number of test cubes
20. Grade and slump of concrete
21. Results of test cubes
22. Reinforcement details :

Main Reinforcement	Stirrups : Type
No._____	No._____
Dia_____	Dia_____
Depth_____	Spacing_____

23. Any other information regarding constructions, delay and other interruption to the sequence of work.

NOTE : The above details are required to be furnished by the Contractor before starting the installation work.

ANNEXURE - C

INSPECTION & TESTING FOR STRUCTURAL STEEL WORKS

1.0 GENERAL

Contractor shall carry out a comprehensive inspections and testing programme during fabrication and erection. An indicative programme of inspection/testing envisaged by Purchaser is given below. This is however not intended to form a comprehensive programme as it is the Contractor's responsibility to draw up and carry out such a programme duly approved by the Purchaser. Such approval shall not relieve the Contractor of the responsibility about the correctness and adequacy of workmanship, materials etc.

1.1 Raw Materials Inspection

1.1.1 Steel

i) Specifications

Check the specification of steel and availability of the relevant Test Certificates.

ii) Physical Conditions

a) Steel shall not be pitted and should be free from scales and rust.

b) If the plates are bent or distorted, bent to distortion shall normally be removed by the cold treatment etc.

c) Straightening under hot stage shall be resorted to only under specific permission from the Purchaser.

d) If any rolling defect viz, laminations, cracks etc. are found in the steel during processing it shall be rejected.

iii) Storage

a) Steel plates of different specifications shall be stacked separately.

b) Steel of IS:2062 quality shall be given a distinctive identification mark.

c) Steel sections shall be stacked over spacers supported on posts of about 50 cm height above round. Passage and space between the stacks shall be sufficient for rigging operations.

1.1.2 Electrodes

i) Electrodes for manual metal arc welding shall be procured envisaged in the welding procedure sheet predetermined before actual welding operation starts.

ii) Electrodes shall be properly stored dry as required by the IS Code or by the manufacturer.

iii) Electrodes shall bear the I.S.I or equivalent Certification mark.

iv) The approval for all the consumables for welding shall be specifically obtained before hand.

1.1.3 Paints/Primers

i) The relevant I.S or equivalent mark on sealed tins shall be checked.

ii) A few tins shall be opened at random to check the condition of the paints. Paint from old stock and showing signs of solidification shall not be accepted.

1.2 Welding Procedure Qualification.

As per ASME section (ix) or equivalent Indian Standards, Welding procedures, Specification shall be submitted by the Contractor for review and approval of Purchaser.

1.3 Welders Qualification Test

As per ASME section (ix) or equivalent Indian Standard.

1.4.0 Inspection for Tack Assembly set up for:

i) Level

ii) Gap

iii) Offsetting

iv) Shrinkage allowance

v) Fitment sequence

vi) Principal overall size.

1.5 Preheating

Temperature control by thermo chalk or suitable equivalent method.

1.6 Inspection of Main welds

a) Fillet welds for

i) Size

ii) Dye Check

iii) Visual examination

iv) Dye penetration test/MPI shall be carried out.

b) Butt welds for

i) Dye check for root after back gauging shall be carried out.

ii) Mechanical testing of welds (Destructive Tests) Minimum on joint per liner length/piece.

iii) Non-destructive - as per FCL: SS:4

- 100% visual examination.

B. FABRICATION CHECK LIST (STANDARD)

Title : Welding Tests on welds and Weld Defects

Mechanical testing of welds (Destructive test) Butt welds having one or more of the following defects are not acceptable.

i) Bend test : No crack on root/face on being bent through 180 deg. with mandrel of 4t where t is the

thickness of plate.

ii) Tensile test : Weld strength not to be less than part metal's strength.

VISUAL EXAMINATION

Following defects are not allowed :

1) Unsatisfactory appearance
2) Incomplete weld
3) Molten metal flow
4) Pits
5) Surface crack, lack of penetration
6) Insufficient length
7) Surface defects exceeding 5% of weld seam area

DYE PENETRATION TEST

All surfaces to be examined shall be free from :

a) Relevant linear indications

b) Four or more rounded defects in a line separated by 1/16" or less (edge to edge) except where the specification for the material establishes requirements for acceptance so far as defects are concerned.

C. TYPICAL WELDING PROCEDURE DATA SHEET

Contractor.....Address.....

Quality of weld metal.....Specification.....

Inspection and Test Schedule .....Specification.....

Material Specification.....Thickness.....Batch/Cast No.....

Joint Preparation (Fig.).....Gap.....

Location of Specimens.....

Weather Conditions.....Time of day.....Wind brake used.....

Electrode Group No..... Make.....Specimen.....

Pre and Post Heating.....

Welding positition.....

Size of Reinforcement.....Whether removed.....

Welding Sequence.....

Backing Strip use.....Type.....

Welding Process.....

Current Conditions-Polarity.....

Size of Electrode.....

Amperage and Voltage.....

Number of Electrodes used per run.....

Cleaning method.....

Remarks.....

Engineer-in-Charge Signature

Power-Grid For and on behalf of Contractor

(Inspecting Authority) Date :

D. FABRICATION CHECK LIST : ACCEPTANCE PROFORMA

No. _____

Dt. _____

Project

_____

Work

_____

Sub-Assy

_____

Sl. No.	Characteristic	As per DRG/FCL	Actual	Accept/ Reject	Remarks

NEA Representative Contractor's Representative

_____

ANNEXURE-D

PROFORMA OF UNDERTAKING BY THE PROPOSED AGENCY FOR PILE FOUNDATION

(On Non-Judicial Stamp Paper of appropriate value, wherever applicable)

To,

Marsyangdi Corridor 220 kV Transmission Line Project.
Nepal Electricity Authority
Satungal-Bauthali Chowk Marg, Matatirtha
Kathmandu

Dear Sir,

Whereas Marsyangdi Corridor 220 kV Transmission Line Project, with its Registered Office at Satungal-Bauthali Chowk Marg, Matatirtha, Kathmandu (hereinafter referred to be as the ‘’), having invited bids for _____ (Name of the package & Specification No.)_____, in response to which M/s._____(Name of the Bidder), with its Registered office at _____(Full Address _____) are submitting the bid vide ref_____ date_____(hereinafter called the ‘Bid’).

We,_____(Name of the Agency) with its Registered Office at_____(Full Address_____(hereinafter referred to as the ‘Agency’, which expression shall unless repugnant to the context and meaning therefore include its successor, administrator, executor and permitted assigns)do hereby undertake in the event of award of the Contract to execute the pile foundation work covered under the scope of the Contract, fulfilling all the requirements and construction schedule agreed under the Contract.

Signed on this day of _____201 at_____

(Signature)_____

Authorised signatory on behalf of

M/s_____

(Name)_____

(Designation)_____

Note: Separate undertaking to be provided in case of more than one agency proposed.

SECTION 23

TECHNICAL DATA SHEET

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No.1: 63MVA POWER TRANSFORMER

	DESCRIPTION	UNIT	NEA REQ	DATA to be Filled
				132/66kV, 63MVA
1	**Manufacturer and Country of Origin**			
2	**Year of manufacturing experience**	Years	7	
3	**Manufacturing's Designation as per submitted catalogue**			
4	**Applicable standard**		IEC	
5	**Type**		Outdoor, oil immersed, Core Type	
6	**Winding / Phase**		Two or Three	
7	**Cooling**		ONAN /ONAF1/ONAF2	
8	**Ratings**			
8.1	Rated MVA		63	
8.1.1	ONAN	MVA	51.5	
8.1.2	ONAF	MVA	63	
8.2	Rated Voltage			
8.2.1	Primary	kV	132	
8.2.2	Secondary	kV	66	
8.2.3	Tertiary (If Provided)	kV	11	
8.3	Maximum Voltage			
8.3.1	Primary	kV	145	
8.3.2	Secondary	kV	72.5	
8.3.3	Tertiary (If Provided)	kV	12	
8.4	**Number of Phases**		Three	
8.5	**Rated Frequency**	Hz	50	
9	**Noise Level**			
	On ONAN Rating	dB	<73	
	On ONAF Rating Rated Voltage	dB	<75	
10	**Temperature Rise**			
10.1	Temperature Rise above 45°C ambient			
	- In Oil by Thermometer	°C	50	
	- In Winding By Resistance	°C	55	
10.2	Hottest Spot Temperature in Winding Limited to	°C	55	
10.3	Temperature Indicators Make		KHILSTROM, Sweden or Equivalent.	
11	**Connection**			
11.1	High Voltage		Star	
11.2	Low Voltage		Star	
11.3	Tertiary(if provided)		Delta	
11.3	Vector Group Ref in accordance with IEC 76			
	Vector Group		YNyn0 d11	

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No. 1: 63MVA POWER TRANSFORMER

	DESCRIPTION	UNIT	NEA REQ	DATA to be Filled
				132/11kV, 63MVA
12	**Taps**			
12.1	Type of Tap changer		OLTC	
12.2	Tap Step		1.25%	
12.3	Tap Range		± 10%	
12.4	Nos. of Tap		17	
13	**Cooling Equipment (For ONAF)**			
13.1	Manufacturer/ Type			
13.2	Number of Fans Connected	Nos		
13.3	Rated Operating Voltage, Vac	Vac	230/400, 50Hz	
13.4	Rated Control Voltage, V	Vdc	220	
13.5	Rated Power	KW		
14	**OLTC Gear**			
14.1	Manufacturer / Type	MR, Germany, ABB, Sweden or Equivalent, Vacuum type		
14.2	Rating - Rated Voltage - Rated Current - Step Voltage - Numbers of Steps	 KV A V Nos	 Suitable for 132kV class 16	
14.3	Control Suitable For - Remote / Local Operation - Auto / Manual Operation - Parallel Operation - Master Slave Operation	 Yes/No Yes/No	 Remote / Local Auto / Manual Yes Yes	
14.4	Rated voltage of Drive Motor	Vac	230/400 50Hz	
15	**Guaranteed losses**			
15.1	No Load Losses at Rated Voltage and Frequency on Max. MVA Base.	kW		
15.2	Load Losses at rated Current and and at 75°C on max. MVA base	kW		
15.3	Cooler Losses for full load operation on max. MVA base	kW		
16	**Impedance at Rated Current and Frequency at 75°C Winding Temperatures on ONAF, MVA Base.** (Tolerance ±7.5% of the Declared Value)	%		
16.1	Positive Sequence Impedance at nameplate Normal tap	%	> 11	
16.2	Positive Sequence at Maximum Voltage Tap **(Tap 17)**	%		
16.3	Positive Sequence at Minimum Voltage Tap **(Tap 1)**	%		
16.4	Zero Sequence at Nameplate Tap			

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No. 1: 63MVA POWER TRANSFORMER

	DESCRIPTION	UNIT	NEA REQ	DATA to be Filled
				132/11kV, 63MVA
17	**Reactance** at rated current and Frequency at 75°C on Maximum MVA base at a nameplate tap			
18	**Efficiency at 75°C Winding Temperature at PF=0.9**			
18.1	At 100% Load	%		
18.2	At 75% Load	%		
18.3	At 50% Load	%	Above 99%	
19	**Load in Percentage** of Full Load and Power Factor at which maximum efficiency occurs.			
20	**Regulation at full Load and at 75C**			
20.1	At Unity Power Factor			
20.2	At 0.85 Power Factor Lagging			
21	**No Load Current in Percentage** of rated Current referred to HV and 50Hz.			
21.1	At 90% Rated Voltage	%		
21.2	At 100% Rated Voltage	%	<1	
21.3	At 110% Rated Voltage	%		
22	**Clearances**			
22.1	Minimum Clearances in air-HV/LV	mm		
22.2	Between Phases Between Phase and Earth	mm		
23	**Insulation Level**			
23.1	Power Frequency Withstand Voltage (1Min rms)			
23.1.1	Primary	kV	275	
23.1.2	Secondary	kV	140	
23.1.3	Tertiary (if Provided)	kV		
23.2	**Impulse Withstand Voltage**			
23.2.1	Primary	kV	650 (Crest)	
23.2.2	Secondary	kV	325 (Crest)	
23.2.2	Tertiary (if Provided)	kV		
24	**Details of Oil Preservation System**			
24.1	Type		Conservator Type	
24.2	Details of Oil Preservation System			
24.3	If Conservator Type, Urethane Air Cell provided	Yes/No	Yes	

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No. 1: 63MVA POWER TRANSFORMER

	DESCRIPTION	UNIT	NEA REQ	DATA to be Filled
				132/11kV, 63MVA
24.4	Volume of Conservator	Cu.m		
24.5	Volume of Oil Between the highest and Lowest Levels	Ltrs		
25	**Pressure Relief Device** Min. pressure setting	Kg/cm2		
26	**Details of Bushings HV / LV / Neutral** Manufacturer / Type		RIP	
26.1	Voltage class	KV	145/72.5	
26.2	Creepage Distance	mm	25mm/kV	
26.3	Weight of Bushing	kg		
26.4	Standard Reference		IEC	
26.5	Dry Flash over Voltage	KV	275/140	
26.6	Wet Flash Over Voltage	KV	275/(140)	
26.7	Impulse Withstand Voltage	KV	650/325	
27	**Insulating Oil**			
i	**Manufacturer and Country of Origin**			
ii	**Manufacturer's type designation**			
iii	**Type**		Insulating Oil	
iv	**Applicable standard**			
v	**Technical Specifications**			
v.1	Dielectric Breakdown Strength (Min) at 2.5mm gap	kV	30	
v.2	Flash Point (Min)	°C	135	
v.3	Density at 20ºC (Max)	g/Cu.cm	0.895	
v.4	Viscosity at 40ºC (Max)	mm^2/s	12	
v.5	Viscosity at -30ºC (Max)	mm^2/s	1800	
v.6	Acidity Neutralization Value (Max)	mgKOH/g	0.01	
v.7	Sludge Value (Max)		0.1%	
v.8	Pour Point (Max)	°C	-40 C	
v.9	Corrosive Sulphur		Non-corrosive	
v.10	Water Content (Max)	ppm	40	
v.11	Dielectric Dissipation factor at 90 (Max)		0.005	
v.12	Appearance		clean free from sediment and suspended matter	
vi.	PCB Content		Not Detectable	
vii.	Approx. volume of Oil, ltrs			
Viii	Whether First filled of Oil with 5% excess provided	Yes/No	Yes	

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No. 1: 63MVA POWER TRANSFORMER

	DESCRIPTION	UNIT	NEA REQ	DATA to be Filled
28	**Core Material**			***132/11kV, 63MVA***
28.1	Maximum flux density at rated voltage on principal tapping and rated frequency:			
	Transformer legs	T		
	Transformer yokes	T		
28.2	Maximum flux density at 110% voltage			
	Transformer legs	T	< 1.9	
	Transformer yokes	T	< 1.9	
28.3	Grade of core used	Prime core		
	Type of Core	CRGO		
	Thickness of core lamination			
	Rated Loss per kg			
29.1	Maximum current density in windings at rated output:			
	Primary (HV)	A/mm^2		
	Secondary (LV)	A/mm^2		
	Weight of copper in windings:			
	Primary (HV)			
	Secondary (LV)			
30	**Bushing Current Transformers**			
30.1	Numbers of Cores - HV - LV - Neutral	 Nos Nos Nos	 2 / phase 2 / phase 1	
30.2	Accuracy class / Burden/Ratio - HV / HV Neutral - LV / LV Neutral		 PS / 15VA/300/1 PS / 15VA/600/1	
31	**Lightning Arrestor mounted on** - HV - LV	 Yes/No Yes/No	 No No	
32	**RTCC Panel Details**			
32.1	AVR make / Model	MR, Germany, ABB, Sweden or Equivalent		
32.2	Annunciator 12 Windows provided	Yes/No	Yes	
32.3	Indicating Voltmeter	Yes/No	Yes	
32.4	Facilities and Provision as per specification provided?	Yes/No	Yes	
33	Online Dissolved Gas Analyzer-Detect 8 Gases as per spec	Yes/No	Yes	
34	**Approximate Overall Dimension (L x W x H)**			

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No. 1: 63MVA POWER TRANSFORMER

	DESCRIPTION	UNIT	NEA REQ	DATA to be Filled
35	**Approximate Weights**			
35.1	Core and Coil	Kg		
35.2	Tank and fittings	Kg		
35.3	Oil	Kg		
35.4	Total Weight	Kg		
36	Delivery of Equipment in Months, following the Award of Contract (Allowing the time for Drawing Approval)		Months	
37	Is manufacturer ISO 9001 holder?	Yes/No	Yes	
38	Type test certificate submitted?	Yes/No	Yes	
39	Has manufacturer exported units?	Yes/No	Yes	
40	User's certificate submitted?	Yes/No	Yes	
41	Technical literature / drawings submitted?	Yes/No	Yes	

NOTE: The bidder must submit the user certificate of the manufacturer of Transformer.

Deviations from technical requirements:

Signed…… As representative for……

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No.2: 45MVA POWER TRANSFORMER

	DESCRIPTION	UNIT	NEA REQ	DATA to be Filled
				132/11kV, 45MVA
1	**Manufacturer and Country of Origin**			
2	**Year of manufacturing experience**	Years	7	
3	**Manufacturing's Designation as per submitted catalogue**			
4	**Applicable standard**		IEC	
5	**Type**		Outdoor, oil immersed, Core Type	
6	**Winding / Phase**		Three	
7	**Cooling**		ONAN /ONAF	
8 8.1 8.1.1 8.1.2	**Ratings** Rated MVA ONAN ONAF	 MVA MVA	 45 31.5 45	
8.2 8.2.1 8.2.2 8.2.3	Rated Voltage Primary Secondary Tertiary (If Provided)	 kV kV kV	 132 11	
8.3 8.3.1 8.3.2 8.3.3	Maximum Voltage Primary Secondary Tertiary (If Provided)	 kV kV kV	 145 12	
8.4	**Number of Phases**		Three	
8.5	**Rated Frequency**	Hz	50	
9	**Noise Level** On ONAN Rating On ONAF Rating Rated Voltage	 dB dB	 <73 <75	
10	**Temperature Rise**			
10.1	Temperature Rise above 45°C ambient - In Oil by Thermometer - In Winding By Resistance	 °C °C	 50 55	
10.2	Hottest Spot Temperature in Winding Limited to	°C	55	
10.3	Temperature Indicators Make		KHILSTROM, Sweden or Equivalent.	
11 11.1	**Connection** High Voltage		 Star	
11.2	Low Voltage		Star	
11.3	Tertiary(if provided)		Delta	
11.3	Vector Group Ref in accordance with IEC 76			
	Vector Group		YNyn0 d11	

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No. 2: 45MVA POWER TRANSFORMER

	DESCRIPTION	UNIT	NEA REQ	DATA to be Filled
				132/11kV, 45MVA
12	**Taps**			
12.1	Type of Tap changer		OLTC	
12.2	Tap Step		1.25%	
12.3	Tap Range		± 10%	
12.4	Nos. of Tap		17	
13	**Cooling Equipment (For ONAF)**			
13.1	Manufacturer/ Type			
13.2	Number of Fans Connected	Nos		
13.3	Rated Operating Voltage, Vac	Vac	230/400, 50Hz	
13.4	Rated Control Voltage, V	Vdc	220	
13.5	Rated Power	KW		
14	**OLTC Gear**			
14.1	Manufacturer / Type	MR, Germany, ABB, Sweden or Equivalent, Vacuum Type		
14.2	Rating - Rated Voltage - Rated Current - Step Voltage - Numbers of Steps	 KV A V Nos	 Suitable for 132kV class 16	
14.3	Control Suitable For - Remote / Local Operation - Auto / Manual Operation - Parallel Operation - Master Slave Operation	 Yes/No Yes/No	 Remote / Local Auto / Manual Yes Yes	
14.4	Rated voltage of Drive Motor	Vac	230/400 50Hz	
15	**Guaranteed losses**			
15.1	No Load Losses at Rated Voltage and Frequency on Max. MVA Base.	kW		
15.2	Load Losses at rated Current and and at 75°C on max. MVA base	kW		
15.3	Cooler Losses for full load operation on max. MVA base	kW		
16	**Impedance at Rated Current and Frequency at 75°C Winding Temperatures on ONAF, MVA Base.** (Tolerance ±7.5% of the Declared Value)	%		
16.1	Positive Sequence Impedance at nameplate Normal tap	%	> 11	
16.2	Positive Sequence at Maximum Voltage Tap **(Tap 17)**	%		
16.3	Positive Sequence at Minimum Voltage Tap **(Tap 1)**	%		
16.4	Zero Sequence at Nameplate Tap			

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No. 2: 45MVA POWER TRANSFORMER

	DESCRIPTION	UNIT	NEA REQ	DATA to be Filled
				132/11kV, 45MVA
17	**Reactance** at rated current and Frequency at 75°C on Maximum MVA base at a nameplate tap			
18	**Efficiency at 75°C Winding Temperature at PF=0.9**			
18.1	At 100% Load	%		
18.2	At 75% Load	%		
18.3	At 50% Load	%	Above 99%	
19	**Load in Percentage** of Full Load and Power Factor at which maximum efficiency occurs.			
20	**Regulation at full Load and at 75C**			
20.1	At Unity Power Factor			
20.2	At 0.85 Power Factor Lagging			
21	**No Load Current in Percentage** of rated Current referred to HV and 50Hz.			
21.1	At 90% Rated Voltage	%		
21.2	At 100% Rated Voltage	%	<1	
21.3	At 110% Rated Voltage	%		
22	**Clearances**			
22.1	Minimum Clearances in air-HV/LV	mm		
22.2	Between Phases Between Phase and Earth	mm		
23	**Insulation Level**			
23.1	Power Frequency Withstand Voltage (1Min rms)			
23.1.1	Primary	kV	275	
23.1.2	Secondary	kV	28	
23.1.3	Tertiary (if Provided)	kV		
23.2	**Impulse Withstand Voltage**			
23.2.1	Primary	kV	650 (Crest)	
23.2.2	Secondary	kV	75 (Crest)	
23.2.2	Tertiary (if Provided)	kV		
24	**Details of Oil Preservation System**			
24.1	Type		Conservator Type	
24.2	Details of Oil Preservation System			
24.3	If Conservator Type, Urethane Air Cell provided	Yes/No	Yes	

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No. 2: 45MVA POWER TRANSFORMER

	DESCRIPTION	UNIT	NEA REQ	DATA to be Filled
				132/11kV, 45MVA
24.4	Volume of Conservator	Cu.m		
24.5	Volume of Oil Between the highest and Lowest Levels	Ltrs		
25	**Pressure Relief Device** Min. pressure setting	Kg/cm2		
26 26.1	**Details of Bushings HV / LV / Neutral** Manufacturer / Type		RIP type	
26.2	Voltage class	KV	145/12	
26.2	Creepage Distance	mm	25mm/kV	
26.3	Weight of Bushing	kg		
26.4	Standard Reference		IEC	
26.5	Dry Flash over Voltage	KV	275/28	
26.6	Wet Flash Over Voltage	KV	275/(28	
26.7	Impulse Withstand Voltage	KV	650/75	
27	**Insulating Oil**			
i	**Manufacturer and Country of Origin**			
ii	**Manufacturer's type designation**			
iii	**Type**		Insulating Oil	
iv	**Applicable standard**			
v	**Technical Specifications**			
v.1	Dielectric Breakdown Strength (Min) at 2.5mm gap	kV	30	
v.2	Flash Point (Min)	°C	135	
v.3	Density at 20ºC (Max)	g/Cu.cm	0.895	
v.4	Viscosity at 40ºC (Max)	mm^2/s	12	
v.5	Viscosity at -30ºC (Max)	mm^2/s	1800	
v.6	Acidity Neutralization Value (Max)	mgKOH/g	0.01	
v.7	Sludge Value (Max)		0.1%	
v.8	Pour Point (Max)	°C	-40 C	
v.9	Corrosive Sulphur		Non-corrosive	
v.10	Water Content (Max)	ppm	40	
v.11	Dielectric Dissipation factor at 90 (Max)		0.005	
v.12	Appearance		clean free from sediment and suspended matter	
vi.	PCB Content		Not Detectable	
vii.	Approx. volume of Oil, ltrs			
Viii	Whether First filled of Oil with 5% excess provided	Yes/No	Yes	

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No. 2: 45MVA POWER TRANSFORMER

	DESCRIPTION	UNIT	NEA REQ	DATA to be Filled
28	**Core Material**			***132/11kV, 45MVA***
28.1	Maximum flux density at rated voltage on principal tapping and rated frequency:			
	Transformer legs	T		
	Transformer yokes	T		
28.2	Maximum flux density at 110% voltage			
	Transformer legs	T	< 1.9	
	Transformer yokes	T	< 1.9	
28.3	Grade of core used	Prime core		
	Type of Core	CRGO		
	Thickness of core lamination			
	Rated Loss per kg			
29.1	Maximum current density in windings at rated output:			
	Primary (HV)	A/mm^2		
	Secondary (LV)	A/mm^2		
	Weight of copper in windings:			
	Primary (HV)			
	Secondary (LV)			
30	**Bushing Current Transformers**			
30.1	Numbers of Cores - HV - LV - Neutral	 Nos Nos Nos	 2 / phase 2 / phase 1	
30.2	Accuracy class / Burden/Ratio - HV / HV Neutral - LV / LV Neutral		 PS / 15VA/200/1 PS / 15VA/2400/1	
31	**Lightning Arrestor mounted on** - HV - LV	 Yes/No Yes/No	 No Yes	
32	**RTCC Panel Details**			
32.1	AVR make / Model	MR, Germany, ABB, Sweden or Equivalent		
32.2	Annunciator 12 Windows provided	Yes/No	Yes	
32.3	Indicating Voltmeter	Yes/No	Yes	
32.4	Facilities and Provision as per specification provided?	Yes/No	Yes	
33	Online Dissolved Gas Analyzer-Detect 8 Gases as per spec	Yes/No	Yes	
34	**Approximate Overall Dimension (L x W x H)**			

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No. 2: 45MVA POWER TRANSFORMER

	DESCRIPTION	UNIT	NEA REQ	DATA to be Filled
35	**Approximate Weights**			
35.1	Core and Coil	Kg		
35.2	Tank and fittings	Kg		
35.3	Oil	Kg		
35.4	Total Weight	Kg		
36	Delivery of Equipment in Months, following the Award of Contract (Allowing the time for Drawing Approval)		Months	
37	Is manufacturer ISO 9001 holder?	Yes/No	Yes	
38	Type test certificate submitted?	Yes/No	Yes	
39	Has manufacturer exported units?	Yes/No	Yes	
40	User's certificate submitted?	Yes/No	Yes	
41	Technical literature / drawings submitted?	Yes/No	Yes	

NOTE: The bidder must submit the user certificate of the manufacturer of Transformer.

Deviations from technical requirements:

Signed…… As representative for……

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No.3: 315kVA STATION TRANSFORMER **Sheet 1 of 1**

	DESCRIPTION	UNIT	NEA REQ	DATA to be Filled
1	Manufacturer and Country of Origin			
2	Rated power	kVA	315	
3	Rated voltage		IEC	
4	Voltage rating			
	a) Primary	kV	11	
	b) Secondary	V	400	
5	Max system Voltage			
	a) Primary	kV	12	
	b) Secondary	V	440	
6	Connection -Primary / secondary		Delta /Y	
7	Cooling		ONAN	
8	Vector group		Dyn 11	
9	Rated impedance voltage		5 %	
10	Withstand Voltage -Primary -Secondary	 kV kV	 75 3	
11	BIL of winding (primary)	kV	75	
12	Off circuit tap changer		+/- 5%	
13	Max. noise level	dB	44	
14	No load loss	W		
15	Load loss	W		
16	Applicable standard		IEC	
17	**Approximate Overall Dimension (L x W x H)**			
18	**Approximate Weights**			
18.1	Core and Coil	Kg		
18.2	Tank and fittings	Kg		
18.3	Oil	Kg		
18.4	Total Weight	Kg		
19	Delivery of Equipment in Months, following the Award of Contract (Allowing the time for Drawing Approval)		Months	
20	Is manufacturer ISO 9001 holder?	Yes/No	Yes	
22	Technical literature / drawings submitted?	Yes/No	Yes	

Deviations from technical requirements:

Signed…… As representative for……

Address…… Date ……

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No.4 : 132kV GIS(132kV CIRCUIT BREAKER) **Sheet 1 of 2**

	DESCRIPTION	UNIT	NEA REQ	DATA to be Filled
				132kV
1	**Manufacturer and Country of Origin**			
2	**Year of manufacturing experience**	Years	7	
3	**Manufacturing's Designation as per submitted catalogue**			
4	**Applicable standard**		IEC	
5	**Type**		GIS	
6	**Poles**		Three pole	
8	**Rated Voltage**	kV	132	
9	**Rated current**			
9.1	Continuous at 50 degree ambient	A	1250,1600, 2000 (B/C) As per PSR	
9.2	Short time for 1 sec at max. kV	kA	31.5	
10	**Frequency**	Hz	50	
11	**Temperature rise above 45 degree C ambient**		As per IEC	
11.1	Contacts	°C	65	
11.2	Terminals	°C	65	
12	**Rated short circuit breaking current**	**kA**	**31.5**	
13	**Rated short circuit making current**			
13.1	Peak	kA	80	
14	**Interrupting time at 100% capacity**			
14.1	Maximum opening time	mS		
14.2	Total interrupting time	mS		
15	**Closing time**	mS		
17	**Maximum capacitive current breaking capacity (rms)**	A		
18	**Insulation level**			
18.1	Impulse withstand voltage (crest)	kV	650	
18.2	Power frequency withstand voltage	kV	275	
19	**Operating mechanism**			
19.1	Type		Spring operated	
19.2	Number of mechanism per breaker		1	
19.3	Single/three phase auto-reclosure		3	
19.4	Operating voltage of closing and tripping coil	V DC	220	
19.5	Operaing voltage range -Closing -Tripping	% of rated voltage	 85-110% 70-110%	
19.6	Closing and tripping current	A		
19.7	Spring charging motor rating -Capacity -Rated voltage	 kW V	 220V DC	
19.8	Time required by motor to charge the spring completely	Sec	<30	

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No. 4a : 132kV kV GIS (132kV CIRCUIT BREAKER)

	DESCRIPTION	UNIT	NEA REQ	DATA to be Filled
				132kV
20	Anti pumping device provided	Yes/No	Yes	
21	Trip-free feature provided	Yes/No	Yes	
22	**Number of N.C. contacts**	No.	8	
23	**Number of N.O. contacts**	No.	8	

ITEM No. 4b: 132kV DISCONNECTING SWITCH & EARTH SWITCH

	DESCRIPTION	UNIT	NEA REQ	DATA to be Filled
			132kV	**132kV**
1	**Applicable standard**		IEC	
2	**Type**		3 pole group operated	
4	**Rated Voltage**			
4.1	Nominal	kV	132	
4.2	Maximum	kV	145	
5	**Rated current**			
5.1	Continuous at 50°C ambient	A	1250 /1600/ 2000 as per PSR	
5.2	Short time for 1 sec at max. kV	kA	31.5	
6	**Temperature rise above 45 degree C ambient at normal rated current**		As per IEC	
6.1	Contacts	°C		
6.2	Current carrying parts	°C		
7	**Insulation level**			
7.1	Impulse withstand voltage(peak)	kV	650	
7.2	Power frequency withstand voltage (1min, rms)	kV	275	
13	**Main contacts**			
	- Material of fixed contacts		Provide	
	- Material of moving contacts		Provide	
	- Material of the contacts of the earthing switch		Provide	
19	**Auxiliary power supply**			
19.2	Control circuit	V, DC	220DC	
19.3	Operating motor	V, phase	220DC	
22	**Number of N.C. contacts**	No.	4 min	
23	**Number of N.O. contacts**	No.	4 min	
25	**Operating mechanism**		Motor & Manual Operated	
	Operating motor	W		
26	**Types of interlocks furnished**		Electrical and manual	
27	**Earthing Switch**			
27.1	Operating Mechanism		Manual and Motor Operated	
	Operating motor	W		

27.2	Type of Interlocks		Electrical and manual	
22	**Number of N.C. contacts**	No.	4	
23	**Number of N.O. contacts**	No.	4	
24	**Operating duty cycle**		O - 0.3sec – CO - 3min – CO	

ITEM No. 4c: 132kV CURRENT TRANSFORMER				
	DESCRIPTION	**UNIT**	**NEA REQ**	**DATA to be Filled**
			132kV	**132kV**
1.	**Type**		Indoor, Metal enclosed	
2.	**Number of cores in each CT**	NO.	5 or As per PSR	
3.	**Rated Primary Voltage**			
3.1	Nominal	kV	132	
3.2	Maximum	kV	145	
4.	**Insulation level**			
4.1	Impulse withstand voltage(peak)	kV	650	
4.2.	Power frequency withstand voltage (1min, rms)	kV	275	
5.	**Short time thermal rating**	kA	31.5	
6.	**Rated Peak Short circuit Current**	kA	80	
7.	**Rated VA burden for each core**	VA	As per PSR	
8.	**Accuracy class**	5P20 for protection 0.2 for metering PS for diff / Bus		
9	**Current Ratio**	A	As per Technical Data in specification/DDE	
10.	**Overvoltage factor**		1.1	
11	**Rated continuous thermal current**		1.2x	

ITEM No. 4d: 132kV VOLTAGE TRANSFORMER					
	DESCRIPTION	**UNIT**	**NEA REQ**	**DATA to be Filled**	**DATA to be Filled**
1	1. Applicable standard		IEC		
2	2. Type		Indoor Metal enclosed		
3	3. Rated primary voltage				
	a) Nominal	kV	132/√3		
	b) Maximum voltage	kV	145/√3		
4	4. Insulation level				
	a) Impulse withstand voltage (primary)	kV	650		
	b) Power frequency withstand (1 min. rms) (primary)	kV	275		
5	5. Rating				
	a) Voltage ratio	kV	132/√3: 0.11/√3		
	b) Rated burden	VA	50		
	c) Accuracy class		3P & 0.2 for metering		
	d) Overvoltage factor				
	- Continuous		1.1		

	- 30 seconds		1.5		
	h) Number of secondary windings		*As per psr*		

ITEM No. 4e: 132 kV & 66 kV LIGHTNING ARRESTOR				
	DESCRIPTION	**UNIT**	**NEA REQ**	**DATA to be Filled**
			132kV, 66kV	**132kV**
1	**Type**		Outdoor, gapless, Metal-Oxide	
2	**Voltage rating of L.A**	kV	120, 60	
3	**Nominal discharge current**	kA	10	
4	**Surge counter with insulating base furnished**	Yes/No	Yes	
5	**Insulation level**			
	a)Impulse withstand voltage(peak)	kV	650, 325	
	b)Power frequency withstand voltage (1min, rms)	kV	275, 140	

4f: GAS INSULATED BUS				
1	**Bus arrangement formation**		Horizontal	
2	**Bus Duct Proposed**	1 or 3 Phase		
4g: GENERAL				
1	**Gas density detector provided**	Yes/No	Yes	
2	**Operation counter provided**	Yes/No	Yes	
3	**Space heater provided for cubicle**	Yes/No	Yes	
4	**Enclosure Protection**		IP55W	
5	**Number of possible operations without maintenance under:** Rated short circuit breaking current Rated normal current	 No No	 10 2000	
6	**Rated SF6 pressure**	kgf/cm2		
7	**Guaranteed SF6 losses/year**	kg	0.5% per Annum	
8	**Padlocking provision for local cubicle**	Yes/No	Yes	
9	UHF sensors for PD detection	Yes/No	Yes	
	Numbers of sensors			
10	**Total weight of the circuit breaker**	Kg		
11	**Mechanical dimension(LXWXH)**	mm x mm x mm		
12	**Delivery of equipment in months** following award of contract	(Allowing time for approval of drawing)		
13	Is manufacturer is ISO 9001 holder?	Yes/No	Yes	
14	Type test certificate submitted?	Yes/No	Yes	
15	Has manufacturer exported units?	Yes/No	Yes	
16	Technical literature / drawings submitted?	Yes/No	Yes	

Deviations from technical requirements:

Signed…….. As representative for……
Address……
Date……

TECHNICAL DATA SHEET (To Be Completed By the Tenderer) ITEM No.4: 132 kV & 66 kV LIGHTNING ARRESTOR Sheet 1 of 1					
	DESCRIPTION	**UNIT**	**NEA REQ**	**DATA to be Filled**	**DATA to be Filled**
			132kV, 66 kV	**132kV**	**66 kV**
1	**Manufacturer and Country of Origin**				
2	**Year of manufacturing experience**	Years	5		
3	**Manufacturing's Designation as per submitted catalogue**				
4	**Applicable standard**		IEC		
5	**Type**		Outdoor, gapless, Zinc-Oxide		
6	**Voltage rating of L.A**	kV	120, 60		
7	**Nominal discharge current**	kA	10		
8	**Surge counter with insulating base furnished**	Yes/No	Yes		
9	**Minimum power frequency sparkover voltage**	kV			
10	**Maximum 1/50 impulse sparkover voltage**	kV			
11	**Maximum front wave sparkover voltage**	kV			
12	**Maximum switching surge sparkover voltage**	kV			
13	**Number of section per Pole**		1		
14	**Insulation level**				
	a)Impulse withstand voltage(peak)	kV	650,325		
	b)Power frequency withstand voltage (1min, rms)	kV	275,140		
15	**Porcelain creepage distance**	mm	3300, 1600		
16	**Earth terminal with accessories provided**	Yes/No	Yes		
17	**Delivery of equipment in months** following award of contract (Allowing time for approval of drawing)	month			
18	Is manufacturer is ISO 9001 holder?	Yes/No	Yes		
20	Has manufacturer exported units?	Yes/No	Yes		
21	Technical literature/drawings submitted?	Yes/No	Yes		

Deviations from technical requirements:

Signed…… As representative
for……

Address……
Date……

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No5: 9 kV LIGHTNING ARRESTOR **Sheet 1 of 1**

	DESCRIPTION	UNIT	NEA REQ	DATA to be Filled
			>11 kV	>11 kV
1	**Manufacturer and Country of Origin**			
2	**Year of manufacturing experience**	Years	5	
3	**Manufacturing's Designation as per submitted catalogue**			
4	**Applicable standard**		IEC	
5	**Type**		Outdoor, gapless, Zinc-Oxide	
6	**Voltage rating of L.A**	kV	9	
7	**Nominal discharge current**	kA	10	
8	**Surge counter with insulating base furnished**	Yes/No	Yes	
9	**Minimum power frequency sparkover voltage**	kV		
10	**Maximum 1/50 impulse sparkover voltage**	kV		
11	**Maximum front wave sparkover voltage**	kV		
12	**Maximum switching surge sparkover voltage**	kV		
13	**Number of section per Pole**		1	
14	**Insulation level**			
	a)Impulse withstand voltage(peak)	kV	28	
	b)Power frequency withstand voltage (1min, rms)	kV	75	
15	**Porcelain creepage distance**	mm	....	
16	**Earth terminal with accessories provided**	Yeas/No	Yes	
17	**Delivery of equipment in months** following award of contract (Allowing time for approval of drawing)	month		
18	Is manufacturer is ISO 9001 holder?	Yes/No	Yes	
19	Has manufacturer exported units?	Yes/No	Yes	
20	Technical literature/drawings submitted?	Yes/No	Yes	

Deviations from technical requirements:

Signed…… As representative for……

Address…… Date……

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No. 6: CONTROL AND RELAY PANEL FOR TRANSFORMER
Sheet 1 of 6

	DESCRIPTION	UNIT		DATA to be Filled
1	**CONTROL AND RELAY PANEL TYPE**	**Duplex / Simplex**		
1.1	Manufacturer and Country of Origin			
1.2	Year of manufacturing experience	Years	5	
1.3	Manufacturing's Designation as per submitted catalogue			
5	**INDICATING INSTRUMENTS**			
5.1	**Ammeter**			
i.	Manufacturer and Country of Origin			
ii.	Type		Digital	
iv.	Accuracy class		0.5	
v.	**Scale**			
	-Type of scale			
	-Range of indication (……./1 Amp CT operated)	A	As required	
	-Overload range	%	1.5	
vi.	VA Burden			
vi.	Transducer operated	Yes/No	Yes	
5.2	**Apparent Power Meter (VA)**			
i.	Manufacturer and Country of Origin			
ii	Type		Digital	
iii	Rated voltage	kV	132/√3 : 0.11/√3	
iv	Rated current	A	……./1	
vi	Accuracy class		0.5	
vii	Scale		Centre zero	
	-Range of indication	MVA	As Required	
viii.	VA Burden Current Coil Voltage Coil			
x	Transducer operated	Yes/No	Yes	
5.3	**KWh Meter**			
i.	Manufacturer and Country of Origin			
ii.	Type		Digital, 3-phase, 4 wire	
iii.	Applicable standard	IEC	IEC	
iv.	Accuracy class		0.2	
v.	Import and Export meter provided	Yes/No	Yes	
vi.	Rated voltage	kV	132/√3 : 0.11/√3	
vii.	Rated current	A	……../1	
viii.	Operating current range	A		
ix.	Operating Voltage range	A		

x.	VA Burden Current Coil Voltage Coil	VA		

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No.6: CONTROL AND RELAY PANEL FOR TRANSFORMER
Sheet 2 of 6

	DESCRIPTION	UNIT		DATA to be Filled
xi.	Impulse contact provided	Yes/No	Yes	
xii.	Programmable at Site		Yes	
xiii.	Software and optical probe provided as per Price schedule & BOQ		Yes	
5.4	**Watt meter, MW**			
i.	Manufacturer and Country of Origin			
ii.	Type		Digital	
iii.	Accuracy class		0.5	
iii	Rated voltage	kV	132/√3 : 0.11/√3	
iv	Rated current	A	……/1	
	-Range of indication	MW	0-50-100	
5.6	**Annunciators**			
I	Manufacturer and Country of Origin			
ii.	Type			
iii.	Manufacturer's type designation			
iv.	Catalogue furnished	Yes/No	Yes	
vi.	Number of active points	No.	24	
vii.	Number of rows	No.	4	
viii.	Number of column	No.	6	
ix.	Type of mounting		Flush	
x.	Replacement of individual inscription plates and lamps from front panel possible	Yes/No	Yes	
xi.	Sequence of operation as per specification	Yes/No	Yes	
6	**PROTECTIVE RELAYS**			
6.1	**PHASE OVERCURRENT RELAYS**			
i.	Manufacturer and Country of Origin			
ii.	Type		Numerical Non Directional	
iii.	Manufacturer's type designation			
iv.	Applicable standard	IEC	IEC	
v.	Triple pole or single pole		Triple Pole	
vi.	Current setting range	% of rated current	20-200%	
vii.	Operating time at 10 times current setting	sec	3	
viii.	Reset time	mS		
ix.	Characteristics		IDMT(standard inverse)	
x.	Instantaneous unit provided -Current setting range -Operating range -NO Contacts	Yes/No % of rated current	Yes 500-2000%	

xi.	Insulating test according to IEC	Yes/No		
xii.	Indication -Hand reset flags provided -Light emitting diode provided	 Yes/No Yes/No		
xiii.	Auxiliary DC Supply	V_{dc}	220	
xiv.	Technical literature submitted	Yes/No	Yes	

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No.6: CONTROL AND RELAY PANEL FOR TRANSFORMER
Sheet 3 of 6

	DESCRIPTION	UNIT		DATA to be Filled
6.2	EARTH FAULT RELAYS			
i.	Manufacturer and Country of Origin			
ii.	Type		Numerical, Non-Directional	
iii.	Manufacturer's type designation			
iv.	Applicable standard	IEC	IEC	
v.	Triple pole or single pole		Triple	
vi.	Continuous overload capacity	x In		
vii.	Current setting range	% of rated current	10-80%	
viii.	Operating time at 10 times current setting	sec	3	
ix.	Characteristics		IDMT(standard inverse)	
x.	Instantaneous unit provided -Current setting range -Operating range -NO Contacts, Nos	Yes/No % of rated current mS	Yes 500-2000%	
xi.	Insulating test according to IEC	Yes/No		
xii.	Indication -Hand reset flags provided -Light emitting diode provided	 Yes/No Yes/No		
xiii.	Auxiliary DC Supply	V_{dc}	220	
xvi.	Technical literature submitted	Yes/No	Yes	
6.3	**Directional Overcurrent Relay**			
i.	Manufacturer and Country of Origin			
ii.	Type		Numerical Directional	
iii.	Manufacturer's type designation			
iv.	Applicable standard	IEC	IEC	
v.	Triple pole or single pole		Triple	
vi.	Current setting range	% of rated current	20-200%	
vii.	Operating time at 10 times current setting	sec	3	
viii.	Reset time	mS		
ix.	Characteristics Characteristic Angle		IDMT(standard inverse), 45°	
x.	Instantaneous unit provided -Current setting range -Operating range	Yes/No % of rated current, mS	Yes 500-2000%	
xi.	Insulating test according to IEC	Yes/No		

xii.	Indication -Hand reset flags provided -Light emitting diode provided	 Yes/No Yes/No		
xiii.	Auxiliary DC Supply	Vdc	220	
6.4	**Directional Earth fault Relay**			
i.	Manufacturer and Country of Origin			
ii.	Type		Numerical Directional	
iii.	Manufacturer's type designation			

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No.6: CONTROL AND RELAY PANEL FOR TRANSFORMER
Sheet 4 of 6

	DESCRIPTION	UNIT		DATA to be Filled
iv.	Applicable standard	IEC	IEC	
v.	Triple pole or single pole		Triple	
vi.	Continuous overload capacity	xIn		
vii.	Current setting range	% of rated current	10-80%	
viii.	Operating time at 10 times current setting	sec	3	
ix.	Characteristics Characteristic Angle		IDMT(standard inverse), 45°	
x.	Instantaneous unit provided -Current setting range -Operating range	Yes/No % of rated current mS	Yes 500-2000%	
xi.	Insulating test according to IEC	Yes/No		
xii.	Indication -Hand reset flags provided -Light emitting diode provided	 Yes/No Yes/No		
xiii.	Technical literature submitted	Yes/No	Yes	
6.5	Transformer Differential relay			
i.	Manufacturer / Country of Origin			
ii.	Standard Reference	IEC	IEC	
iii.	Type of Construction			
iv.	Type		Numerical	
v.	Voltage Rating	V	110/220	
vi.	Type of Mounting		Flush	
vii.	Operating Time Setting, Sec	mS	<30	
viii.	Sensitivity Setting		20-50% x In	
ix.	Bias Setting			
x.	CT Ratio Compensating Range			
xi.	Burden for Current Circuit	VA		
xii.	DC Burden	VA		
xiii.	Tripping	A		
xiv.	Making current	A		
xv.	Closing Load (At 220V DC)	A		
6.6	**AUXILIARY TRIPPING & LOCKOUT RELAYS**			
i.	Manufacturer and Country of Origin			

ii.	Type			
iii.	Manufacturer's type designation			
iv.	Applicable standard	IEC	IEC	
v.	Operating time	mS	<15	
vi.	Does the lockout relay reset by the manually operated or electrically operated reset device			
vii.	Is the cut-off contact provided to interrupt the operating coil ?	Yes/No		
viii.	Contact rating at 125V DC	A		
xi.	Technical literature submitted	Yes/No	Yes	

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No.6: CONTROL AND RELAY PANEL FOR TRANSFORMER
Sheet 5 of6

	DESCRIPTION	**UNIT**		**DATA to be Filled**
6.7	**Breaker Fail Lockout Relay, 86K**			
i.	DC Voltage Rating, V	V	220	
ii.	Nos. of Electrically separate NO & NC Contacts			
6.8	**Breaker Failure Lockout Relay, 86BF & LBB Protection**			
i.	DC Voltage Rating, V	V	220	
ii.	Nos of Electrically separate NO & NC Contacts			
v.	Technical literature submitted	Yes/No	Yes	
6.9	**BREAKER FAILURE PROTECTION RELAYS**			
i.	Manufacturer and Country of Origin			
ii.	Manufacturer's type designation			
iii.	Applicable standard	IEC	IEC	
iv.	Triple pole or single pole		Triple Pole	
v.	Current setting range	% of rated current	20-200%	
vi.	Time setting range	sec		
vii.	Reset time	mS		
viii.	Insulating test according to IEC	Yes/No		
ix.	Indication -Hand reset flags provided -Light emitting diode provided	 Yes/No Yes/No		
x.	Auxiliary DC Supply	V_{dc}	220	
xi.	Is manufacturer ISO 9001 holder?	Yes/No	Yes	
xii.	ISO certificate submitted	Yes/No	Yes	
xiii.	Technical literature submitted	Yes/No	Yes	
7	**CONSTRUCTION OF CONTROL & RELAY PANEL**			
i.	Type(Simplex/Duplex)		Duplex	
ii.	Manufacturer's type designation			
iii.	Applicable standard	IEC	IEC	
iv.	Control panels furnished as per specifications	Yes/No	Yes	
v.	Enclosure protection class	IP	IP 4X	
vi.	Thickness of sheet metal used			

	-Front and rear portion -Side, top and bottom covers -Doors	mm mm mm	>=3 >=2 >=3	
vii.	All instruments, meters, relays and control switches flush or semi-flush type		Flush	
viii.	Ground bus -Material -Size	 mm x mm	 Copper 25 X 6	
ix.	Internal Wiring - Type of Insulation - Voltage Grade of Wires - Cross Section of wire Current circuit Voltage & auxiliary Circuit	 V Sq.mm	 600	
x.	Overall dimension of control boards (LxWxH)	mm		

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No.6: CONTROL AND RELAY PANEL FOR TRANSFORMER
Sheet 6 of 6

	DESCRIPTION	UNIT		DATA to be Filled
xi.	Shipping data -Size of large package -Weight of the heaviest package	 mm Kg		
xii.	Delivery of equipment in months following award of contract (Allowing time for approval of drawing)	month		
xiii.	Is manufacturer is ISO 9001 holder?	Yes/No	Yes	
xiv.	ISO 9001 certificate submitted?	Yes/No	Yes	
xv.	Has manufacturer exported units?	Yes/No	Yes	
xvi.	User's certificate submitted?	Yes/No	Yes	
xvii.	Technical literature/drawings submitted?	Yes/No	Yes	

Deviations from technical requirements:

Signed…… As representative
for……

Address……
Date……

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No.7: CONTROL AND RELAY PANEL FOR LINE

	DESCRIPTION	UNIT		DATA to be Filled
1	**CONTROL AND RELAY PANEL TYPE**	**Duplex / Simplex**		
1.1	Manufacturer and Country of Origin			
1.2	Year of manufacturing experience	Years	5	
1.3	Manufacturing's Designation as per submitted catalogue			
2	**CONTROL DISCREPANCY SWITCHES**			
2.1	Manufacturer and Country of Origin			
2.2	Type		Discrepancy	
2.3	Current Rating	A		
3	**PUSH BUTTON**			
3.1	Manufacturer and Country of Origin			
3.2	Type			
3.3	Contact Rating, continuous Making Current Breaking Current	Amp Amp Amp		
4	**INDICATING LAMPS**			
4.1	Manufacturer			
4.2	Voltage Rating	V		
4.3	Wattage	W		
5	**INDICATING INSTRUMENTS**			
5.1	**Ammeter**			
i.	Manufacturer and Country of Origin			
ii.	Type		Digital	
iv.	Accuracy class		0.5	
v.	**Scale**			
	-Range of indication (……/1 Amp CT operated)	A	As Required	
	-Overload range	%	1.5	
vi.	VA Burden			
vi.	Transducer operated	Yes/No	Yes	
5.2	**Apparent Power Meter (VA)**			
i.	Manufacturer and Country of Origin			
ii	Type		Digital	
iii	Rated voltage	kV	132/√3 : 0.11/√3	
iv	Rated current	A	……/1	
vi	Accuracy class		0.5	
vii	Scale		Centre zero	
	-Range of indication	MVA	As Required	
viii.	VA Burden Current Coil Voltage Coil			
x	Transducer operated	Yes/No	Yes	

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No.7: CONTROL AND RELAY PANEL FOR LINE

	DESCRIPTION	UNIT		DATA to be Filled
5.3	**KWh Meter**			
i.	Manufacturer and Country of Origin			
ii.	Type		Digital, 3-phase, 4 wire	
iii.	Applicable standard	IEC	IEC	
iv.	Accuracy class		0.2	
v.	Import and Export meter provided	Yes/No	Yes	
vi.	Rated voltage	kV	132/√3 : 0.11/√3	
vii.	Rated current	A	……../1	
viii.	Operating current range	A	1-10A	
ix.	Operating Voltage range	A	0-480V	
x.	VA Burden Current Coil Voltage Coil	VA		
xi.	Impulse contact provided	Yes/No	Yes	
xii.	Programmable at Site		Yes	
xiii.	Software and optical probe provided as per Price schedule & BOQ		Yes	
5.4	**Power Factor meter, PF**			
i.	Manufacturer and Country of Origin			
ii.	Type		Digital	
iii.	Accuracy class		0.5	
iii	Rated voltage	kV	132/√3 : 0.11/√3	
iv	Rated current	A	……/1	
5.5	**Voltmeter meter, V**			
i.	Manufacturer and Country of Origin			
ii.	Type		Digital	
iii.	Accuracy class		0.5	
iii	Rated voltage	kV	132/√3 : 0.11/√3	
iv.	-Range of indication	V	0-150	
5.6	**Frequency Meter**			
i.	Manufacturer and Country of Origin			
ii.	Type		Digital	
iii.	Accuracy class		0.5	
iii	Rated voltage	kV	132/√3 : 0.11/√3	
5.7	**Annunciators**			
I	Manufacturer and Country of Origin			
ii.	Type			
iii.	Manufacturer's type designation			
iv.	Catalogue furnished	Yes/No	Yes	
vi.	Number of active points	No.	Min 18	

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No.7: CONTROL AND RELAY PANEL FOR LINE

	DESCRIPTION	UNIT		DATA to be Filled
6	**PROTECTIVE RELAYS**			
6.1	**PHASE OVERCURRENT RELAYS**			
i.	Manufacturer and Country of Origin			
ii.	Type		Numerical Differential/ Directional	
iii.	Manufacturer's type designation			
iv.	Applicable standard	IEC	IEC	
v.	Triple pole or single pole		Triple	
vi.	Current setting range	% of rated current	20-200%	
vii.	Characteristics Characteristic Angle		IDMT(standard inverse), 45°	
viii.	Instantaneous unit provided -Current setting range -Operating range	Yes/No % of rated current, mS	Yes 500-2000%	
ix.	Auxiliary DC Supply	Vdc	220	
6.2	**Directional Earth fault Relay**			
i.	Manufacturer and Country of Origin			
ii.	Type		Numerical Directional	
iii.	Manufacturer's type designation			
v.	Triple pole or single pole		Triple	
vi.	Current setting range	% of rated current	10-80%	
vii.	Characteristics Characteristic Angle		IDMT(standard inverse), 45°	
x.	Instantaneous unit provided -Current setting range -Operating range	Yes/No % of rated current mS	Yes 500-2000%	
6.3	**Different /Distance Protection**			
i.	Manufacturer / Country of Origin			
ii.	Standard Reference	IEC	IEC	
iii.	Type of Construction			
iv.	Type		Numerical Non switched	
v.	Voltage Rating	V	110/220	
vi.	Type of Mounting		Flush	
vii.	Stepped Characteristic	mS	<30	
viii.	Number of Zone		3 Fw / 1 Rev	
ix.	Tripping		1 P / 3P	
x.	Weak infeed feature		Yes	
xi.	permissive under reach/ over reach/ blocking communication mode		Yes	
xii.	number of potential free contacts for Carrier aided Tripping, Auto reclosing, CB failure, Disturbance recorder & Data acquisition system		Yes	
xiii.	power swing blocking protection		Yes	

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No.7: CONTROL AND RELAY PANEL FOR LINE

	DESCRIPTION	UNIT		DATA to be Filled
xiv.	Fault Recorder / Disturbance Recorder		Yes	
xv.	Distance Fault Locator		Yes	
xvi	Other features as per specification		Yes	
6.4	**Auto reclosing Relay**			
i.	Manufacturer and Country of Origin			
ii.	Type			
6.5	**Breaker Failure Lockout Relay, 86BF & LBB Protection**			
i.	DC Voltage Rating, V	V	220 V	
ii.	Nos of Electrically separate NO & NC Contacts			
6.6	**AUXILIARY TRIPPING & LOCKOUT RELAYS**			
i.	Manufacturer and Country of Origin			
ii.	Type			
iii.	Manufacturer's type designation			
v.	Operating time	mS	<15	
viii.	Insulating test according to IEC	Yes/No		
ix.	Indication -Hand reset flags provided -Light emitting diode provided	 Yes/No Yes/No		
x.	Auxiliary DC Supply	V_{dc}	220	
xi.	Technical literature submitted	Yes/No	Yes	
7	**CONSTRUCTION OF CONTROL & RELAY PANEL**			
i.	Type(Simplex/Duplex)		Duplex	
ii.	Manufacturer's type designation			
iii.	Applicable standard	IEC	IEC	
iv.	Control panels furnished as per specifications	Yes/No	Yes	
v.	Enclosure protection class	IP	IP 4X	
vi.	Thickness of sheet metal used -Front and rear portion -Side, top and bottom covers -Doors	 mm mm mm	 >=3 >=2 >=3	
viii.	Ground bus -Material -Size	 mm x mm	 Copper 25 X 6	
x.	Overall dimension of control boards (LxWxH)	mm		
xii.	Delivery of equipment in months following award of contract (Allowing time for approval of drawing)	month		
xvii.	Technical literature/drawings submitted?	Yes/No	Yes	

Deviations from technical requirements:

Signed…… As representative
for……
Address……
Date……

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No.8: CONTROL AND RELAY PANEL FOR BUSCOUPLER

	DESCRIPTION	UNIT		DATA to be Filled
1	**CONTROL AND RELAY PANEL TYPE**	**Duplex / Simplex**		
1.1	Manufacturer and Country of Origin			
1.2	Year of manufacturing experience	Years	5	
1.3	Manufacturing's Designation as per submitted catalogue			
2	**CONTROL DISCREPANCY SWITCHES**			
2.1	Manufacturer and Country of Origin			
2.2	Type		Discrepancy	
2.3	Current Rating	A		
2.3	Catalogue furnished	Yes/No	Yes	
3	**PUSH BUTTON**			
3.1	Manufacturer and Country of Origin			
3.2	Type			
3.3	Contact Rating, continuous Making Current Breaking Current	Amp Amp Amp		
4	**INDICATING LAMPS**			
4.1	Manufacturer			
4.2	Voltage Rating	V		
4.3	Wattage	W		
5	**INDICATING INSTRUMENTS**			
5.1	**Ammeter**			
i.	Manufacturer and Country of Origin			
ii.	Type		Digital	
iv.	Accuracy class		0.5	
v.	**Scale**			
	-Type of scale		Center zero	
	-Range of indication (……./1 Amp CT operated)	A	As Required	
	-Overload range	%	1.5	
vi.	Transducer operated	Yes/No	Yes	
5.2	**Annunciators**			
I	Manufacturer and Country of Origin			
ii.	Type			
iii.	Manufacturer's type designation			
iv.	Catalogue furnished	Yes/No	Yes	
vi.	Number of active points	No.	Min 18	

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No.8: CONTROL AND RELAY PANEL FOR BUSCOUPLER

	DESCRIPTION	UNIT		DATA to be Filled
6	**PROTECTIVE RELAYS**			
6.1	**PHASE OVERCURRENT RELAYS**			
i.	Manufacturer and Country of Origin			
ii.	Type		Numerical Non Directional	
iii.	Manufacturer's type designation			
iv.	Applicable standard	IEC	IEC	
v.	Triple pole or single pole		Triple Pole	
vi.	Current setting range	% of rated current	20-200%	
vii.	Characteristics		IDMT(standard inverse)	
viii.	Instantaneous unit provided -Current setting range -Operating range -NO Contacts	Yes/No % of rated current	Yes 500-2000%	
x.	Auxiliary DC Supply	V_{dc}	220	
x.	Technical literature submitted	Yes/No	Yes	
6.2	**EARTH FAULT RELAYS**			
i.	Manufacturer and Country of Origin			
ii.	Type		Numerical, Non-Directional	
iii.	Manufacturer's type designation			
iv.	Applicable standard	IEC	IEC	
vi.	Continuous overload capacity	x In		
vii.	Current setting range	% of rated current	10-80%	
ix.	Characteristics		IDMT(standard inverse)	
x.	Instantaneous unit provided -Current setting range -Operating range -NO Contacts, Nos	Yes/No % of rated current mS	Yes 500-2000%	
xi.	Auxiliary DC Supply	V_{dc}	220	
xii.	Technical literature submitted	Yes/No	Yes	
6.3	**AUXILIARY TRIPPING & LOCKOUT RELAYS**			
i.	Manufacturer and Country of Origin			
ii.	Type			
iii.	Manufacturer's type designation			
iv.	Applicable standard	IEC	IEC	
v.	Operating time	mS	<15	

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No.8: CONTROL AND RELAY PANEL FOR BUSCOUPLER

	DESCRIPTION	UNIT		DATA to be Filled
6.4	**BREAKER FAILURE PROTECTION RELAYS**			
i.	Manufacturer and Country of Origin			
ii.	Manufacturer's type designation			
iii.	Applicable standard	IEC	IEC	
iv.	Triple pole or single pole		Triple Pole	
v.	Current setting range	% of rated current	20-200%	
7	**CONSTRUCTION OF CONTROL & RELAY PANEL**			
i.	Type(Simplex/Duplex)		Duplex	
ii.	Manufacturer's type designation			
iii.	Applicable standard	IEC	IEC	
iv.	Control panels furnished as per specifications	Yes/No	Yes	
v.	Enclosure protection class	IP	IP 4X	
vi.	Thickness of sheet metal used -Front and rear portion -Side, top and bottom covers -Doors	 mm mm mm	 >=3 >=2 >=3	
vii.	All instruments, meters, relays and control switches flush or semi-flush type		Flush	
viii.	Ground bus -Material -Size	 mm x mm	 Copper 25 X 6	
x.	Overall dimension of control boards (LxWxH)	mm		
xii.	Delivery of equipment in months following award of contract (Allowing time for approval of drawing)	month		
xiii.	Technical literature/drawings submitted?	Yes/No	Yes	

Deviations from technical requirements:

Signed…… As representative
for……

Address……
Date……

This schedule contains GTP for all the possible parameters of SCADA Equipments BCU generally have. Instead of simply confirming, the Bidder shall fill in the particulars against appropriate items in respect of each rating and type of equipment offered in the broad categories listed below along with supporting authentic technical documents.

(In the absence of GTP in the below mentioned format, the purchaser has every right to evaluate the product accordingly and bidder cannot raise any objection against any point of the technical scrutiny.)

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)
ITEM No.9: SUBSTATION AUTOMATION SYSTEM
Sheet 1 of 6

Sr. No.	Parameters	To be filled by bidder
A	**BCU**	
1	Make and Type	
2	Numerical Technology	
3	Modular design	
4	Nos of Analogue Input	
5	Nos of Digital Input	
6	Nos of Output	
7	Data Storage	
8	Self- monitoring	
9	Power supply	
10	IEC 61850 Protocol Compatibility	
11	Binary Input processing & Nos	
12	Analogue Input processing & Nos	
13	Measured value acquisition	
14	Derived values	
15	Digital Outputs	
16	Sub-station/bay inter-locking	
17	Trip Circuit Supervision	
18	Event Logging Nos	
19	Disturbance files & record of wave forms , storage capacity	
20	Gateway support	
21	Local control, Operation and Display	
22	Contact bouncing in digital inputs shall not be assumed as change of state	
23	I/O processing capacities	

TECHNICAL DATA SHEET (To Be Completed By the Tenderer) ITEM No.9: SUBSTATION AUTOMATION SYSTEM		Sheet 2 of 6
24	Internal Ethernet switches	
	Nos of port –	
26	Environmental conditions	
27	Mounting & design	
28	Warranty	
	Bay control functions	
	Control mode selection	
	Command supervision	
	Commands for	
32	Local communication facility through HMI	
	Local communication facility provided on front side for	
34	Compatibility with owner's SCADA for remote control	
35	Extension possibilities with additional I/O's inside the unit or via fiber-optic communication and process bus.	
B	Gateway	
1	Power supply	
2	Processor Type	
3	Chipset	
4	Memory Type	
5	Standard memory	
6	Memory slots	
	Internal hard disk drive	
	Hard disk drive speed	
	Optical drives	
	Video adapter, bus	
	Expansion slots	
	Network Interface	
	External I/O ports	
	Operating system installed.	
	Make	
	Antivirus s/w	

	TECHNICAL DATA SHEET **(To Be Completed By the Tenderer)** **ITEM No.9: SUBSTATION AUTOMATION SYSTEM** **Sheet 3 of 6**	
D	**HMI SERVER**	
1	Power supply	
2	Processor Type	
3	Chipset	
4	Memory Type	
5	Standard memory	
6	Memory slots	
7	Memory upgrade	
8	Internal hard disk drive	
9	Hard disk drive speed	
10	Optical drives	
11	Flexible disk drives	
12	Chassis type	
13	Video adapter, bus	
14	Expansion slots	
15	Audio	
16	Modem	
17	Network Interface	
18	External I/O ports	
19	Monitor	
20	Keyboard	
21	Pointing Device	
22	Operating system installed.	
23	Other	
24	Warranty	
25	UPS	
26	Make	
27	Antivirus s/w	

	TECHNICAL DATA SHEET **(To Be Completed By the Tenderer)** **ITEM No.9: SUBSTATION AUTOMATION SYSTEM** **Sheet 4 of 6**	
E	**DR WORK STATION**	
1	Power supply	
2	Processor Type	
3	Chipset	
4	Memory Type	
5	Standard memory	
6	Memory slots	
7	Memory upgrade	
8	Internal hard disk drive	
9	Hard disk drive speed	
10	Optical drives	
11	Flexible disk drives	
12	Chassis type	
13	Video adapter, bus	
14	Expansion slots	
15	Audio	
16	Modem	
17	Network Interface	
18	External I/O ports	
19	Monitor	
20	Keyboard	
21	Pointing Device	
22	Operating system installed.	
23	Other	
24	Warranty	
25	UPS	
26	Make	
27	Antivirus s/w	

	TECHNICAL DATA SHEET **(To Be Completed By the Tenderer)** **ITEM No.9: SUBSTATION AUTOMATION SYSTEM**	**Sheet 5 of 6**
F	**LINE INTERFACE UNIT**	
1	Area Network Type	
2	Power Supply	
3	Protocol/ Network	
4	Module	
5	No. of Ports	
6	Ports/Interfaces	
7	Features	
8	Make	
9	Manufacturer Warranty	
10	Suitability for Nos of F.O. Inlet/Outlet	
11	IEC 61850 Compatibility	
G	**COLOUR LASER JET PRINTER**	
1	Model	
2	Power Supply	
3	Black Print Speed	
4	Black Print Resolution	
5	Print Memory	
5	Processor	
6	Supported paper sizes	
7	Print technology	
8	Pages quantity	
9	Paper handling	
10	Connectivity	
11	Manufacturer Warranty	
12	Networking:	
13	Supporting OS	
14	Make	
15	Suitability to print all types of drafts and graphics	

	TECHNICAL DATA SHEET **(To Be Completed By the Tenderer)** **ITEM No.9: SUBSTATION AUTOMATION SYSTEM**	**Sheet 6 of 6**
H	**LASER JET PRINTER**	
1	Model	
2	Power Supply	
3	Black Print Speed	
4	Black Print Resolution	
5	Print Memory	
6	Processor	
7	Supported paper sizes	
8	Print technology	
9	Pages quantity	
10	Paper handling	
11	Connectivity	
12	Manufacturer Warranty	
13	Networking:	
14	Supporting OS	
15	Make	
16	Suitability to print all types of drafts and graphics	

Deviations from technical requirements and reasons for such deviations:

Signed……. As representative
for……

Address…….
Date……

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

TEM No.10: 11kV XLPE POWER CABLES

	DESCRIPTION	UNIT	NEA REQ	DATA to be Filled
1	**Manufacturer and Country of Origin**			
2	**Manufacturer's type designation**			
3	**Type**		Armoured	
4	**Applicable standard**		IEC	
5	**Voltage rating** a) Suitable for max. system voltage b) voltage grade of this cable	 kV kV	 12 6/10(12)	
	c) Rated voltage between each conductor and screen	kV	11/√ 3	
	d) Rated voltage between two conductors	kV	11	
6	**Conductor material**	Copper / Al		
7	**Insulating material**		Polyethylene	
	Thickness			
8	**Overall jacket material**		PVC	
	Thickness			
9	**Overall Cross sectional Area of the cable, Copper**	Sq.mm		
	Copper	Sq.mm		
	Aluminum for Outgoing	Sq.mm		
10	**Type of Cable**	Copper	Single Core	
		Aluminum	Three core	
11	**Continuous Current Rating at 45DegC Ambient Temperature in Duct**	A		
	3Rx1CxCopper 800 sq.mm	A		
	Aluminium 400 sq.mm	A		
	Aluminium 185 Sq.mm	A		
12	**Short Circuit Current rating**	kA	> 20	
13	**Fire Retardive**	Yes	Yes	
14	**Mositure Resistant**	Yes	Yes	
15	**Technical Leaflets provided**	Yes / No	Yes	
16	**Delivery of equipment in months** following award of contract (Allowing time for approval of drawing)	month		

Deviations from technical requirements:

Signed…… As representative for……

Address…… Date……

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

ITEM No.11: 132 kV XLPE POWER CABLES

Sl. No	**Name of the Particulars**	**Desired Value**	
		300 sq mm for 132 kV	
1	No. of cores	1(Single)	
2	Size (in mm2)	300 sq mm for 132 kV	
3	Voltage Grade(in kV)	76/132(145) kV	
4	Type of cable		
5	Standard according to which cable has been manufactured and tested	IEC- 62067, Testing as per IEC- 60840.	
6	Permissible Voltage & Frequency variation for satisfactory operation.		
	Voltage	± 10%	
	Frequency	± 5%	
7	Maximum rated conductor temperature	90^0C	
8	Max. allowable conductor temperature during short circuit	250^0C	
9	Conductor Details		
	(a) Normal Cross-Sectional Area	300 mm^2	
	(b) Material and Grade	Copper as per Specs	
	(c) Shape of Conductor	Compacted stranded circular	
10	**Conductor Screen**		
	(a)Material	Extruded Semi-Conducting XLPE	
	(b)Nominal Thickness	1.5mm(Approx.)	
11	**Insulation**		
	(a) Material	Cross linked Polyethyle	
	(b) Nominal Thickness	18.0 mm	
12	**Insulation Screen**		
	(a) Material	Extruded Semi-Conducting XLPE (SC) layer followed by water swellable SC tapes	
	(b) Min. Thickness	1.0 mm followed by water swellable SC	
	(c) Longitudinal Water Sealing	Semiconducting water blocking tape(s) with 50% over lap	
13	**Metallic Sheath**		
	(a) Material	Seam Welded/ Corrugated Aluminum sheath with anti corrosion protection	
	(b) Thickness	3.0 mm	
	(c) Short Circuit current of metallic screen for 1 sec (kA)	>31.5	
14	**Outer Sheath**		
	(a) Material	Extruded HDPE	
	(b) Colour	Black	
	(c) Thickness (Nom/Min)	4.0 mm	

	(d) Conducting layer over outer sheath	Graphite Coating	
15	Standard Drum Length with Tolerance	500m±5%	
16	Minimum Bending Radius allowable during installation	20 x OD	
17	Safe Pulling force	5kg/mm^2 of CU	
20	(a) Impulse Withstand	650kVp	
21	(b) One minute Power Frequency Withstand Voltage (kV)	190kV for 30 sec	
22	Short circuit current for one second(kA)	143	
	Max conductor DC resistance at 20^{0}C		
	Approx. AC resistance at 90^{0}C		
	Max. capacitance		
23	Continuous Current Rating for cable laid in close trefoil formation	**BEB/ SPB**	
	(i) In ground at 30^{0}C ground temp, Depth of laying 1.5 m, Thermal Resistivity of soil 150°C Cm/W		
	(ii) In free air at 40^0 C Ambient Air Temperature		
	BEB: Sheath both end bonded **SPB:** Sheath single point/ Cross bonded		
	1. The following details shall be embossed/ Printed on outer sheath at regular interval not exceeding one metre. (a) Manufacturer"s Name or Trade name (b) Year of Manufacture (c) Voltage grade of Cable i.e. (d) Cable Code i.e. (e) Number of cores & cable size e.g. 1000 Sqmm (Cu) 1 core		

Deviations from technical requirements:

Signed…… As representative for……

Address…… Date……

TECHNICAL DATA SHEET
(To Be Completed By the Tenderer)

Item No 12: 132kV GIS Cable Sealing End

Item	Description	Unit	Requirement	Manufacturer's Particulars Data to
1	Manufacturer name and address			
2	Voltage rating	kV	132	
3	Current rating	amp	As per cable	
4	Type		Elastomeric stress	
5	Insulator material		Epoxy bushing	
6	Pollution severity levels		Heavy	
7	Pitch circle diameter	mm		
8	Overall length of insulator	mm		
9	Weight of bushing including sealing compound	kg		
10	Total creepage distance of shedding	mm	450mm (approx)	
11	Impulse withstand voltage (External)			
12	(a) Positive	kV	650	
	(b) negative	kV	650	
	Standards		IEC 60840	

Item no 13: 132kV Outdoor Cable Sealing End

Item	Description	Unit	Requirement	Manufacturer's Particulars / Data
1	Manufacturer name and address			
2	Voltage rating	kV	132	
3	Current rating	amp	As per cable	
4	Type		Porcelain/polymeric insulator.	
5	Insulator material		Porcelain/Polymeric bushing	
6	Pollution severity levels		Heavy	
7	Pitch circle diameter	mm		
8	Overall length of insulator	mm		
9	Weight of bushing including sealing compound	kg		
10	Total creepage distance of outdoor sealing End	mm	4500mm	
11	Total creepage distance of shedding	mm	450mm (approx)	
12	Impulse withstand voltage (External)			
	(a) Positive	kV	650	
	(b) negative	kV	650	
	Standards		IEC 60840	
13	Height of steel mounting structure over the finished switchyard level	mm	2000 (min.)	

Deviations from technical requirements:

Signed……. As representative for……

Address……. Date……