

Annexure - II

A PGCIL Specifications

1 Technical Specification, Section Project

Charikar & Doshi Substation Package

C/ENGG/SPEC/PROJECT

Clause

	1 General
	2 Scope
	3 Physical & other parameters
	4 Schedule of quantities
	5 Basic reference drawings
	6 Order of precedence of different sections of technical specification
	9 Construction & power
	10 Specific requirement
Annexure - I	Geotechnical Investigation
Annexure - VI	Building - General requirements
Annexure - VII	Specification for roads & culverts
Annexure - X	Precautions for concreting under cold weather.

Technical Specification for Civil Works

C/ENGG/SPEC/CIVIL Rev No:05

B PGCIL Drawings

1 C/Engg/DOSHI/LAY/01	Layout & Section of 220kV DOSHI Substation
2 PG/Afghan/IM	Topographical and contour details
3 C/Engg/CHARIKAR/LAY/01	Layout & Section of 220kV CHARIKAR Substation
4	Contour plan of Charikar S/S
5 C/ENGG/CVL/SYD/FENCE-01	Chainlink Fencing
6 C/ENGG/CVL/SYD/GATE-02	Switchyard Gate
7 C/ENGG/STD/CT-01 to 04	Details of cable trench section, sump pit & cable trench crossing.
8 C/ENGG/STD/DRAIN - 01	Details of drain section.
9 C/ENGG/STD/ROAD CULVERTS - 01	Detail of road culverts
10 C/ENGG/STD/ROAD - 411	Details of concrete road (Rigid Pavement) in switchyard area.
11 C/ENGG/AFGH/BW-01	Boundary wall details
12 C/ENGG/AFGH/BW-02	Guard house architectural plan, elevation & section
13 C/ENGG/AFGH/BW-03	Guard house RC details of footing column & plinth beam
14 C/ENGG/AFGH/BW-04	Guard house RC details of roof
15 C/ENGG/AFGH/BW-05	Details of Gate

1.0 GENERAL

1.1 Preamble:

- 1.1.1 The Ministry of Energy and Water (MEW), Islamic Republic of Afghanistan had approached the Govt. of India for its assistance in the construction of 220kV D/C line between Pul-E-Khumari to Kabul in Afghanistan. The transmission system from Pul-E-Khumari to Chimtala S/S(Kabul) which is under construction with help of grant from Govt. of India, is passing through province of Doshi and Charikar. MEW, Govt. of Afghanistan has represented to Govt. of India regarding construction of Doshi and charikar S/S. This involves construction of two new 220/20kV substations at Doshi and charikar.

1.1.2 Associated Transmission system

The following transmission system is envisaged

- (a) LILO of first circuit of 220kV D/C line of Pul-E-Khumari-Chimtala at Doshi substation (64 KM from Pul-E-Khumari substation)
- (b) LILLO of second circuit of 220kV D/C line of Pul-E-Khumari-Chimtala at Charikar substation (62 KM from Chimtala substation)

2.0 SCOPE

- 2.1 The scope of this specification covers the following;

- i) **Construction of new 220/20 kV Substation at Doshi with the provision of following bays:**
 - (a) 220kV bay for termination of LILLO of first circuit of Pul-E-Khumari-Chimtala 220kV D/C line
 - (b) 220kV bay for 1no, 220/20kV, 4 MVA Power transformer.
 - (c) 20kV Indoor switchgears for 4 nos. line feeders & 1 no. for 100KVA, 20/0.433kV LT Transformer & 1 no. for Bus Section
- ii) **Construction of new 220/20 kV Substation at Charikar with the provision of following bays:**
 - (a) 220kV bays for termination of LILLO of second circuit of Pul-E-Khumari-Chimtala 220kV D/C line
 - (b) 220kV bays for 2 nos, 220/20kV, 16 MVA Power transformers.
 - (c) 20kV Indoor switchgears for 6 nos. line feeders & 2 nos. for 100KVA, 20/0.433kV LT Transformer & 1 no. for Bus Section.

2.2 The detailed scope of work is brought out in subsequent clauses of this section.

2.3. 220/20 kV Doshi Substation (New)

2.3.1. Design, engineering, manufacture, testing, supply on FOR destination site basis, including transportation & insurance, storage, erection, testing and commissioning of the following equipments/items, complete in all respects

- (a) 1x4MVA, 220/20kV Power transformer
- (b) 220kV circuit breakers including support structures, isolators, current transformers, capacitor voltage transformers and surge arresters.
- (c) 100 KVA, 20/0.433 kV auxiliary transformer along with associated equipments
- (d) Complete Control, Relay and protection system
- (e) Digital protection couplers shall be provided for Doshi end of Doshi-Pul-E-Khumari 220kV S/C line and Doshi-Chimtala 220kV S/C.
- (f) i) Fire protection system and portable fire extinguishers for control room building
ii) Trolley / wheel mounted fire extinguisher for Transformers as per BPS
- (g) Ventilation System & Heating System
- (h) LT switchgear (AC/DC Distribution boards) .
- (i) 100kVA DG Set (The DG set shall be supplied with suitable arrangement to facilitate auto start in all weather conditions & to avoid freezing of fuel).
- (j) Batteries & Battery Chargers.
[Battery shall be of Ni-Cd type suitable for low temperature application at site conditions]
- (k) 1.1 kV grade Power & Control cables along with complete accessories [cables offered shall be suitable for low temperature conditions of site] for substation & township.
- (l) 20kV, 3X1C-150Sqmm(Minimum) Al conductor XLPE, Cable from 4MVA, 220/20kV transformer to 20kV Indoor Switchgear and 20kV, 3X1Cx150 Sqmm (Minimum) Al conductor XLPE cable from 20kV Indoor switchgear to 100KVA, 20/0.433kV LT Transformer and 20kV 3X1Cx300 Sq.mm. Cu. conductor XLPE cable from 20kV Indoor switchgear to 20kV line take off gantries along with necessary cable terminations , accessories etc.

[Cable shall have compacted circular copper / Aluminum conductor, Conductor screened with extruded semi conducting compound, XLPE insulated (dry cured), insulation screened with extruded semi conducting compound, armoured with non-magnetic material, followed by extruded PVC/PE/Rubber outer sheath (Type ST-2, with FR properties) conforming to IS 7098 Part-2. In addition to above cables offered shall be suitable for low temperature conditions of site].

Sizes of cables indicated above are minimum. Contractor shall submit detailed calculation for sizing of power cables keeping in view continuous current, voltage drop & short-circuit consideration of the system. Relevant calculations shall be submitted by contractor during detailed engineering for Employer's approval.

- (m) (i) Lattice structures for Towers and beams and 20kV equipment structure
- (ii) Pipe structures for 220kV equipment supports
- (n) Bus Post Insulators, insulator strings and hardware, clamps & connectors, Aluminum tubes, Bus bar and earthing materials, Bay marshalling box, spacers, cable supporting angles/channels, Cable trays & covers, Junction box, buried cable trenches etc
- (o) Complete lighting and illumination of the switchyard including road in switchyard area, Control Room cum Administrative building
- (p) OPGW cable and its fitting as per Annexure-XI
- (q) 20kV, 3 phase, 50 Hz. draw out type, indoor, metal clad, free floor standing, extendable type panels with Vacuum/SF6 circuit breakers, current transformers, protective relaying, meters, indicating lamps etc.
- (r) Mandatory Spares.
- (s) Any other equipment/material required to complete the specified scope.

2.3.2 Civil works - The work shall include but not limited to the following:

- i) **Design, Engineering and civil works for**
 - (a) Soil investigation as per Annexure-I
 - (b) Foundation of Transformers alongwith jacking pad, foundation bolts & rail track.
 - (c) Foundation for Lattice & pipe structures and equipments including DG set

- (d) Foundation for lighting poles, Bay marshalling box, panels and control cubicles of equipments wherever required.
- (e) Anti-weed treatment, PCC and Stone spreading of substation area.
- (f) Permanent water supply for control room building.
- (g) Buildings for store(50 Sq.m) with roof steel truss and 0.9mm thick C.G.I. sheet roofing
- (h) Foundation of 100 kVA Auxiliary LT transformer.
- (i) Control room building cum Administrative building and switch gear hall with RCC sloping roof.
- (j) Alignment of approach road from highway to sites.
- (k) Bore well and distribution network for water supply

ii) **Civil works based on POWERGRID drawings :**

- (a) Cable trenches along with covers and sump pits (As per POWERGRID drawings)
- (b) Cable trench crossings with roads, rail tracks, culverts etc(As per POWERGRID drawings).
- (c) All roads including approach road from nearest existing road (As per POWERGRID drawings)
- (d) Substation site levelling (As per enclosed spot level and leveling drawing)
- (e) Complete Drainage system in the substation area (Section details as per POWERGRID drawing)
- (f) Substation boundary wall, fencing, gates and security room (As per POWERGRID drawing)

2.4 220/20 kV Charikar Substation (New)

- 2.4.1. Design, engineering, manufacture, testing, supply on FOR destination site basis, including transportation & insurance, storage; erection, testing and commissioning of the following equipments/items, complete in all respects
- (a) 2x16MVA, 220/20kV Power transformer
 - (b) 220kV circuit breakers including support structures, isolators, current transformers, capacitor voltage transformers and surge arresters

- (c) 2X100 KVA, 20/0.433 kV auxiliary transformer along with associated equipments
- (d) Complete Control, Relay and protection system
- (e) Digital protection couplers shall be provided for Charikar end of Charikar-Pul-E-Khumari 220kV S/C line and Charikar-Chimtala 220kV S/C
- (f) i) Fire protection system and portable fire extinguishers for control room building
ii) Trolley / wheel mounted fire extinguisher for Transformers as per BPS
- (g) Ventilation System & Heating System
- (h) LT switchgear (AC/DC Distribution boards)
- (i) 100kVA DG Set (The DG set shall be supplied with suitable arrangement to facilitate auto start in all weather conditions & to avoid freezing of fuel).
- (j) Batteries & Battery Chargers.
[Battery shall be of Ni-Cd type suitable for low temperature application at site conditions]
- (k) 11 kV grade Power & Control cables along with complete accessories [cables offered shall be suitable for low temperature conditions of site; for substation & township
- (l) 20kV, 3X1C-630Sqmm(Minimum) Cu conductor XLPE, Cable from 4MVA, 220/20kV transformer to 20kV Indoor Switchgear and 20kV, 3X1Cx150 Sqmm (Minimum) Al conductor XLPE cable from 20kV Indoor switchgear to 100KVA, 20/0.433kV LT Transformer and 20kV 3X1Cx300 Sq.mm. Cu. conductor XLPE cable from 20kV Indoor switchgear to 20kV line take off gantries along with necessary cable terminations, accessories etc.

[Cable shall have compacted circular copper / Aluminum conductor, Conductor screened with extruded semi conducting compound, XLPE insulated (dry cured), insulation screened with extruded semi conducting compound, armoured with non-magnetic material, followed by extruded PVC/PE/Rubber outer sheath (Type SF-2, with FR properties) conforming to IS 7098 Part-2. In addition to above cables offered shall be suitable for low temperature conditions of site]

Sizes of cables indicated above are minimum. Contractor shall submit detailed calculation for sizing of power cables keeping in view

continuous current, voltage drop & short-circuit consideration of the system. Relevant calculations shall be submitted by contractor during detailed engineering for Employer's approval.

- (m) (i) Lattice structures for Towers and beams and 20kV equipment structure
- (ii) Pipe structures for 220kV equipment supports
- (n) Bus Post Insulators, insulator strings and hardware, clamps & connectors, Aluminum tubes, Bus bar and earthing materials, Bay marshalling box, spacers, cable supporting angles/channels, Cable trays & covers, Junction box, buried cable trenches etc
- (o) Complete lighting and illumination of the switchyard including road in switchyard area and Control Room cum Administrative building.
- (p) OPGW cable and its fittings as per Annexure-XI
- (q) 20kV, 3 phase, 50 Hz, draw out type, indoor, metal clad, free floor standing, extendable type panels with Vacuum/SF6 circuit breakers, current transformers, protective relaying, meters, indicating lamps etc
- (r) Mandatory Spares.
- (s) Any other equipment/material required to complete the specified scope.

2.4.2 Civil works - The work shall include but not limited to the following: -

- i) Design, Engineering and civil works for**
 - (a) Soil investigation as per Annexure-I
 - (b) Foundation of Transformers alongwith jacking pad, foundation bolts, rail track and fire resistance wall between transformers
 - (c) Foundation for Lattice & pipe structures and equipments including DG set
 - (d) Foundation for lighting poles, Bay marshalling box, panels and control cubicles of equipments wherever required.
 - (e) Anti-weed treatment, PCC and Stone spreading of substation area.
 - (f) Permanent water supply for control room building.
 - (g) Buildings for store (50 Sq mt.) with roof steel truss and 0.9 mm thick C.G.I. sheet roofing.

- (h) Foundation of 100 kVA Auxiliary LT transformers.
- (i) Control room building cum Administrative building and switch gear hall with RCC sloping roof
- (j) Alignment of approach road from highway to sites.
- (k) Bore well and distribution network for water supply
- ii) **Civil works based on POWERGRID drawings:**
 - (a) Cable trenches along with covers and sump pits (As per POWERGRID drawings)
 - (b) Cable trench crossings with roads, rail tracks, culverts etc(As per POWERGRID drawings).
 - (c) All roads including approach road from nearest existing road (As per POWERGRID drawings)
 - (d) Substation site levelling (As per enclosed spot level and leveling drawing)
 - (e) Complete Drainage system in the substation area (Section details as per POWERGRID drawing)
 - (f) Substation boundary wall, fencing, gates and security room (As per POWERGRID drawing)

- 2.5 Before proceeding with the construction work of the substations, the Contractor shall survey the route of transportation and substation site and fully familiarize himself with the route of transportation, culverts, roads & rail bridges, loading & unloading facilities, site conditions and General arrangements & scheme etc. Though the Employer shall endeavor to provide the information, it shall not be binding for the Employer to provide the same. Any strengthening / modification required in the existing culverts, road, bridges, etc, for transportation shall be carried out by the Contractor without any additional cost implication to the Employer. The bidders are advised to visit the substation sites and acquaint themselves with the topography, infrastructure and also the design philosophy. The bidder shall be fully responsible for providing all equipment, materials, system and services specified or otherwise which are required to complete the construction and successful commissioning, operation & maintenance of the substations in all respects. All materials required for the Civil and construction/installation work shall be supplied by the Contractor. The cement and steel shall also be supplied by the Contractor.

The complete design (unless specified otherwise in specification elsewhere) and detailed engineering shall be done by the Contractor based on conceptual tender drawings.

- 2.6 The Contractor shall also be responsible for the overall co-ordination with internal/external agencies, project management, training of Employer's manpower, loading, unloading, handling, moving to final destination for successful erection, testing and commissioning of the substation/switchyard.
- 2.7 In 220/20kV Doshi (new) and 220/20kV Charikar(new) substations, the minimum bay width for 220kV shall be 18metres (minimum) and the minimum equipment interconnections shall be at 5.9mtrs from the plinth level for 220kV subject to maintaining required statutory clearances after applying an altitude correction factor of 1.1 for Charikar and 1.01 for Doshi. The short circuit forces, spacer span based on the phase to phase spacing and conductor span/configuration indicated in the layout drawings enclosed with this specification shall be calculated by the contractor and the short circuit values, spacer span indicated in Section-Switchyard Erection technical specifications shall not be applicable for the substations. The short circuit forces values applicable for equipment support structures shall also be calculated by the contractor. Design of substation and its associated electrical & mechanical auxiliaries systems includes preparation of single line diagrams and electrical layouts, erection key diagrams, electrical and physical clearance diagrams, design calculations for Earth mat, Direct Stroke Lighting Protection (DSLPP) Bus Bar & Spacers, control and protection schematics, wiring and termination schedules, civil designs (as applicable) and drawings, design of control room, store & FFPH illumination and other relevant drawings & documents required for engineering of all facilities at Doshi and Charikar substations to be provided under this contract, are covered under the scope of the Contractor.

2.8 **Specific exclusions**

The following items of work are specifically excluded from the scope of the specifications for all substations:

- (a) Employer's site office and stores.
- (b) DG Building & Fire Fighting Pump House
- (c) Transmission line side insulator string for line termination and tension clamp for earth wire termination.
- (d) Rain Water harvesting
- (e) Covered Car Parking
- (f) Water treatment plant
- (g) Horticulture and Landscaping.
- (h) 50V Battery, 50V Battery charger & 50 V DCDBS

- 2.9 Any other items not specifically mentioned in the specification but which are required for erection, testing and commissioning and satisfactory operation of the substation are deemed to be included in the scope of the specification unless specifically excluded

- 2.10 **Employer** has standardized its technical specification for various equipments and works for different voltage levels. Items, which are not applicable for the scope of this package as per schedule of quantities described in BPS (Vol-IB), the technical specification for the such items should not be referred to.

3.0 PHYSICAL AND OTHER PARAMETERS

- 3.1 **Location of the Substation** - The Doshi substation is located at a distance of 70km (approx.) from Pul-e-Khumari town & 150km (approx) from city of Kabul and Charikar substation is located at a distance of 65km. (approx.) from main city of Kabul.

3.2 Meteorological data

The meteorological data of the substations is as mentioned below:

1.	Maximum ambient air temperature (Degree Centigrade)	40.0
2.	Minimum ambient air temperature (Degree Centigrade) (-)	20.0
3.	Annual average Rainfall	327 mm
4.	Humidity	100%
5.	Wind & dust	Sand & Dust storms in summer
6.	Isocramic level	23 thunder storms days per year
8.	Altitude	1725 mtr above MSL for Charikar S/Sand 1050 mtr above MSL for Doshi S/S

For design purposes, loading of 20mm snow shall be considered.

3.3 Soil Data

The bidder shall be responsible for carrying out the required tests and should fully satisfy himself about the nature of soil expected to be encountered prior to the submission of bid. Any variation of soil data during detailed engineering or construction stage shall not constitute a valid reason in affecting the terms and conditions of the bid.

4.0 SCHEDULE OF QUANTITIES

The requirement of various items/equipments and civil works are indicated in Bid price Schedules (Vol. IB).

→All equipments/items and civil works for which bill of quantity has been indicated in BPS (Bid price Schedules -Vol.IB) shall be payable on unit rate basis. During actual execution, any variation in such quantities shall be paid based on the unit rate under each item incorporated in Letter of award.

Wherever the quantities of items/works are not indicated, the bidder is required to estimate the quantity required for entire execution and completion of works and incorporate their price in respective Bid price schedules (Vol.IB). For

For the purpose of present scope of work, technical specification (Vol II) shall consist of following sections and they should be read in conjunction with each other.

- 1) Section-Project
- 2) Section-General Technical Requirement (GTR) (Rev.12)
- 3) Section- Transformer (Rev.08)
- 4) Section-Switchgear (Rev.08)
- 5) Section-Power and Control Cables (Rev.05)
- 6) Section-LT Switchgear (Rev.04)
- 7) Section-Battery and Battery Charger (Rev.06)
- 8) Section-Lighting System (Rev.04)
- 9) Section-LT transformer (Rev.02)
- 10) Section-Fire Protection System (Rev.05)
- 11) Section-DG Set (Rev.04)
- 12) Section-Switchyard Erection (Rev.07)
- 13) Section- Structures (Rev.04)
- 14) Section-Civil Works (Rev.05)
- 15) Section-Control and Relay Panels (Rev.07)

In case of any discrepancy between Section-PROJECT, Section-GTR and other technical specifications on scope of works, Section-PROJECT shall prevail over all other sections

In case of any discrepancy between Section-GTR and individual sections for various equipments, requirement of individual equipment section shall prevail.

The details furnished under Clause No.10 of this Section are to be read in conjunction with the technical specification of relevant sections

9.0 CONSTRUCTION POWER & WATER

9.1 The contractor shall make his own necessary arrangements for construction power at his own cost.

9.2 The contractor shall also make his own arrangement for construction water supply at his cost and the Employer shall in no case be responsible for any delay in works because of non-availability of water. The contractor can utilize the borewells for construction works and hand over the same in proper running condition at the time of completion of work.

10.0 SPECIFIC REQUIREMENT

10.1 The bidder shall be responsible for safety of human and equipment during the working. It will be the responsibility of the Contractor to co-ordinate and obtain clearance from the Ministry of Energy and Water (MEW), Islamic Republic of Afghanistan before commissioning. Any additional items, modification due to observation of such statutory authorities shall be provided by the Contractor at no extra cost to the Employer.

10.10 CIVIL WORKS

Specific Requirement for civil works:

- 10.10.1 The detailed design and drawings for Control room cum Administrative building, switchgear hall and store shall be prepared by successful bidder during detailed Engineering and in conformity with requirements of technical specification.
- 10.10.2 Control Room Building: Clause no 12 (buildings) of Section -Civil of technical specification has been revised and is enclosed at Annexure-VI . Accordingly Clause no. 12 of Section-Civil of technical specifications stands superseded by Annexure.
- 10.10.3 Clause no. 6 (Roads and Culverts) of Section -Civil has been revised and is enclosed at Annexure VII. Accordingly Clause no. 6 of Section-Civil of

**Technical Specification, Section – Project
Charikar & Doshi Substation Package
C/ENGG/SPEC/PROJECT**

technical specifications stands superseded by Annexure-VII. All roads shall be of concrete as per drawing no. C/ENGG/STD/ROAD/410 & 411. Section for drains and culverts shall be as per drawing enclosed. Roads, drains and culverts shall be constructed as per CPWD specification.

- 10.10.4 The Control room shall be single storey type and shall have a provision of cable entry through cable trenches passing through the switchyard and control room building. Hence no cable vault is required.
- 10.10.5 Construction of cable trench along with covers, sump pits and road crossings shall be as per drawings enclosed.
- 10.10.6 General guideline for concreting below 5 degree temperature are enclosed at annexure-X. However, the procedure for cold weather concreting shall generally be as per recommended practice given in IS-7861. The detailed procedure taking into account specific site and environmental/climatological condition shall be submitted by the contractor for review / approval of POWERGRID site in-charge before commencement of concreting at site.
- 10.8.8 Design and drawing for all contractor engineered items shall be developed by the contractor and submitted for approval of POWERGRID.
- 10.8.9 Bricks of 50kg per sqm compressive strength shall be used. However, Contractor can propose use of fly ash based bricks, hollow concrete blocks or solid concrete blocks to suit the availability at site.
- 10.8.11 All structure shall be designed for wind speed of 39m/Sec as per IS code 875 (Latest).
- 10.8.12 All the building and structure shall be designed as equivalent to Earthquake zone IV in accordance with IS code 1893 (Latest).
- 10.8.13 Sewerage system: A septic tank and soak pit shall provided for control room building.
- 10.8.14 Para 13.13.6 and first sub para of para 14.00 of section civil of technical specification stands deleted.
- 10.8.15 Peripheral drains around the building shall be deemed to be included in the building work. Minimum size of peripheral drain shall be 150mm wide and 300mm deep with slope of 1:250. Connection between peripheral drain and main drain shall be measured as item for drains.
- 10.8.16 Water is to be made available by the contractor from underground bore wells as under.

a) Control room water requirement of 2000 litres per day

The contractor shall make one or more no. of bore wells in order to be able to deliver quantity of water mentioned at (a) above by four hours of operation of pumping system. All water supply piping shall be buried one meter below the ground. All exposed plumbing pipes shall be insulated with thermal insulation tubing 9 mm thick.

The number, diameter, depth of borewell and rating of pumps shall be decided after a trial bore is made at site.

10.8.17 All items of works shall be executed in accordance with CPWD specification.

For all RCC items concrete mix used shall be 1:1.5:3 (Cement : 1.5 coarse sand : 3 stone aggregate 20mm nominal size).

Annexure - I

GEOTECHNICAL INVESTIGATION

1.0 GENERAL

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 report to the effect will be submitted by the Contractor for Owner's specific approval giving details regarding data proposed to be utilised for civil structures design.

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.

2.0 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 Owner.

All the work shall be carried out as per latest edition of the corresponding Indian Standard Codes.

2.1 Bore Holes

Bore holes of 150 mm diameter in accordance with the provisions of IS: 1892 at the rate of minimum one number bore hole per hectare up to 10 meter depth or to refusal which ever occur earlier shall be drilled. In any case number of boreholes shall not be less than five. 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 is 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 25 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.

Collecting undisturbed samples of 100/75 mm diameter 450 mm long from the bore holes at intervals of 2.5 m and every change of stratum starting from 1.0 m below ground level onwards in clayey strata.

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-charge.

2.2 Trial Pits

Trial pits shall be carried at specified one locations per Hectare as directed by the Owner. The trial pits shall be 2 m x 2 m in size extending to 4 m depths, or as specified by the Owner. Undisturbed samples shall be taken from the trial pits as per the direction of the Owner.

2.3 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 conform to IS:3043. The test shall be conducted using Wagner's four electrode method as specified in IS : 1892, Appendix-B2. 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 0.2 m upto a distance of 50.0 m.

2.4 Plate load test

Plate load test shall be conducted 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 IS : 1888. Modulus of sub grade reaction shall be conducted as per IS: 9214. The location and depth of the test shall be as given below:

- (a) One at Control Room Building location at the proposed foundation depth below finished ground level for bearing capacity.

Undisturbed tube samples shall be collected at 1.0 m and 2.5m depths 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 IS: 1888.

Backfilling of the pit shall be carried out as per the directions of the Owner. 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.

2.5 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.

2.6 Back Filling of Bore Holes

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

2.7 Laboratory Test

1. The laboratory tests shall be carried out progressively during the field work after sufficient number of samples have 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 I.S. Codes.

The following laboratory tests shall be carried out

- a) Visual and Engineering Classification
- b) Liquid limit, plastic limit and shrinkage limit for C-Ø soils.
- c) Natural moisture content, bulk density and specific gravity.
- d) Grain size distribution.
- e) Swell pressure and free swell index determination.
- h) California bearing ratio.
- f) Consolidated drained test with pore pressure measurement.

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.

In case of rock samples following tests shall also be conducted:

- (i) Rock quality designation (RQD), RMR.
- (ii) UCC test.
- (iii) Point load index test.

2.8 Test Results and Reports

- 2.8.1 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. 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 test data shall bear the signatures of the Investigation Agency, Vendor and also site representative of POWERGRID.

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

- a) A plan showing the locations of the exploration work i.e. bore holes, dynamic cone penetration tests, trial pits. Plate load test etc.

- h) 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.

2.8.3 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 Owner. 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 shall be provided.
- d) Recommendations regarding slope of excavations and dewatering schemes.
- 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.

If expansive soil is met with, recommendations on removal or retainment of the same under the structure, road, drains, etc. 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.

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

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

12.0 BUILDINGS - GENERAL REQUIREMENTS

12.1 GENERAL

The scope includes the design, engineering and construction including anti-termite treatment, plinth protection, DPC including sanitary, water supply, electrification false ceiling etc. of Control room building, 20kV indoor switch gear building, fire fighting pump house and store building. The building shall be of RCC framed structure of concrete of M20 grade (Min.)

The contractor shall appoint a reputed architect (to be approved by POWERGRID) for design of architecturally pleasing building and to incorporate local architecture.

12.2 CONTROL ROOM BUILDING

Minimum floor area requirements have been given in following paragraph which may be increased, if required, at the time of detailed engineering to suit project requirements

An open space of 1 m minimum shall be provided on the periphery of the rows of panel and equipment generally in order to allow easy operator movement and access as well as maintenance.

Minimum carpet area requirement for various rooms in the substation Control room cum Administrative building:

- Control room 100 sq.m
- ACDB cum DCDB room 150sq.m
- Battery room 75sq.m
- Electrical lab. 25 sq.m.
- Conference room 20 sq.m.
- S/stn. Incharge office 25 sq.m.
- Plus attached Toilet
- Plus PS room
- Room for executives 40 sq.m.
- Room for non-executives 15 sq.m
- Lobby 10 sq.m
- Corridor As per Requirement (Minimum Width 1.6mtr)
- Portico 15 sq.m. (approx)
- Common toilet 18 sq.m.
- Toilet attached to conference room 3.5 sq.m
- Janitor room 20 sq.m.
- Pantry 4 sq.m.
- No cable vault shall be provided. Suitable RCC cable trench with covers made of chequered steel plate shall be provided within the building.

Any future possibility of annexe building shall be taken care of while finalising the layout of the control room building.

Dimensions of Indoor switch gear building shall be as per requirement.

12.3 DESIGN

- a) The building shall be designed:
 - 1 to the requirements of the relevant Building Code applicable in Afghanistan if any, and the standards quoted therein. In case codes and standard for building construction does not exist in Afghanistan, then National Building Code of India shall be followed. The statutory requirement of local Govt. Authority shall also be adhered to.
 2. for the specified climatic & loading conditions.
 - 3 to adequately suit the requirements of the equipment 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. for a life expectancy of structure, systems and components not less than that of the equipment which is contained in the building, provided regular maintenance is carried out.
 6. to be aesthetically pleasing. Different buildings shall show a uniformity and consistency in architectural design.
 - 7 to allow for easy access to equipment and maintenance of the equipment.
 8. with, wherever required, fire retarding materials for walls, ceilings and doors, which would prevent supporting or spreading of fire.
 9. with materials preventing dust accumulation
- a) Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns
- b) Individual members of the buildings frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion etc.

- c) Permissible stresses for different load combinations shall be taken as per relevant IS Codes.
- d) The building lighting shall be designed in accordance with the requirements of relevant section.
- e) The building auxiliary services like air conditioning and ventilation systems, fire protection and detection systems and all other miscellaneous services shall be designed in accordance with the requirements specified in relevant section or elsewhere in this Specification

12.4 DESIGN LOADS

Building structures shall be designed for the most critical combinations of dead loads, super-imposed loads, equipment loads, crane load (if any), wind loads and seismic loads.

Dead loads shall include the weight of structures complete with finishes, fixtures and partitions and should be taken as per IS: 1911

Super-imposed loads in different areas shall include live loads, snow loads, minor equipment loads, cable trays, small pipe racks/hangers and erection, operation and maintenance loads. Equipment loads shall constitute, if applicable, all load of equipments to be supported on the building frame.

For crane loads an impact factor of 30% and lateral crane surge of 10% (lifted weight + trolley) shall be considered in the analysis of frame according to provisions of IS: 875. The horizontal surge shall be 5% of the static wheel load.

The wind loads shall be computed as per IS 875, Seismic Coefficient method/Response Spectrum method shall be used for the seismic analysis as per IS 1893 with importance factor 1.5.

Wind and Seismic forces shall not be considered to act simultaneously

Floors/slabs shall be designed to carry loads imposed by equipment, cables and other loads associated with building. Floors shall be designed for live loads as per relevant IS. Cable load shall also be considered additionally for floors where these loads are expected.

In addition, beams shall be designed for any incidental point loads to be applied at any point along the beams. The floor loads shall be subject to Purchaser's approval.

For consideration of loads on structures, IS: 875, the following minimum superimposed live loads in addition to snow load shall, however, be considered for the design.

a.	Roof	1.5 KN/M ² 0.75 KN/M ²	for accessible roofs for in-accessible roofs
b.	RCC-Floor	(i) 5 KN/M ² (ii) 10 KN/M ² (minimum)	for offices For equipment floors or actual requirement, if higher than 10 KN/M ² . based on equipment component weight and layout plans.
c.	Stairs & balconies	5 KN/M ²	
d.	Toilet Rooms	2 KN/M ²	
e.	Chequered plate floor	4 KN/M ²	
f.	Walkways	3 KN/M ²	

Any additional load coming in the structure shall be calculated as per IS 875.

12.5 SUBMISSION

The following information shall be submitted for review and approval to the Purchaser

1. Design criteria shall comprise the codes and standards used, applicable climatic data including wind loads, earthquake factors maximum and minimum temperatures applicable to the building locations, assumptions of dead and live loads, including equipment loads, impact factors, safety factors and other relevant information.
2. Structural design calculations and drawing (including construction/fabrication) for all reinforced concrete and structural steel structures.
3. Fully dimensioned concept plan including floor plans, cross sections, longitudinal sections, elevations and perspective view of each building. These drawings shall be drawn at a scale not smaller than 1:50 and shall identify the major building components
4. Fully dimensioned drawings showing details and sections drawn to scales of sufficient size to clearly show sizes and configuration of the building components and the relationship between them.

5. Product information of building components and materials, including walls partitions flooring ceiling, roofing, door and windows and building finishes.
6. A detailed schedule of building finishes including colour schemes.
7. A door & window schedule showing door types and locations, door lock sets and latch sets and other door hardware.

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

12.6 INTERNAL FINISH SCHEDULE

The finishing schedule is given in subsequent clauses.

TABLE-I

S.No.	Location	Flooring & Skirting (50mm high)	Wall Internal	Ceiling	Doors, Windows, Ventilators
1.	Control Room	Vitrified tiles 8mm thick size 600x600mm	Oil bound washable distemper on smooth surface applied with 2mm thick Plaster of Paris putty.	RCC ceiling White wash and false ceiling	Anodized aluminium indal or equivalent extruded sections as per IS 733 & 1285. Flat drawn sheet glass (min. 5.5mm thick)
2	Substation Incharge Offices, Conference corridor, staff, lab rooms	--Do--	Oil bound washable distemper on smooth surface applied with POP putty.	RCC ceiling White wash and false ceiling	Doors, Windows, Ventilators aluminium as at 1 with 5.5mm thick glazing.
3	Reception/Lobby	Vitrified tiles 8mm thick size 600x600mm	Oil bound washable distemper on smooth surface applied with POP putty.	RCC ceiling White wash and false ceiling	Anodised alum. extruded sections as at 1 with glazing 5.5mm thick.
4	Battery room	IPS flooring	Dry Distemper	White wash	Steel door 45mm thk double sheet 18G steel suitably reinforced and filled with mineral wool Windows, Ventilators aluminium as at 1 with 5.5mm thick glazing
5	DCDB, MCC Room	Ironite flooring	Dry Distemper	White wash	Steel door double sheet as above. Windows, Ventilators aluminium as at 1 with 5.5mm thick glazing
6	Toilet, Pantry, Janitor room	Vitrified tiles 8mm thick size 600x600mm	DADO glazed tile 2.1M high for toilet for pantry above working	White wash	Aluminium frame for door. 25mm thick particle board door shutters with aluminium "U" type beading (Item 16.20 of DSR'02) and anodized aluminium fixtures best quality.

			platform upto 750 mm		Windows, Ventilators aluminum as at 1 with 5.5mm thick glazing
7	Other areas not specified	Vitrified tiles 8mm thick size 600x600mm	Dry distemper	White wash	
8	Switchgear hall	Vitrified tiles 8mm thick size 600x600mm	Oil bound washable distemper on smooth surface applied with 2mm thick Plaster of Paris putty.	White wash	Anodised aluminium indal or equivalent extruded sections as per IS 733 & 1285. Flat drawn sheet glass (min. 5.5mm thick)
9	Fire fighting pump house	Ironite flooring	Dry Distemper	White wash	Rolling shutter and Steel door double sheet as at sr no-5. Hot rolled steel framed glazed window and ventilators with 4mm thick single glazing.
10	Store building	Ironite flooring	Dry Distemper	White wash	Rolling shutter and Steel door double sheet as at sr no-5. Hot rolled steel framed glazed window and ventilators with steel grill and 4mm thick single glazing.

12.7 FLOORING

Flooring in various rooms of control room building shall be as for detailed schedules given in Table -1.

12.8 Walls

Control room buildings shall be of RCC framed structure. All walls shall be non-load bearing walls. Min. thickness of external walls shall be 230 mm brick masonry with 1:6 cement sand mortar.

12.9 Plastering

All internal walls shall have minimum 12mm thick plaster on smooth side and 15mm thick plaster on rough side of brick wall with cement mortar 1:6 (1 cement : 6 sand). The ceiling shall have 6mm thick 1:4 cement sand plaster.

12.10 External Finishing

External plaster 18mm thick shall be of 1:6 cement sand plaster in two layers under layer 12mm thick and 6mm thick upper layer. External surface of the building shall be painted with Acrylic smooth exterior paint "TRUMP" of M/s Snowcem India Ltd or equivalent (DSR item code 13 79 B.1)

12.11 ROOF

Sloping RCC cast in situ roof shall be provided for all buildings except for store building with false ceiling as mentioned in finish schedule. Store building shall be provided with a sloping roof using 0.9mm thick corrugated G.I. sheet over steel truss.

12.12 FALSE CEILING

The control room and all other areas specified in internal finish schedule elsewhere shall have closed aluminium ceiling system comprising 84mm wide, 12.5mm deep panels of approved colour with a recessed flange of 23.9mm roll formed out of 0.5mm thick aluminium alloy AA 5050 /5052/3003 chromatised and stove enamelled on both sides, panels to be fixed on roll formed carriers 32mm wide 39mm deep out of minimum 0.9mm thick aluminium alloy strip with cut outs to hold panels in a module of 100mm minimum at maximum 1.6 m c/c carrier suspended from roof by 4mm diameter galvanised steel wire rod hangers with special height adjustment springs/clips made out of spring steel at maximum spacing of 1.5m c/c. The system is to be got approved by purchaser before installation

12.13 DOORS AND WINDOWS

The details of doors and windows of the control room building shall be as per finish schedule Table-1 and relevant IS code. Rolling steel shutters and rolling steel grills shall be provided as per layout and requirement of buildings. Paints used in the work shall be of best quality specified in CPWD specification.

12.2.12 PARTITION

Partition made of anodised aluminium frame provided with 5.5 mm thick clear glass shall be supplied and installed between relay area and control room.

12.14 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) Galvanised MS pipe of medium class conforming to IS: 1239 shall be used for internal & external piping work for potable water supply

- (iii) Sand CI pipes with lead joints conforming to IS: 1729 shall be used for sanitary works above ground level.
- (iv) Each toilet shall have the following minimum fittings.
 - (a) WC (Western type) 390 mm high with toilet paper roll holder and all fittings
 - or
 - WC (Indian Type) Orissa Pattern (580 x 440 mm) with all fittings.
 - (both types of WCs shall be provided at alternate locations)
 - (a) Urinal (430 x 260 x 350 mm size) with all fittings.
 - (b) 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) Soap holder and liquid soap dispenser.
- (v) 1 no, stainless steel kitchen sink with Drain board (510 x 1040 x 178 mm bowl depth) for pantry shall be provided.
- (vi) All fittings, fastener, grating shall be chromium plated.
- (vii) 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.
- (viii) Soil, waste and drain pipes, for underground works shall be stone ware for areas not subject to traffic load. Heavy duty cast iron pipes shall be used otherwise.

SPECIFICATION FOR ROADS AND CULVERTS

- a) All roads shall be concrete road (rigid) pavement.
- b) Layout of the roads shall be as shown in the General Arrangement drawing for the substation issued along with the tender documents. Adequate turning space for vehicles shall be provided and bend radii shall be set accordingly. Road to the Autotransformer/Reactor shall be as short and straight as possible.
- c) CPWD specification shall be followed for construction of Roads
- d) Cross section of the road shall be as per drawings C/ENGG/STD/ROAD/410 & 411 enclosed with the tender documents
- e) Culverts shall be constructed as per drawings enclosed with tender documents.

Precautions for concreting under cold weather

The following precautions are to be followed when concreting is carried out at temperatures less than 5°C :

- a) Use wooden form work only.
- b) Use rapid hardening concrete or accelerating admixtures.
- c) Make sure concrete is delivered to the point of placement at a temperature not less than 5°C either by heating the aggregates or by using hot water.
- d) Place concrete quickly after mixing and cover the laid concrete suitably with polythene sheets or tarpaulins or as described in clause 8.2 in IS-7861 Part-II.
- e) Minimum 400 kg/cu m cement to be used for M20 concrete.
- f) When placing concrete at or near freezing temperature, it shall be ensured that the concrete has a temperature of at least 5°C and that the temperature of concrete after having been placed and compacted is maintained above 2°C until it has hardened thoroughly
- g) When temperatures are around 0°C curing may be omitted and precautions as mentioned at clause 8.3 of IS: 7861 Part II be followed.
- h) Removal of form work shall not be earlier than the period specified in table 5. clause 8.4 of IS: 7861 Part II.

14.0 TECHNICAL SPECIFICATION FOR CIVIL WORKS

14.1 GENERAL

The intent of specification covers the following:

Design, engineering, and construction of civil works as per the scope of works. Civil works shall also satisfy the general technical requirements specified in other Sections of this 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 National/ 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 Indian 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 Purchaser.

The work shall be carried out according to the design/drawings to be developed by the Contractor and approved by the purchaser based on Tender Drawings Supplied to the Contractor by the Purchaser. 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 based on the input provided by the Purchaser. Certain minimum requirements are indicated in this specification for guidance purposes only. However, the Contractor shall quote according to the complete requirements.

14.2 GEOTECHNICAL INVESTIGATION

- 14.2.1 Levelled site shall be handed over to the Contractor. The finished ground level shall be the finished formation level furnished by the owner. The Contractor shall perform a detailed soil investigation, if specified in Section-Project, 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 report to the effect will be submitted by the Contractor for Purchaser's

specific approval giving details regarding data proposed to be utilised for civil structures design.

- 14.2.2 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. Tests must be conducted under all the critical locations i.e. Control Room Building, Lightning Mast, Tower locations, Auto-transformer/Reactor etc.

14.2.3 **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 Purchaser.

All the work shall be carried out as per latest edition of the corresponding Indian Standard Codes.

14.2.3.1 **Bore Holes**

Bore holes of 150 mm diameter in accordance with the provisions of IS: 1892 at the rate of minimum one number bore hole per hectare up to 10 meter depth or to refusal whichever ever occur earlier shall be drilled. In any case number of boreholes shall not be less than five. 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 is 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 25 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.

Collecting undisturbed samples of 100/75 mm diameter 450 mm long from

the bore holes at intervals of 2.5 m and every change of stratum starting from 1.0 m below ground level onwards in clayey strata.

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-charge

14.2.3.2 Trial Pits

Trial pits shall be carried at specified one locations per Hectare as directed by the Purchaser. The trial pits shall be 2 m x 2 m in size extending to 4 m depths, or as specified by the Owner. Undisturbed samples shall be taken from the trial pits as per the direction of the Purchaser.

14.2.3.3 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 IS:3043. The test shall be conducted using Wagner's four electrode method as specified in IS : 1892, Appendix-B2. 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 0.2 m upto a distance of 50.0 m.

14.2.3.4 Plate load test

Plate load test shall be conducted 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 IS 1888. Modulus of sub grade reaction shall be conducted as per IS 9214. The location and depth of the test shall be as given below:

- (a) One at Control Building location at the proposed foundation depth below finished ground level for bearing capacity.

Undisturbed tube samples shall be collected at 1.0 m and 2.5m depths 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 IS: 1888.

Backfilling of the pit shall be carried out as per the directions of the Owner. 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.

14.2.3.5 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.

14.2.3.6 Back Filling of Bore Holes

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

14.2.3.7 Laboratory Test

1. The laboratory tests shall be carried out progressively during the field work after sufficient number of samples have 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 I.S Codes.

The following laboratory tests shall be carried out

- a) Visual and Engineering Classification
- b) Liquid limit, plastic limit and shrinkage limit for C-Ø soils.
- c) Natural moisture content, bulk density and specific gravity
- d) Grain size distribution.
- e) Swell pressure and free swell index determination.
- h) California bearing ratio.
- f) Consolidated drained test with pore pressure measurement.
- g) 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.
- h) In case of rock samples following tests shall also be conducted:
 - (i) Rock quality designation (RQD), RMR.
 - (ii) UCC test.
 - (iii) Point load index test.

14.2.3.8 Test Results and Reports

14.2.3.8.1 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. 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 test data shall bear the signatures of the Investigation Agency, Vendor and also site representative of POWERGRID

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

- a) A plan showing the locations of the exploration work i.e. bore holes, dynamic cone penetration tests, trial pits. Plate load test 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 Owner. 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 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. shall be given. In the latter case detailed specification of any special treatment required including specification of 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.
- h) In case of foundation in rocky strata, type of foundation and recommendation regarding rock anchoring etc. should also be given

14.3 SITE PREPARATION :

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 Purchaser. the Contractor shall give all help in instruments, materials and personnel to the Purchaser for checking the detailed layout and shall be solely responsible for the correctness of the layout and levels

14.3.1 SCOPE

This clause covers the design and execution of the work for site preparation, such as clearing of the site, the supply and compaction of fill material, excavation and compaction of backfill for foundation, road construction, drainage, trenches and final topping by stone (broken hard stone)

14.3.2 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 standard specifications.
- 2) If fill material is required, the fill material shall be suitable for the above requirement. The fill shall be such a material and the site so designed as to prevent the erosion by wind and water of material 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 and to be approved by the Purchaser
- 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 area's as directed by purchaser upto a maximum lead of 2 km.

14.3.3 EXCAVATION AND BACKFILL

1. Excavation and backfill for foundations shall be in accordance with the relevant code.
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.

14.3.4 COMPACTION

1. The density to which fill materials shall be compacted shall be as per relevant IS and as per direction of Purchaser. 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 subgrade for the roads and embankment filling shall be compacted to minimum 95% of the Standard Proctor's density at OMC. Cohesionless material subgrade 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 center of the road or towards the building as applicable. Rolling will also be required on rockfills. No compaction shall be carried out in rainy weather.

14.3.5 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 Purchaser.

14.4 ANTIWEED TREATMENT & STONE SPREADING

14.4.1 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 and direction of the Purchaser.

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.

14.4.2 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.

14.4.2.1 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 Table 2 of IS:383 – 1970. Hardness, flakiness shall be as required for wearing courses are given below :

- (a) Sieve Analysis limits (Gradation)
(IS : 383 – Table – 2)

Sieve Size	% passing by weight
63mm	100
40mm	85-100
20mm	0-20

10mm

0-5

"One Test" shall be conducted for every 500 cu.m.

(b) Hardness

Abrasion value (IS:2386 Part-IV) – not more than 40%

Impact value (IS:2386 Part-IV) – not more than 30% and frequency shall be one test per 500 cu m. with a minimum of one test per source

(c) Flakiness Index

One test shall be conducted per 500 cu.m. of aggregate as per IS:2386 Part – I and maximum value is 25%.

14.4.2.2 After all the structures/equipments are erected, antiweed 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 antiweed 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 everyday 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 Engineer – in- charge. The final approval shall be given by Engineer – in -charge based on the results.

14.4.2.3 Engineer-in-charge 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

14.4.2.4 After antiweed treatment is complete, the surface of the switchyard area shall be maintained, rolled/compacted to the lines and grades as decided by Engineer-in-charge. 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.

14.4.2.5 In areas that are considered by the Engineer-in-Charge 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.

- 14.4.2.6 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.
- 14.4.2.7 Over the prepared sub grade, 75mm thick base layer of cement concrete in 1:5:10 (1 cement : 5 fine sand : 10 burnt brick aggregate) 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 fine 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.
- 14.4.2.8 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.

14.5 SITE DRAINAGE

Providing rain water drainage system within the switchyard fencing 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 50M away from boundary wall, only 50 metre drain outside the boundary wall is in the scope of contractor. Outfall point shall be got approved from Engineer- in- charge 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 on both sides of roads. 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 trapezoidal drains having 300mm bottom width and sides having slope of 1 horizontal: 1.5 vertical with 300mm depth at starting point of drain shall be provided.
- (d) Longitudinal slope shall not be less than 1 in 1000
- (e) Open surface drains shall be constructed with 100mm thick plain cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 stone aggregate 20mm nominal size) PCC 1:2:4 shall be laid over 40mm thick layer of PCC 1:4:8 (1 cement: 4 coarse 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, IS:456 and IS:783 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 within the substation boundary.
- m) The drainage scheme and associated drawings shall be got approved from the employer before commencement of construction.

14.5.A RAINWATER HARVESTING:

- In addition to drainage of rainwater in accordance with clause 5.0 of section civil of Technical Specification, the contractor shall make arrangement for rainwater harvesting also. Rainwater harvesting shall not be done if the depth of water table is within 8.0m from finished ground level
- 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 upto a depth of 2.0 meter from ground level and 345mm thick brickwork below 2.0 meter depth. The brickwork 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 IS 1161 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 borewell. 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.

A drawing showing details of recharge structure for rainwater harvesting is enclosed.

14.6 ROADS AND CULVERTS

- All the roads within the substation fencing under the present scope is in the scope of contract. Layout of the roads are as shown in the General detail & Arrangement drawing for the substation issued along with the tender documents. Adequate turning space for vehicles shall be provided and bend radii shall be set accordingly. Road to the Autotransformer/Reactor shall be as short and straight as possible.
- The double lane road shall have 7.0m black topping with 1.6 m wide earthen shoulder on either side of the road. Other roads shall be with 3.75 m black topping and 1.3 m wide earthen shoulder on either side of the road.
- All roads shall be designed for class "C" traffic as per IRC- 37 (Guidelines for design of flexible pavements).
- CPWD specification shall be followed for construction of Roads.
- All the culverts and allied structures (required for road/rail, drain, trench crossings etc.) shall be designed for class AA loading as per IRC standard / IS code and should be checked for Autotransformer / Reactor loading.

14.7 AUTOTRANSFORMER / REACTOR FOUNDATION, RAIL TRACK/ ROAD CUM RAIL TRACK

The Contractor shall provide a RCC Rail cum road system integrated with the Autotransformer / 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 I.R.C. standard / relevant IS

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

Each Autotransformer/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 Autotransformer/Reactor shall be 20% of the Autotransformer/Reactor height or 0.8m whichever is more. The oil collection pit thus formed shall have a void volume equal to 200% volume of total oil in the Autotransformer/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 autotransformer 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 an 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 150, 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

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.

14.7.1 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.

14.7.2 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

14.8 FIRE PROTECTION WALLS

14.8.1 GENERAL

Fire protection walls shall be provided, if required, in accordance with Tariff Advisory Committee (TAC) recommendations.

14.8.2

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

14.8.3

DIMENSIONS

The firewall shall extend 600 mm on each side of the Autotransformer/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 2.0 meter clearance shall be provided between the equipments e.g. Autotransformer/Reactors and firewalls

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

14.8.4

MATERIALS

The firewall will be made of reinforced concrete (M-20 grade), as per the system requirements

14.9

CABLE & PIPE TRENCHES

- a) The cable trenches and pre-cast removable RCC cover (with lifting arrangement) shall be constructed using RCC of M20 grade
- b) The cable trench walls shall be designed for the following loads.

- 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.

14.10 FOUNDATION /RCC CONSTRUCTION

14.10.1 GENERAL

1. Work covered under this Clause of the Specification comprises the design and construction of foundations and other RCC constructions for switchyard structures, equipment supports, trenches, drains, jacking pad, pulling block, control cubicles, bus supports Autotransformer/Reactors, marshalling kiosks, auxiliary equipments & systems buildings, tanks 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 IS:456 and all the tests shall be conducted as per relevant Indian Standard Codes as mentioned in Standard field quality plan appended with the specification

A minimum grade of M20 concrete (1: 1.5: 3 mix) shall be used for all structural/load bearing members as per latest IS 456 .
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 IS Code 2911. 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 bidder 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 have 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.

14.10.2 DESIGN

- 1 All foundation shall be of reinforced cement concrete. The design and construction of RCC structures shall be carried out as per IS:456 and minimum grade of concrete shall be M-20. Higher grade of concrete than specified above may be used at the discretion of Contractor without any additional financial implication to the Purchaser.
- 2 Limit state method of design shall be adopted unless specified otherwise in the specification.
- 3 For detailing of reinforcement IS:2502 and SP:34 shall be followed. Cold twisted deformed bars ($F_y=415 \text{ N/mm}^2$) conforming to IS:1786 or TMT bars as per CPWD specifications shall be used as reinforcement. However, in specific areas, mild steel (Grade I) conforming to IS.432 can also be used. 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 IS.456 (latest)

4. RCC water retaining structures like storage tanks, etc. shall be designed as uncracked section in accordance with IS.3370 (Part I to IV) by working stress method. However, water channels shall be designed as cracked section with limited steel stresses as per IS.3370 (Part I to IV) by working stress method.
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 IS Codes of foundation design. Detailed design calculations shall be submitted by the bidder showing complete details of piles/pile groups proposed to be used.
6. Design shall consider any sub-soil water pressure that may be encountered following relevant standard strictly.
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.
8. RCC columns shall be provided with rigid connection at the base.
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 IS Codes 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.
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. 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.
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.
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.
 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.
 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.
 16. The foundations of transformer/reactor and circuit breaker shall be of block type foundation. Minimum reinforcement shall be governed by IS:2974 and IS.456
 17. The tower and equipment foundations shall be checked for a factor of safety of 2.2 for normal condition and 1.65 for 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.

14.10.3 ADMIXTURES & ADDITIVES

- 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.

2. Admixtures in concrete shall conform to IS:9103. The water proofing cement additives shall conform to IS:2645. Concrete Admixtures/ Additives shall be approved by Purchaser.
3. The Contractor may propose and the Purchaser 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
4. The water-reducing set-retarding admixture shall be an approved brand of Ligno-sulphonate type admixture.
5. The water proofing cement additives shall be used as required/advised by the Purchaser

14.11 CHAINLINK FENCING AND GATE

14.11.1 General

Fencing and gate shall be provided as per details given below :

14.11.2 Areas requiring Fencing

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

14.11.3 Product materials

The minimum requirements are as follows .

Chain link fence fabric (without galvanization) in accordance to IS:2721.

- | | | |
|----|---------------------|--|
| 1 | Size of mesh | 75mm |
| 2 | Nominal wire size | 3.15mm dia meter |
| 3. | Width of chain link | 1500mm |
| 4 | Painting | Two or more coats of approved standard make synthetic enamel paint over a coat of standard steel primer. |

Posts

The posts shall be of medium M.S. tubes of 50mm diameter conforming to grade Yst-22 (Kg/mm²). The tubes shall also conform to IS : 1161/IS 806. The length of tubular post shall be 2600 mm as shown in the tender drawing enclosed with bid documents.

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 as shown in the drawing.

The tubular post shall be welded with 8 number of M S flat of size 50 x 6mm – 75mm long as shown in the drawing. 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 IS:209

Fence Fabric Panel

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 as shown in the drawing 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 synthetic enamel paint over approved standard steel primer.

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 (12 diameter) on each flat.
- 7 The painting pattern of fence panels shall be decided by Engineer-in-charge. It shall be preferable to paint the panel in different colour pattern such that it gives better aesthetic look

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. Other details shall be as shown in the drawing.
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.
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

14.12 BUILDINGS - GENERAL REQUIREMENTS

14.12.1 GENERAL

The scope include the design, engineering and construction including anti-termite treatment, plinth protection DPC of Building including sanitary, water supply, electrification false ceiling etc. of control room building (excluding design and Engineering), fire fighting building and DG set building

14.12.2 CONTROL ROOM-CUM-ADMINISTRATIVE BUILDING

Control Room cum Administrative building shall be constructed as per the drawings and BOQ supplied by the owner. CPWD specification shall be followed in all the building works. In case of non-scheduled items, BOQ item description shall be adopted for execution. The owner has furnished the tentative BOQ for all the building works for which design and drawing has been developed by the owner. Bidders are requested to quote the unit rate as well as the cost of item based on the quantities furnished in the BPS.-Any variation to these quantities during actual execution of the project shall be adjusted based on the unit rate quoted by the contractor

14.12.2.1 FINISH SCHEDULE

The finishing schedule shall be as per the drawings and schedule of items.

14.12.2.2 FLOORING

Flooring in various rooms of control room building shall be as per the drawings and schedule of items

14.12.2.3 Walls

Control room buildings shall be of framed superstructure. All walls shall be non-load bearing walls. Min. thickness of external walls shall be 230 mm (one brick) with 1:6 cement sand mortar.

14.12.2.4 Plastering

All internal walls shall have cement plaster as per provision in BOQ. The ceiling shall have 6mm thick 1:3 cement sand plaster.

14.12.2.5 Finishing

External finish shall be five coats/three coats of "Renvo/ Terracco" synthetic plaster overcoat at the locations as per drawing pattern.

14.12.2.6 ROOF

Roof of the C.R. 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 CPWD specification (item no. 25.8 of DSR 1997). 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 IS: 2645 over the RCC slab including cleaning the surface before treatment.
- (b) Laying cement concrete using broken bricks/brick bats 25mm to 100mm size with 50% of cement mortar 1:5 (1 cement : 5 coarse sand) admixed with proprietary water proofing compound conforming to IS: 2645 over 20mm thick layer of cement mortar of min 1:5 (Cement : 5 coarse sand) admixed with proprietary water proofing compound conforming to IS: 2645 to required slope and treating similarly the adjoining walls upto 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 IS: 2645

- (d) Finishing the surface with 20mm thick joint less cement mortar of mix 1:4 (1 cement : 4 coarse sand) admixed with proprietary water proofing compound conforming to IS: 2645 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

With average thickness of 120 mm and minimum thickness at khurra at 65 mm

14.12.2.7 GLAZING

Sun film shall be provided for all windows/doors of AC rooms. Thickness of glazing shall be as specified in internal finish schedule elsewhere

14.12.2.8 FALSE CEILING

Providing and fixing seamless ceiling with Gypboard 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 engineer-in-charge

The rate includes for all necessary cutting of ceiling for the fixing of complete fixtures as per drawing.

14.12.2.9 Underdeck 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 engineer-in-charge

14.12.2.10 DOORS AND WINDOWS

The details of doors and windows of the control room building shall be as

per drawing and with the relevant IS code. Rolling steel shutters and rolling steel grills shall be provided as per drawing and requirement of buildings. Paints used in the work shall be of best quality specified in CPWD specification

14.12.2.11 PARTITION

Partition made of anodised aluminium frame provided with 5.5 mm thick clear glass shall be supplied and installed at locations shown in tender drawings

14.12.2.12 PLUMBING & SANITATION

All plumbing and sanitation shall be executed as per the schedule of items and the drawings 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

- 14.12.2.13** Bidder should include all such items in the BPS which are not specifically mentioned but are essential for the execution of the work. Items which explicitly may not appear in various schedules and are required for successful completion of the building work shall be included in the bid price and shall be provided at no extra cost to owner

14.13 OTHER BUILDINGS: (DG Building cum Fire Fighting Pump House)

- 14 13 1** The minimum dimensions and details of the building are indicated in the tender drawings which may be increased at the time of detailed engineering to suit project requirements.

- 14 13 2** It is the intention of the Purchaser to have the DG and FF buildings adjacent to each other for convenience of maintenance of equipment. The common wall shall be as per TAC requirements. However, due to space constraints if it becomes inevitable to construct two separate buildings, no extra claim will be admissible on this account.

- 14 13 3** All the equipment foundations and structural members shall be designed as per the relevant clauses of this specification and IS codes. Arrangement shall be made for collection of spilt oil from oil diesel/operated equipment, in the form of drain and sump along the periphery

Diesel storage area shall be adequate to accommodate minimum of 4 standard drums (200 litre each) of diesel oil which could be connected to the pump. Suitable piping arrangement with valves shall be provided

Diesel handling area/room shall be provided with tiles upto 2.1 m level and a wash basin with water line. Pumping arrangement to be provided for diesel oil from the oil storage area upto the diesel tanks of all the diesel engines

- 14.13.4 A wash basin/sink with water supply shall be provided in the building.
- 14.13.5 Piping shall be provided for conveying oil from the storage tank (common for all diesel/engines) to individual fuel tank of engine.
- 14.13.6 All the external features of the DG cum FF building shall be similar to CR building
- 14.13.7 Doors and windows shall be provided as indicated in drawings
- 14.13.8 An architecturally pleasing parking shed of RCC pavement and roof slab to accommodate 10 Cars and one filter machine shall be provided.

14.14 BUILDING STORM WATER DRAINAGE FOR ALL BUILDINGS

The building drain shall be provided for the collection of storm water from the roofs. This water shall be collected in junction boxes and these boxes shall drain to the main drainage system of the station

Cast Iron rain water downcomers conforming to IS:1230 with water tight lead joints shall be provided to drain off the rain water from the roof. These shall be suitably concealed with masonry work of cement concrete or cladding material. The number and size of downcomers shall be governed by IS:1742 and IS:2527.

All drains inside the buildings shall have minimum 40 mm thick grating covers and in areas where heavy equipment loads would be coming, precast RCC covers shall be provided in place of steel grating

For all buildings, suitable arrangement for draining out water collected from equipment blowdown, leakages, floor washings fire fighting etc. shall be provided for each floor

14.15 MISCELLANEOUS GENERAL REQUIREMENTS

- 14.15.1 Dense concrete with controlled water cement ratio as per IS-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.
- 14.15.2 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.

- 14.15.3 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
- 14.15.4 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 IS:2629 and IS:2633. Galvanizing shall be checked and tested in accordance with IS:2633. The galvanizing shall be followed by the application of an etching primer and dipping in black bitumen in accordance with BS:3416.
- 14.15.5 A screed concrete layer not less than 100 mm thick and of grade not weaker than M10 conforming to IS:456-1978 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
- 14.15.6 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
- 14.15.7 Doors and windows on external walls of the buildings (other than areas provided, with insulated metal claddings) shall be provided with RCC sunshade 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.
- 14.15.8 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 shall be provided in control buildings.
- 14.15.9 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.
- 14.15.10 Anti termite chemical treatment shall be given to column pits, wall trenches, foundations of buildings, filling below the floors etc. as per IS 6313 and other relevant Indian Standards

- 14.15.11 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 IS 277). All rungs for ladder shall also be galvanised as per IS:277 medium class

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

- 14.15.12 For all civil works covered under this specification, nominal mix by volume batching as per CPWD specification is intended. The relationship of grade of concrete and ratio of ingredients shall be as below :

S No	Mix	Cement	Sand	Coarse aggregate of 20 mm down grade as per IS 383
1	M 10	1	3	6
2	M 15	1	2	4
3	M 20	1	1.5	3

The material specification, workmanship and acceptance criteria shall be as per relevant clauses of CPWD specification and approved standard Field Quality Plan.

- 14.15.13 The details given in tender drawings shall be considered along with details available in this section of the specification while deciding various components of the building.

- 14.15.14 → Items/components of buildings not explicitly covered in the specification but required for completion of the project shall be deemed to be included in the scope

14.16 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/embedments, 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

14.17 WATER SUPPLY

- (i) Water shall be made available by purchaser at any feasible point near scope boundary at single point to the contractor. Contractor shall state the total water requirement both in terms of quantity and head to the purchaser.
- (ii) The contractor shall carry out all the plumbing/erection works required for supply of water in control room building beyond the single point as at (i).
- (iii) The contractor shall carry out all the plumbing/erection works required for supply of water to DG building cum FF pump house beyond the single point as at (i).
- (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 the Purchaser 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
- (vi) Bore wells and pumps for water supply is not in the scope of contractor

14.18 SEWERAGE SYSTEM

- (i) Sewerage system shall be provided for control room building cum administrative building
- (ii) The Contractor shall construct septic tank and soak pit suitable for 50 users in case of 400 & 220 kV sub stations and for 20 users in case of 132 kV and below sub stations.
- (iii) The system shall be designed as per relevant IS Codes.

14.19 STATUTORY RULES

- 14.19.1 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 Water Act for pollution control etc.

- 14.19.2 Provisions for fire proof doors, no. of staircases, fire separation wall, plastering on structural members (in fire prone areas) etc. shall be made according to the recommendations of Tariff Advisory Committee.
- 14.19.3 Statutory clearance and norms of State Pollution Control Board shall be followed as per Water Act for effluent quality from plant
- 14.19.4 Requirement of sulphate resistant cement (SRC) for sub structural works shall be decided in accordance with the Indian Standards based on the findings of the detailed soil investigation to be carried out by the Bidder.
- 14.19.5 Foundation system adopted by Bidder shall ensure that relative settlement and other criteria shall be as per provision in IS:1904 and other Indian Standards
- 14.19.6 All water retaining structures designed as uncracked section shall also be tested for water tightness at full water level in accordance with clause no. 10 of IS.3370 (Part-I).
- 14.19.7 Construction joints shall be as per IS: 456.
- 14.19.8 All underground concrete structures like basements, pumps houses, water retaining structures etc. shall have plasticizer cum water proofing cement additive conforming to IS:9103. In addition, limit on permeability as given in IS:2645 shall also be met with. 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, Injection Method shall be applied for repairing the leakage.
- 14.19.9 All building/construction materials shall conform to the best quality specified in CPWD specifications if not otherwise mentioned in this specification.
- 14.19.10 All tests as required in the standard field quality plans have to be carried out.