

8.1 GENERAL

- The civil works to be provided by the Contractor, in accordance with the Specification, shall include the design & construction of all the items required, in converter station, including site and general services; buildings; foundations; structures; noise, fire walls etc.
- Contractor shall carry out civil and associated works for covered store, foundation for valve cooling towers, false flooring for Control Room if any damaged during execution, valve-cooling room and its flooring. All areas used for equipment installation in the existing areas/building in station shall be restored to finished condition.
- All civil works shall satisfy the 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 and implied as per national / international Standards.
- All civil works shall be carried out as per applicable Indian Laws, BIS Codes. The Contractor shall furnish all design, drawings (in soft and hard editable versions), Contractor shall labour, tools, equipment, materials, temporary works, constructional plant, 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 directions of the Employer.
- All the Works shall be carried out according to the design/drawings to be developed by the Contractor and approved by the Employer.
- For all buildings, structures, foundations etc. necessary layout and details shall be developed by the Contractor keeping in view the functional requirement of the plant and facilities and providing enough space and access for operation, use and maintenance. Certain minimum requirements are indicated in this Specification for guidance purpose only. However, the Contractor shall provide according to the complete requirements.
- In case any item is not covered under specification then the same shall be carried out as per CPWD specifications and applicable Standards and IS

Codes. Any item for which specification is not provided herein and is not covered under CPWD specification shall be executed as per the best practices recommended by reputed manufacturers or the Public Works Department or International code practices or according to the instructions of the Engineer-in-Charge.

- All quality standards, fabrication and erection check lists, welding standards and other technical requirements as covered in the Specification shall be strictly adhered to by the Contractor.
- Standard Field Quality Plan (SFQP) appended with this specification shall be followed. All testing required shall be arranged by the Contractor at his own cost. Relevant clauses of CPWD specifications and IS codes shall be followed for items not covered in the standard FQP. For items not covered in FQP, CPWD specifications and IS Codes, the testing plan shall be as per international codes and industry practices.
- The supply of all materials including steel, cement etc. required for the civil works shall also be in the scope of the Contractor.
- The sub-vendors shall be assessed by the contractor in association with the Employer before finalizing the sub-contract.
- The bidder shall fully apprise himself of the prevailing conditions at the proposed site, Climatic conditions including monsoon patterns, local conditions and site-specific parameters, soil parameters, availability of construction material and shall include for all such conditions and contingent measures in the bid, including those which may not have been specifically brought out in the specifications.
- The material specification, workmanship and acceptance criteria shall be as per approved standard Field Quality Plan. In case certain item is not covered in FQP, it shall be constructed as per CPWD specification/ relevant BIS.

8.2 CIVIL WORKS DESIGN BASIS

8.2.1 GENERAL

- The Contractor shall design and construct all civil works to meet the requirements of the Specification and to be suitable for the intended use at the specified locations.

In particular the Contractor shall be responsible for obtaining all data not specifically detailed herein which is required to ensure compliance with the Specification.

- The foundations and structures shall be designed to ensure that relative movement over the specified life of the installation does not result in stresses in any part of the Works which exceed the maximum design levels.
- A design intent memorandum (DIM) to the effect shall be submitted by the Contractor for the Employer's specific approval giving details regarding his assumed data, loading for all civil design.

8.2.2 GEOTECHNICAL INVESTIGATION

The foundation of various buildings/ structures/ equipments/ shall be designed based on the recommendations of the soil report. If the soil report is not available with the employer the required soil investigation report shall be developed by the bidder after conducting the **one bore hole test at Store building location and one bore hole test at cooler foundation** for the design of the foundation.

- Bore holes of 150 mm diameter in accordance with the provisions of IS: 1892 up to 15meter depth into virgin soil or to refusal whichever occurs earlier shall be drilled.
By refusal it shall mean that a standard penetration blow count (N) of 100 is recorded for 30 cm penetration. In case rock is encountered within five meter from existing ground level or three meter from FGL, coring in all the boreholes shall be carried out up to 3 meter in rock.
- The Contractor shall carry out Standard Penetration Tests at approximately 1.5 m interval in the borehole starting from 0.5 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.
- The Contractor shall collect 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 0.5 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 laboratory without any damage or loss.
- The logging of the borehole 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.
- Chemical tests required for construction works shall also to be carried out.

8.3 SITE PREPARATION

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

8.3.1 EXCAVATION AND BACKFILL

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

8.3.2 COMPACTION

- The density to which fill materials shall be compacted shall be as per relevant IS and as per direction of Employer. All compacted sand filling shall be confined as far as practicable. Backfilled earth

shall be compacted to minimum 95% of the Standard Proctor's density at OMC. The sub grade for the roads and embankment filling shall be compacted to minimum 95% of the Standard Proctor's density at OMC. Cohesion less material sub grade shall be compacted to 70% relative density (minimum).

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

8.4 ANTIWEED TREATMENT & STONE SPREADING

8.4.1 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 Employer.
- Stone spreading along with cement concrete layer shall be done in the areas of the switchyard under present scope of work within fenced area. Outside the fenced area where no equipment is envisaged, the Employer may carryout landscaping in those areas. Landscaping shall not be in the Contractors scope.

8.4.2 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 Employer.

- The material to be used for stone filling/site surfacing shall be stone aggregate 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:

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

Sieve Size	% passing by weight
63mm	100
40mm	85-100
20mm	0-20
10mm	0-5

- Hardness : Abrasion value (IS: 2386 Part-IV) – not more than 40% Impact value (IS: 2386 Part-IV) – not more than 30%
- Flakiness Index : As per IS: 2386 Part I maximum value is 25%.
- Frequency of test shall be conducted for sieve analysis, Hardness & Flakiness index as per SFQP.
- After all the structures/equipments are erected, anti-weed treatment shall be applied in the switchyard where ever stone spreading along with cement concrete is to be done and the area shall be thoroughly de-weeded including removal of roots. The recommendation of local agriculture or horticulture department may be sought where ever feasible while choosing the type of chemical to be used. The anti-weed chemical shall be procured from reputed manufacturers. The doses and application of chemical shall be strictly done as per manufacturer’s recommendation. Nevertheless, the effectiveness of the chemical shall be demonstrated by the Contractor in a test area of 10MX10M (approx) and shall be sprinkled with water at least once in the afternoon every day after forty-eight hours of application of chemical. The treated area shall be monitored over a period of two to three weeks for any growth of weeds by the Engineer–in–charge. The final approval shall be given by Engineer–in–charge based on the results.
- 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.

- After anti-weed treatment is complete, the surface of the switchyard area shall be maintained, rolled/compacted to the lines and grades as decided by 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. 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 plate compactors. Due care shall be exercised so as not to damage any foundation structures or equipment during rolling compaction.

- The sub grade shall be in moist condition at the time the cement concrete is placed.

If necessary, it should be saturated with water for not less than 6 hours but not exceeding 20 hours before placing of cement concrete. If it becomes dry prior to the actual placing of cement concrete, it shall be sprinkled with water and it shall be ensured that no pools of water or soft patches are formed on the surface.

- Over the prepared sub grade, 75mm thick base layer of cement concrete in 1:5:10(1 cement : 5 fine sand : 10 burnt brick aggregate/stone aggregate) shall be provided in the area excluding roads, drains, cable, trenches as per detailed engineering drawing.
- In case acceptable quality of burnt brick aggregate is not available in any of the locations stone aggregate shall be used without any financial implication to POWERGRID.
- 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.

- The cement concrete shall be laid over a saturated sub-grade to ensure avoiding of leaching of slurry. A layer of cement slurry of mix 1:6 (1cement: 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.
- 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.

8.5 DRAINAGE

8.5.1 SITE DRAINAGE

The Contractor shall provide rain water drainage system within the switchyard fencing wherever required. Connection at one or more locations to the Existing drains located inside the station is in the scope of the Contractor.

While designing the drainage system following points shall taken care of:

- The surface of the switchyard shall be sloped to prevent accumulation of water.
- Drain shall be constructed on one or two suitable sides of roads. In the switchyard maximum spacing between two drains shall not be more than 100 meter. It shall be ensured that no area is left un- drained.
- RCC open storm water drains shall be suitably designed with Pre-cast or cast in situ.
- 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.
- 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.
- For pipe drains, concrete pipe of class NP3 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. Design of RCC pipe drain for road crossing shall be provided.

- Pipe drains shall be connected through manholes at an interval of maximum 30m.
- The drainage scheme and associated drawings shall be approved by the Employer before commencement of construction.
- Placing drains on filled up soil shall be accepted. However, the layers of soil for a depth of 500 mm below such drains shall be compacted to a proctor density of 95%.

8.6 ROADS

- All roads shall be concrete road (rigid) pavement.
- Adequate turning space for vehicles shall be provided and bend radii shall be set accordingly. Road to the Converter/Power transformer/ Reactor shall be as short and straight as possible.
- CPWD specification shall be followed for construction of Roads.
- The minimum section of road shall consist 300 mm thk consolidated Water Bound Macadam or Wet Mix Macadam in three layers (each 100 mm thk.) provided over well compacted soil (95% of dry Proctor density). 100 mm thk PCC (1:4:8) layer shall be laid over WBM. Top layer shall consist of 100 mm thick M25 Grade RCC vacuum dewatered with 8 mm dia reinforcement 300 mm c/c bothways.
- The camber of 1:50 shall be provided all along the road. Expansion joints (12mm thick) shall be provided. Polythene sheet of 125 microns shall be placed between the PCC & RCC. 100 mm dia RCC Hume pipe (NP-3) shall be placed across the road wherever required. The finished top of road crest shall be 175 mm (minimum) above F.G.L. (switchyard formation level).
- If expansive soil is encountered at founding level, it shall be removed to a minimum depth of 300 mm and shall be replaced by well compacted CNS material in 3 equal layers.

- All the culverts and allied structures (required for road/rail, drain, cable trench crossings etc.) shall be designed for class AA loading as per IRC standard / IS code and should be checked for transformer loading also.
- The road outside the switchyard fenced area and shall have shoulder of 1.75 m in case of 7.0m wide road and 1.3 m in case of 4.5m wide road with Kerb stone at the two side ends of the road. Factory made Paver blocks M-30 grade shall be laid on the earthen shoulders. Kerb stone with M-25 grade are to be provided at both the side of the roads. The Kerb stone on both sides of the roads shall be painted yellow and black alternatively. Main approach road towards Service building shall be 7.0 m with the same features as stated above.
- In case of all other switchyard roads 600mm wide compacted earthen shoulder shall be provided on both sides of road without Kerb stones and paver blocks.
- Dedicated roads along with drain crossing, for Breakers maintenance are to be provided.

8.7 FOUNDATIONS AND OTHER RCC CONSTRUCTIONS

8.7.1 GENERAL

- Work covered under this Clause comprises the design, supply and construction of foundations and other RCC constructions for switchyard structures, equipment supports, trenches, drains, jacking pad, pulling block, fencing, boundary wall, control cubicles, bus supports, transformers, reactors, marshalling kiosks, auxiliary equipments & systems, buildings, tanks, rail tracks or for any other equipment or service and any other foundation/RCC construction required to complete the work. This clause is as well applicable to the other RCC constructions.
- **Reinforced Cement Concrete**
 - a. The environmental exposure condition of the site falls under severe category as per IS:456. All RCC shall be of Design mix with minimum M-30 grade for all RCC Structure and Foundation including boundary

walls, Cable Trenches, RCC drains, labour hut etc. irrespective of grade of concrete mentioned in drawing.

- b. The type of cement to be used for this project shall be as per the recommendation of soil consultant/ soil investigation report.
 - c. All foundations surfaces including boundary walls, Cable Trenches, underground RCC works, RCC drains etc. touching with soil shall be painted with bituminous or silica-fluoride coatings as per IS:456. The cost of painting/coating shall be deemed to be included in the corresponding item of BPS.
 - d. Water used for mixing of any type of concrete and curing shall be conforming to IS: 456.
- Only weigh batching shall be allowed for design mix concretes. In case, where the concrete volume is very small nominal mix conforming to CPWD specification may be used.
 - Ready mix concrete Confirming to IS: 4926, of design mix stipulated in this TS of reputed manufacturer such as LAFARGE, ACC, ULTRATECH or manufacturer of similar repute shall be accepted. However, Site-in-charge shall approve the source of materials.
 - The switchyard foundations plinth and building plinth shall be minimum 300 mm and 750 mm above finished ground level respectively. In case of Valve Halls the plinth level shall be decided based on electrical clearances and maintenance requirements. □Minimum 75 mm thick lean concrete 1:4:8 (1 cement: 4 coarse sand: 8 stone aggregate 40mm nominal size) shall be provided below all underground structures, foundations, trenches etc. to provide a base for construction.
 - Concrete made with Portland Pozzolana or slag cements cement shall be carefully cured and special importance shall be given during the placing of concrete and removal of shuttering. In case of encountering of aggressive soils and sub soil water OPC/PPC Sulphate resisting cement shall be used for foundations as per the provisions of IS 456.
 - Precast foundations for tower and equipments shall also be accepted.

- For water retaining structure pressure grouting shall be carried out as per requirement.
- **Reinforcement Steel**
 - a. The corrosion resistant steel (CRS) shall be used.
 - b. The minimum grade of reinforcement steel shall be 500D.
 - c. Clear cover to reinforcement shall be as per IS: 456.
- Dense concrete with controlled water cement ratio preferably 0.45 (As per IS 456) 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.
- 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/ Contractor.
- Foundation system adopted by the Contractor shall ensure that relative settlement shall be as per provisions in IS-1904 and other Indian Standards.
- Water retaining structures designed as un-cracked section shall also be tested for water tightness at full water level as per clause no. 10 of IS-3370 (Part-I).
- Construction joints at the following locations shall be provided
 - a. At the meeting points of the columns and the raft.
 - b. At the points of contra flexure in the columns. Additional reinforcements and shear keys shall be provided at the construction joints.
- All underground concrete structures like pump 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 coats of bituminous painting for water/damp proofing. In case of water leakage in the above structures, Injection grouting shall be applied for repairing the leakage.

- A screed of concrete layers not less than 100 mm thick and of grade not weaker than M10 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.

8.7.2 DESIGN

- All the foundations shall be of reinforced cement concrete. The design and construction of RCC structures shall be carried out as per IS-456.
- The design and construction of steel-concrete composite beam shall be carried out as per IS-11384.
- For detailing of reinforcement IS-5525 and SP: 34 shall be followed. However, in specific areas, mild steel (Grade I) conforming to IS-432 can also be used with specific approval of the Employer. Clear cover to reinforcement shall be as per IS: 456.
- RCC water retaining structures like storage tanks, cooling water basin etc. shall be designed as un-cracked section in accordance with IS-3370 (Part-I to IV) by working stress method. However, water channels and substructure of pump house shall be designed as cracked section with limited steel stresses as per IS-3370 (Part I to IV) by working stress method.
- 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 super structure, and other conditions, which produces the maximum stresses in the foundation or the foundation component and as per relevant IS codes.
- 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 there of. The spread footings foundation or pile foundation as may be required based on soil/sub-soil conditions and superimposed loads shall be provided.

- When pile foundations are adopted, the same shall be cast-in-situ/driven/bored type as per relevant IS. Only RCC piles shall be provided. Suitability of the adopted pile foundations shall be justified by way of full design calculations. Detailed design calculations shall be submitted by the Contractor showing complete details of piles/pile groups proposed to be used. Necessary initial load test shall also be carried out by the Contractor at their entire cost, to establish the piles design capacity. Only after the design capacity of piles has become established, the Contractor shall take up the job of piling. All the work (design & testing) shall be planned in such a way that these shall not cause any delay in project completion.
- All foundations shall extend to a depth of at least 500 mm below virgin ground level as stipulated in IS 1904.
- For small structures like minor foundations of marshalling kiosks, fire fighting pipe line pylon supports, fencing posts, cable trenches, drains etc., coming on filled up soil, layers of soil for a depth of 500 mm below foundation shall be compacted to a proctor density of 95% before laying PCC. Foundations for equipments other than main block for Reactor, CB and Transformers may also be placed on filled soil provided the net intensity of soil pressure does not exceed 5 t/sqm.
- All R.C.C. piles (including short piles) shall be suitably anchored into hard virgin strata. The friction resistance of back fill earth shall be neglected for calculation of pile capacity for design purposes, however negative friction due to earth fill, if any, has to be duly considered for deciding pile capacity.
- Designs shall consider any sub-soil water pressure that may be encountered following relevant standard strictly.
- Necessary insulation shall be provided in reinforcement steel to avoid closed loops, wherever required e.g. reactor foundations.
- 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.
- RCC columns shall be provided with rigid connection at the base.

- All building sub-structures including pump houses shall be checked for sliding and overturning for 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.
- Earth pressure for all underground structures shall be calculated using coefficients of earth pressure at rest; co-efficient of active or passive earth pressure (whichever is applicable). However, for the design of substructure of any underground enclosures, earth pressure at rest shall be considered.
- In addition to earth pressure and ground water pressure etc., a surcharge load of minimum 2 T/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., to account for the vehicular traffic in the vicinity of the structure.
- Following conditions shall be considered for the design of substructure of pump house, channels, sumps, tanks, trenches and other underground structures: -
 - a. Full water pressure from inside and no earth pressure & ground water pressure & surcharge pressure from outside (applicable 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.
- Base slab of the any underground enclosure/tank shall also be designed for its 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.

- 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 enclosure shall be designed considering water in one pump sump only and the other pump sump being empty e.g. for maintenance.
- 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. Foundation settlements shall, in no case, exceed the permissible limits specified in relevant Indian Standard Specification.
- All machine foundations shall be designed in accordance with the provisions of the relevant parts of IS-2974, IS-456 and IS-2911. The provisions of DIN-4024 (latest) shall also be followed.
- For the foundations of rotating machines, detailed static and dynamic analysis shall be done. A fatigue factor of at least 2.0 shall be considered for dynamic forces. Minimum reinforcement shall be governed by IS-2974 as well as IS-456. RCC design shall be done by working stress method.
- For the foundations supporting minor equipments weighing less than one ton or if the mass of the rotating parts is less than one-hundredth of the mass of the foundation, dynamic analysis is not must. However, if such minor equipment is to be supported on building structures, floors etc. suitable vibration isolation shall be provided by means of springs, neoprene pads etc. and such vibration isolation system shall be designed suitably.
- All other foundations shall be designed in accordance with the provisions of the relevant parts IS-2911 and IS-456.
- Factor of safety for design of tower, equipment foundation shall be 1.5 in both normal and short circuit condition as per IS 456.
- Minimum two piles shall be provided in any pile group.

- Factor of safety for stability of tower, equipment foundation like overturning shall be 2 (without wind or seismic), 1.5 (with wind or seismic) for normal and short circuit condition as per IS 1904.

8.7.3 ADMIXTURES & ADDITIVES

- 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 labeled containers to enable identification.
- 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 the Employer.
- The Contractor shall use an approved neutralized vinsol resin or air-entraining agent in concrete. The Air-entraining agent shall be supplied and batched as a solution with a solid content not exceeding 15% by weight with suitable, stable and consistent pH. Air- entraining requirements shall be in accordance with CP 100 Part I.
- The Contractor can propose and the Employer, at his discretion, may approve the use of a water-reducing set retarding admixture in some of the concrete. The use of such an admixture shall 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 overcoming unusual circumstances and placing conditions.
- The water-reducing set-retarding admixture shall be an approved brand of ligno-sulphonate type admixture.
- The water-proofing cement additives shall be used only after approval of the Employer.

8.7.4 HOT WEATHER REQUIREMENTS

- During hot weather all necessary precautions, as per relevant Codes, shall be taken to avoid premature stiffening of the fresh mix and to reduce water absorption and evaporation losses and when the temperature of the surrounding air is higher than 30°C. The following shall apply unless otherwise approved by the Employer:
 - a. The formwork shall be continuously sprayed with cold water in advance of concreting and excess water shall be removed from inside the forms immediately prior to placement of concrete.
 - b. The reinforcement and the formwork (if metal forms are used), shall be protected from the effects of hot winds and direct sunlight.
 - c. Suitable barriers shall be provided to protect the freshly placed concrete from wind until the concrete is sufficiently hard to allow it to be covered according to (e) below.
 - d. The concrete when placed shall be maintained at a temperature of less than 30 degree C by the use of chilled mixing water or by spraying the aggregate with cold water.
 - e. The concrete shall be mixed, transported, placed and consolidated as rapidly as possible and shall then be covered with an impervious membrane or wet Hessian until moist curing **begins**.
- Curing compounds shall not be used as an alternative to the requirements of Clause 8.4.3.
- During hot weather (atmospheric temperature above 40 deg C) or cold weather (atmospheric temperature at & below 5 deg C) the concreting shall be done as per the procedure set out in IS-7861 (Part I & II).

8.8 CABLE & PIPE TRENCHES

- RCC trenches (Pre-cast/Cast-in-situ) with pre-cast removable concrete covers (with lifting arrangement) shall be designed to withstand surcharge loads of 1000 kg/m² from maintenance trucks and a concentrated load of 200 kg at mid span of cover. Cable trenches shall also be designed with water pressure along with earth pressure.

- Cable trench dimensions, cable support details etc. shall be provided as per the requirements. Box culverts or NP3 Pipe for cable trench crossings with road shall be designed for class AA loading as per IRC standard/ IS code and should be checked for transformer loading. Box culverts of suitable width shall also be provided at appropriate locations to facilitate movement of cranes/trucks for a load of at-least 30 tones to access all switchyard equipment areas.
- Trenches shall be drained. Necessary sumps and sump pumps shall be supplied, as required. Cable trenches shall not be used as storm water drains. All necessary pumps shall be of submersible type with auto start/stop facility.
- The top of trenches shall be kept at least 150 mm above the final gravel level and be constructed such that the surface rain water do not enter the trench.
- All metal parts inside the trench shall be connected to the grounding system.
- Cables from trench to equipment shall run in hard conduits that are heavy duty PVC pipe.
- Trench wall shall not foul with the foundation. Suitable clear gap shall be provided.
- A clear (vertical) space of at least 300 mm shall be available for each tier in cable trench. From trench bed to lowest tier, a minimum clearance of 200 mm shall be available for one tier trench & 300 mm for trench having more than one tier.
- At least the following tray to opposite wall (and between trays for multi row trench) clear clearance shall be available:

• For trench having depth	• Minimum clearance
• <500 mm	• 200 mm
• 5001 to 1000 mm	• 400 mm
• >1000 mm	• 500mm

- The Contractor may use steel brackets to support cable as per section 6.16 of this specification.
- The trench bed shall have a slope of 1/1000 along the run & 1/250 perpendicular to the run.
- In case of cast-in-situ in water logged areas, the joints of cable trenches i.e. between base slab to base slab and the junction of vertical wall to base slab as well as from vertical wall to wall shall be provided with approved quality PVC water stops of approx. 230 mm x 5 mm size for those cable trenches where the ground water table is expected to be above the junction of base slab and vertical wall of cable trenches.
- Suitable expansion joints with PVC water stops and bitumen impregnated board sealing shall be provided at an approximate interval of 30 m for all sections of cable trenches.
- Cable trench cover shall be designed and casted with RCC M-30 without providing edge protection angles. Angles with lugs shall be provided for edge protection along the edge of the cable trench wall. However no edge protection is required for pre-cast cable trenches.
- Adequate fire and water sealing shall be provided to all cable trenches at the junction of cable trench entry into a building.
- Placing of cable trench on filled up soils shall be accepted. However, the layers of soil for a depth of 500 mm below such cable trench shall be compacted to a proctor density of 95%.

8.9 BUILDINGS

8.9.1 DIMENSIONS

- The building design shall take into consideration the layout of the panels, equipment, etc, in order to allow enough area for maintenance.
- An open space as per IE rules shall be provided on the periphery of the rows of panels, and equipment generally, in order to allow easy operator movement and access as well as maintenance.

8.9.2 DESIGN

The buildings shall be designed:

- to the requirements of the National Building Code of India, and the standards quoted therein, and as specified in this Specification;
- for the specified climatic & loading conditions;
- 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;
- with a functional and economical space arrangement;
- for a life expectancy of structure, systems and components not less than that of the equipment which is contained in the buildings;
- Should be aesthetically pleasing. Different buildings shall show a uniformity and consistency in architectural design;
- to allow for easy access to equipment and maintenance of the equipment; wherever access to roof is required.
- with, wherever required, fire retarding materials for walls, ceilings, doors etc., which would prevent supporting or spreading of fire;
- with material preventing dust accumulation.
- Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with a provision of twin columns.
- 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.
- Permissible stresses for different load combinations shall be taken as per relevant IS Codes.
- All steel buildings shall be designed by using IS 800-2007 LSD.
- Design of RCC floor/roof slab shall be carried out either by limit state method or working stress method.
- Sunken RCC slab shall be provided in false flooring area so as to keep the finished floor level of these areas same as that of the surrounding area.

- Minimum height of skirting above finished floor level shall be 150 mm.
- All up stands and parapet walls on roof shall be of RCC construction for buildings wherever technically required. Minimum height of parapet walls shall be 750 mm.
- All Cable trenches, wherever required inside the building, shall be covered with minimum 6 mm thick chequered plate.

8.9.3 DESIGN LOADS

- Building structures shall be designed for the most critical combinations of dead loads, super-imposed loads, equipment loads, erection loads, crane loads, wind loads, seismic loads, short circuit loads and temperature loads.
- Dead loads shall include the weight of structures complete with finishes, fixtures and partitions and shall be taken as per relevant IS codes.
- Super-imposed loads in different areas shall include live loads, minor equipment loads, cable trays, small pipe racks/hangers and erection, operation & maintenance loads. Equipment loads shall constitute, if applicable, all load of equipment to be supported on the building frame including those expected during erection.
- For crane loads an impact factor of 30% and lateral crane surge of 10% of (lifted weight + trolley weight) 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 - 1987, Seismic Coefficient method/Response Spectrum method shall be used for the seismic analysis as per IS 1893 (Part-I) for all buildings. However for valve hall and all stack-like structures, IS 1893 (Part-IV) shall be used. Response spectrum method shall be used for the seismic analysis using at least first 14 modes of vibration.
- For temperature loading, the total temperature variation shall be considered as 2/3 of the average maximum annual variation in

temperature. The average maximum annual variation in temperature for the purpose shall be taken as the difference between the mean of the daily minimum temperature during the coldest month of the year and mean of daily maximum temperature during the hottest month of the year. The structure shall be designed to withstand stresses due to 50% of the total temperature variation.

- Wind and Seismic forces shall not be considered to act simultaneously.
- Floors/slabs shall be designed to carry loads imposed by equipment, cables, piping, travel of maintenance trucks (if required) and equipment and other loads associated with the building. In general, floors shall be designed for live loads as per relevant IS and cable and piping loads, if applicable, of not less than 5 kN/sq.m hanging from the underside.
- In addition, beams shall be designed for incidental point loads of 20 kN to be applied at any point along the beams. The floor loads shall be subject to the Employer's approval.
- For consideration of loads on structures, IS-875, "Code of practice for structural safety of buildings" shall be followed. The following minimum superimposed live loads shall, however, be considered for the design:
 - a) 150 kg/m² for accessible roofs
 - b) 75 kg/m² for non-accessible roofs
 - c) RCC Floors: 500 kg/m² or actual requirement, if higher than 500 kg/m², based on equipment weight and layout plans but 1000 kg or more shall be taken for GIS floor.

d) Stairs & balconies	500 kg/m ²
e) Toilet Rooms	200 kg/m ²
f) Chequered plate floor	400 kg/m ²
g) Walkways	300 kg/m ²

8.9.4 SUBMISSIONS

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

- The architectural drawings, layout of buildings
- Design criteria for structural steel and reinforced concrete design. The criteria shall comprise the codes and standards used, applicable climatic data including wind loads, earthquake factors and 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.
- Structural design calculations and drawings (including construction/fabrication) both hard and soft copies for all reinforced concrete and structural steel structures.
- Fully dimensioned floor plans, cross sections, longitudinal sections and elevations of each building identifying the major building components.
- 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.
- Product information of building components and materials, including walls, partitions, flooring, ceilings, roofing, doors, wall paneling and windows and building finishes.
- A detailed schedule of building finishes including colour schemes.
- A door & window schedule showing door & window types and locations, 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.

8.9.5 FALSE FLOORING

- Entire false flooring to be replaced as per the site requirement and as per the direction of site-in –charge.
- The false floor system to be installed shall provide a maximum finished floor height of 750mm/ as per the site from the existing floor level. The system shall provide for suitable pedestal and under structure design to withstand various static loads and rolling loads. The entire access floor system shall provide for adequate fire resistance, acoustic barrier and air leakage resistance. The system shall be able to accept an independent floor covering i.e. antistatic PVC/ Laminate with PVC beading. The under structure should be able to withstand a UDL of 1080 Kg/m² and a point load of 360kg.
- The under structure should be able to accept a pedestal axial load of 2200kg. Panels should be made from steel. The bottom of panel shall be embossed in hemispherical shape to give strength and flexural rigidity. The top sheet shall be plain and resistant welded at various locations after the top and bottom sheets have been degreased and phosphated. The above hollow panel shall have an infill of light weight cementitious material. The entire panel shall be coated with epoxy coating on the exposed surface.
- The surface shall have factory laminated anti – static PVC/ Laminate with PVC beading on all sides for edge protection. Panel shall provide for impact resistance top surface minimal deflection, corrosion resistance properties and shall not be combustible or aid surface spread of flame. Panel shall be free standing on to the under structure with stringers. Pedestal installation to support the panel shall be suitable to achieve a minimum finished floor height of 750mm height of 750mm from the existing floor level. Pedestal shall support an axial load of 3500kg.

8.9.6 FALSE CEILING SYSTEM:

- Repair/ Modification/ Replacement of existing false Ceiling shall be done only for the damages done by the bidder during execution in control room.
- False ceiling with approx. 600x600 mm size panels shall be provided as per the drawing where ever is required.
- The specification of false ceiling is as below:
15mm thick approximately 600 X 600mm Mineral fiber board panel false ceiling and making cut-outs for electrical fixtures, AC diffusers, openable access etc complete with silhouette profile system with 15mm wide flange incorporating 6mm central recess white / black main runners at 1200mm centre-centre and not greater than 600mm from the adjacent wall. The cross tees shall be provided to make a module of approximately 600mm X 600mm by fitting 600 mm long cross tees centrally placed between 1200 mm long cross tees. Cross tees also have 15mm wide flange incorporating 6mm central recess white/black. The module formed above shall be anchored to the slab with channels or angles, suspenders as per manufacturer's specifications.

8.9.7 PRE-ENGINEERED STORE BUILDING

The building will consist of all components required to construct the primary and secondary framing (wind bents, wall & roof purlins) plus the wall and roof cladding. The plinth level of building shall be 750 mm above FGL.

General Features

- Type : TCCS (Tapered Column Clear Span)
- Size : About **18mx80M** (without any internal columns) Eave height : 7.0m clear under the knee
- Roof slope : 1 in 10 Frame : Rigid Frame with clear span
- Roof panel : as per detailed product specification as under.
- Wall panel : as per detailed product specification as under.
- Girts : Sidewall girts and end wall girts are mounted on the exterior face of the main column.
- Fasteners : Mechanically galvanised Hex-washer head self-drilling fasteners with integral EPDM seals (Grade AS3566/Class 3 with EPDM washer).
- Accessories : Flashing, trims, eave gutters & downspouts.
- Doors : as per manufacture specification/recommendation
- Ventilator : Aluminium Glazed
- Flooring : Minimum 100 mm thk. ready mixed concrete Vacuum Flooring dewatered floor in M-25 grade concrete with hardener and nominal reinforcement over 100 mm thk. 1:4:8 PCC laid over well compacted stone soiling of minimum 200 mm thick using stone of size 150 mm & below with interstices filled with sand over 100 mm thk. local sand bed
- The store building shall be pre-engineered fabricated in the factory and shall be assembled at site.

- These structures shall be mounted on the RCC foundation by means of base plate, foundation bolts etc. Erection joints can be bolted joints with high strength friction grip bolts.
- Manufacturing Quality Plan (MQP) of Pre-engineered Buildings shall be finalized after award of work and finalization of sub vendor for this package. The fabricated steel work/ pre-fabricated buildings shall be inspected as per approved Manufacturing quality plans and certified by the owner or his authorised representative as satisfactory before it is dispatched to the erection site. Such certification shall not relieve the contractor from his responsibility regarding adequacy and completeness of fabrication.
- The pre-engineered structure manufacturers shall be as per Compendium of vendors of POWERGRID.
- The conceptual design drawings will be verified and approved by the employer, All other drawings required for fabrication shall be verified by the bidder and to be submitted to the employer for information.
- **THE WORK INCLUDES:**
 - i. Rigid frame structural for columns, rafters with end plates, purlins, girts.
 - ii. All necessary flashings, trims, eave gutters & downspout
 - iii. Roofing & cladding sheets
 - iv. Structural hardware & sheeting fasteners
 - v. End lap sealant
 - vi. Bracing
 - vii. Anchor bolts and templates
 - viii. All structural steel shall be supplied with one coat of primer followed by one coating of epoxy paint and final coating of PU (min. 100 microns).
Two nos. rolling shutters of min size 3.0Mx5.0M above 2.5m wide canopies with Single skin Roof Liner.
 - ix. Wall mount fans-20 nos. and Industrial exhaust fans 8 nos.
 - x. All Civil, Electrical and services works.

- xi. The installation shall be done in accordance to the standard practices as specified by the manufacturer or as approved by the Engineer-in-charge.

8.9.8 MATERIAL SPECIFICATION FOR PRE ENGINEERED BUILDINGS:

8.9.7.1. PRIMARY STRUCTURAL STEEL MEMBERS

1. Primary structural framing shall include the transverse rigid frames, columns, corner columns, end wall wind columns and crane gantry girders and Frames at Door openings.
2. All hot rolled plates, miscellaneous structural members, rod bracings, angle bracings, wind bracings, sag rods, etc. shall conform to the physical specification of IS: 2062.
3. All structural pipes material and their grade shall be as per IS 1161. Designation of the pipes shall be as per approved drawings.
4. All the materials used for making of the columns or Rafters in the form of I section by cutting hot rolled plates with double side welding shall be as per the material grade designation E350 and quality BR. However, vendor may supply B0 and C type material without any additional cost implication to POWERGRID.
5. All other hot rolled members shall be as per the material grade designation E250.
6. All welded structural steel members shall be provided with suitable treatment of shot blasting SA 2.5 before application of steel primer. Protective coating shall be applied to the surface of all the structural steel members after grit/shot blasting of structural members. The final DFT (dry film thickness) shall not be less than 200 microns. The complete Work shall be as below: Shot blasting to SA 2 ½ + Zinc silicate primer of thickness 40-60 microns DFT + MIO (Micaceous Iron Oxide) Epoxy Intermediate coat of thickness 100-120 microns DFT + PU (Polyurethane) finish coat of thickness 40-60 microns DFT.
8. The structural steel members of cage ladder shall be galvanized with 900gm/sqm.

8.9.7.2. SECONDARY STRUCTURAL MEMBERS -PURLINS AND GIRTS

MEMBERS:

1. Purlins, girts, necessary clips and other cold rolled structural members shall conform to IS:277 and IS 513
2. The class designation of materials is GP-350 class 1 and class of coating 275 inclusive of both sides.
3. The minimum thickness of all purlins and Girts shall be 2.5mm.

8.9.7.3. ROOF & WALL SHEETING, CLOSURES, FLASHINGS, TRIMS, GUTTERS & DOWNSPOUTS:

1. Factory assembled 50mm thick puff (overall average density 40kg/cu.m. +/- 2 Kg/cu m as per IS: 11239 Part-2) sandwiched panels shall be provided for Roof & wall sheeting.
2. These panels shall be made of puff insulation sandwiched between two high tensile steel sheets each of 0.5 mm thickness (TCT).
3. The material of sheets for ROOF & WALL SHEETING, CLOSURES, FLASHINGS, TRIMS, GUTTERS & DOWNSPOUTS shall confirm IS 15961 & IS 15965 with material designation IS: 15965/YS350/AZ150 class 3.
4. The steel sheets of walls & roofing panels, Trims, Downspouts, Flashings, Gutter etc. shall be provided with 200 GSM zinc aluminium coating. After zinc aluminium coating, the external face of the steel sheet shall be provided with PVDF (Polyvinyl di fluoride) paint coating in place of SMP (Silicon Modified Polyester) paint.
5. The tolerance of base metal thickness (BMT) of steel sheet shall be as per IS 16163. After hot dip coating of Zinc aluminium alloy, the sheet shall be provided with steel primer and silicon modified polyester (SMP) paint. The total thickness of primer and paint shall be 40 microns inclusive of both sides (TCT) comprising of 20 microns of SMP paint on top surface and 10 microns of backer coat (polyester coat) on back surface over 5 microns thick primer each on both surfaces with inorganic pigments coated free from heavy metals.

6. In case SMP paint is not available, Super Durable Polyester paint (SDP) can also be used by the bidder without cost implication to POWERGRID.
7. Flashing and / or trim shall be furnished at the rake, corners, eaves, and framed openings and wherever necessary to provide weather tightness and finished appearance. Colour shall be matching with the colour of wall/Roof.
8. Solid or closed cell closures matching the profiles of the panel shall be installed along the eaves, rake and other locations. It should be specifically specified on drawings.
9. Gutters and downspouts shall be adequately designed to ensure proper roof drainage system.

8.9.7.4. SHEETING FASTENERS:

Standard fasteners shall be self-tapping zinc plated metal screws with EPDM bonded zinc plated washers. All screws shall be colour coated to match roof and wall sheeting.

8.9.7.5. SEALER:

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

8.9.7.6. WALL LIGHTS:

For day lighting purpose of GIS hall, minimum 2 mm thick approved translucent polycarbonate sheet shall be provided for wall lighting in addition to windows for at least 10% of wall area on upper portion of both long walls. The polycarbonate sheet shall be fixed with necessary EPDM/rubber gasket, Silicon Sealant, cold forged fastener, aluminum profile etc. including MS supporting structural steel (conforming to IS:1161/4923) frame to ensure water tight arrangement.

8.9.7.7.CONNECTIONS:

A) SITE CONNECTIONS

All primary bolted connections shall be provided with galvanized high strength bolts, washers, nuts conforming to specifications of grade 8.8 of IS 1367. All secondary bolted connections shall be furnished with bolts, nuts, washers conforming to the specifications of grade 4.6 of IS 1367.

Foundation bolts shall be as per IS: 5624.

B) SHOP CONNECTIONS

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

8.9.7.8. VENDORS & MQP FOR PEB BUILDINGS

1. All the material required for Pre-engineered (steel) building shall be procured from approved vendors as per list of compendium of vendors available on POWERGRID web site or any other reputed manufacturer for which prior approval shall be obtained from POWERGRID.
2. Manufacturing of various parts of the building shall start only after approval of "Manufacturing Quality Plan". Design and structural drawings shall be approved by POWERGRID.

8.9.7.9. FABRICATION DRAWINGS AND APPROVAL:

1. Shop/fabrication showing each and every detail along with bill of material for all members of structures, joints, nuts & Bolts, welding shall be prepared and approved by vendors as per standard practice of fabrication based on POWERGRID approved design and structural drawings.

2. Complete material shall be offered for inspection by CC (Corporate Centre) QA&I department before dispatch. Inspection of Material by POWERGRID CC QA &I deptt. shall be carried out based on Shop/fabrication drawing and BOM as approved by Vendors. Approval of BOM and shop/fabrication drawings from Employer is not required.

8.9.7.10. Installation and Maintenance manuals:

3 sets of standard Installation and maintenance manuals needs to be submitted at site for information purpose by the successful bidder during execution of work at the site.

8.9. 8 VALVE HALLS:

- The scope in this building is for changing the existing equipment of inside valve halls with new ones. In this regard, whatever available existing data of the Valve hall building is attached as a part of the tender specification. However, the bidder is advised to visit the site once to acquaint themselves with the requirement of the works or for if any data is necessarily required for bidding purpose.
- The structural/Architectural damages if any observed or made during the erection of equipment shall be repaired by the bidder
- The Building shall be properly sealed to avoid ingress of air and Rain water
- Protective coating shall be applied to the surface of all the structural steel members after grit/shot blasting of structural members. The final DFT (dry film thickness) shall not be less than 200 microns. The complete Work shall be as below: Shot blasting to SA 2 ½ + Zinc silicate primer of thickness 40-60 microns DFT + MIO (Micaceous Iron Oxide) Epoxy Intermediate coat of thickness 100-120 microns DFT + PU (Polyurethane) finish coat of thickness 40-60 microns DFT.

- The colour and specification of the paints and other finishing materials for refurbishing the building shall be same as the existing material type or as per the direction of site –in-charge.
- The rate of civil works for Valve hall shall include all the above said works, refurbishing the building structurally, architecturally, floor finish by using 2 coats of PU, making good in all respects, other associated works which are required for healthy commissioning of the building.

8.9.9 MAIN SERVICE BUILDING

- The scope in this building is for replacement of the battery charger in the battery room, in the control room and other associated miscellaneous works.
- In this regard, all the available existing data of the Main service Building is attached as a part of the tender specification. However, the bidder is advised to visit the site once to acquaint themselves with the requirement of the works or for if any data, which is necessarily required for bidding purpose.
- The structural/Architectural/false floor damages if any observed or made during the erection of equipment shall be repaired by the bidder without any cost implication to POWERGRID.
- The colour and specification of the paints and other finishing materials for refurbishing the building shall be same as the existing material type or as per the direction of site –in-charge.
- The rate of civil works of Main service Building shall include all the above said works making good in all respects, architecturally, strengthening of the building required if any, repairing of false flooring inside control room if any, other associated works which are required for healthy commissioning of the building.

8.9.10 Valve Hall Cooling Room:

- The scope in this building is for replacement of the existing equipment inside of the building with new equipment and other associated works.
- In this regard, all the available existing data of the said buildings is attached as a part of the tender specification. However, the bidder is advised to visit the site once to acquaint themselves with the requirement of the works or for if any data is necessarily required for bidding purpose.
- Construction of new foundations for the coolers, further any modification/ refurbishment/ making good of existing road for crossing of cooling pipes is also in the scope of work.
- After dismantling of existing cooling system, valve hall cooling system etc. the existing flooring of the building is to be rectified and the floors of rooms shall have concrete metallic hardener floor finish matching with the existing material type or as per the direction of site –in-charge.
- The structural/ Architectural/ floor damages if any made during the erection of equipment shall be repaired by the bidder.
- Two coats of PU coating (100microns) over the floor shall be provided after installation of new equipment.
- The colour and specification of the paints and other finishing materials for refurbishing the building shall be same as the existing material type or as per the direction of site –in-charge
- The rate of civil works of Valve Hall cooling Room shall include all the above said works making good, architecturally, repairing of flooring if required, other associated works which are required for healthy commissioning of the building.

8.10 STRUCTURAL STEEL

- The scope shall include supply and erection of all types of structures which are required for completion of scope as per chapter-1 including bolts, nuts, washers, hangers, shackles, clamps anti-climbing devices, bird guards, step bolts, inserts in concrete, gusset plates, equipment mounting

bolts, structure earthing bolts, foundation bolts, spring washers, fixing plates and any other items as required to complete the job.

- Structural steel conforming to Grade A of E250 for MS and E350 for HT shall be acceptable for lattice structures.
- All steel structures and anchor/foundation bolts shall be fully galvanized. The weight of the zinc coating shall be at least 900g/m² for anchor bolts / foundation bolts and for structural members.
- In case structural members are under 5 mm, but not less 2 mm, weight of zinc coating shall be 900g/m².
- One additional nut shall be provided below the base plate which may be used for the purpose of leveling. **A lock nut shall be provided on top of the nut.**
- For filter equipment, valve cooling towers and for equipments inside of valve hall etc anchor fasteners may be used.
- All structural steel works and pipe supports shall be galvanized after fabrication. Zinc required for galvanising shall have to be arranged by the manufacturer. Purity of zinc to be used shall be 99.95% as per IS: 209. Structure shall be hot dip galvanized as per IS: 4759. The Zinc coating shall be 900g/m²
- The Supplier shall be responsible for the stability of the structure at all stages of its erection at site and shall take all necessary measures by the additions of temporary bracings and guying to ensure adequate resistance to wind and also to loads due to erection equipment and their operations
- The bidder shall carry out the proto assembly of the standard and non-standard structures as per the issued fabrication drawings. Proto-corrected drawings shall be approved by contractor and submitted to Owner for information only.
- For design of steel structures loads such as dead loads, live loads, wind loads etc. shall be based on IS:875, Parts I to V. For materials and permissible stresses IS: 802, Part-I, Section-2 shall be followed in

general. However, additional requirements given in following paragraphs shall be also considered.

- The minimum thickness of members shall be as follows:

Leg members	6 mm
Bracing members	5 mm
Redundant members	4 mm

- The maximum slenderness ratios for leg members, other stressed members and redundant members for compression force shall be as per IS-802.
- The minimum distance from hole centre to edge shall be 1.5 x bolt diameter and the minimum distance between centre to centre shall be 3.0 x bolt diameter.
- The minimum bolt diameter shall be 16 mm.
- All equipment supports shall be designed for the worst combination of dead and loads, erection load, wind load/seismic forces, short circuit forces operating forces acting on the equipment and associated bus bars as per IS- 806.

8.11 CHAINLINK FENCING AND GATE

- Fencing shall be provided as per the approved layout. Necessary gates shall be provided for each area so fenced as per the requirement.

- MATERIALS**

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 if required.

The minimum requirements are as follows:

- Galvanised Chain link fence fabric in accordance to IS:2721: 2003
- **Posts:**
 - a) The posts shall be of medium M.S. tubes of 50mm diameter conforms to grade YST-22 (Kg/mm²). The tubes shall also conform to IS: 1161/IS 806. The length of tubular post shall be 2900 mm (2000mm length above FGL). A brick masonry wall of 600 mm, (300mm above FGL and 300 mm below FGL) in cement mortar (1:6), shall be provided over 75 mm thk P.C.C. (1:4:8).
 - b) 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.
 - c) The tubular post shall be welded with 8 number of M S flat of size 50 x 6mm – 75mm long. 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.
 - d) The whole assembly of tubular post shall be hot dip galvanized. The minimum zinc coating shall be 900 gram per sq. meter. The purity of zinc shall be 99.95% as per IS:209.
 - e) The height of the finished fencing shall however be governed by the latest safety regulations of CEA and Indian Electricity Act/ Rules.
- **Fence Fabric Panel:**
 - a) Chain link fencing shall be fabricated in the form of panel 1500 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.

- b) The fence panel shall be provided with two or more coats of approved standard synthetic enamel paint over approved standard steel primer if required.

- **Installation**

- a) Fence shall be installed as shown in the approved drawings.
- b) All posts shall be 3.0m apart measured parallel to ground surface.
- c) 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.
- d) Fence fabric shall not be installed until concrete has been cured for a minimum of 7 days.
- e) Fence fabric panel shall be fixed to the post by 4 nos. GI flat each of 50x6, 75 long through 2 nos. of bolts (12 diameters) on each flat.

- **Gate**

- a) The gate shall be made of medium duty M.S. tube conforms to IS: 1161 or M.S. Hollow section conforms to IS: 4923 with welded joints. The gate shall have Main frame along with vertical secondary members. The spacing of secondary members shall not exceed 125mm (maximum) shall be welded with the main frame. The detailed drawing of gate shall be got approved before fabrication.
- b) 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.
- c) The gates shall be provided with suitable locking arrangement including 2 nos. 150 highx1.25 mm thick M.S. plate horizontally on entire length.

d) Gate shall be installed in location as shown in approved G.A. drawing.

8.12 MISCELLANEOUS GENERAL REQUIREMENTS: -

- The material specification, workmanship and acceptance criteria shall be as per the provisions of IS 456:2000 In case of nominal mixes relevant clauses of CPWD specifications shall be adopted.
- All joints including construction and expansion joints for the water retaining structures shall be made watertight 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 6 mm and minimum width shall be 230 mm.
- In case the Contractor can demonstrate for adopting a suitable construction technique to avoid seepage of ground water, then the PVC water stops need not be used as specified above.
- 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.
- All mild steel parts used in the water retaining structure shall be hot double dip galvanized. The minimum coating of the zinc shall be 900gm/sq.m. for galvanized structures and shall comply with IS-2629 and IS-2633. Galvanizing shall be checked and tested in accordance with IS-2629. The galvanizing shall be followed by the application of an etching primer and dipping in black bitumen in accordance with BS-3416.
- Bricks having minimum 75 kg/cm² compressive strength can only be used for masonry work.
- Monorails, monorail girders and fixtures shall be provided, wherever required.
- Doors and windows on external walls of buildings (other than areas provided with insulated metal cladding) shall be provided with RCC sun-

shade over the openings with 300 mm projection. Projection of sunshade from the wall shall be minimum 450 mm over window openings and 750 mm over door openings.

- All stairs shall have a maximum riser height of 150 mm and a minimum tread width of 300mm. Minimum clear width of stairs shall be 1500 mm. Adequate landings should be provided as per relevant clause of NBC/IS codes.
- All steel staircases shall be shot blasted and coated with one coat of primer followed by one coating of epoxy paint and final coating of PU (min. 100 microns).
- Angles with lugs shall be provided for edge protection all round cut-outs and openings in floor slabs, edges of manholes supporting covers and any other place where breakage of corners of concrete is expected. However no edge protection angles are required for precast cable trenches and drains.
- Anti-termite treatment shall be done as per CPWD specification.
- Hand railing minimum 1200 mm high shall be provided around all floor/roof openings, projections/balconies, walkways, platforms, steel stairs etc. All handrails and ladder pipes shall be 32 mm nominal bore MS pipes (medium class) and shall be galvanized (medium-class as per IS-277). All rungs for ladder shall also be galvanized as per IS-277 medium class.
- All centering and shuttering materials used shall be of steel only. However, for sides of footings, beams and columns, densified wood may be used.
- The proper coordination & execution of all interfacing civil works activities like fixing of conduits in roofs/ walls/ floors, fixing of foundation bolts, fixing of lighting fixtures, fixing of supports/embedment, 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.

8.13 STATUTORY RULES

- The Contractor shall comply with all the applicable statutory rules pertaining to Factories Act, Fire Safety Rules of Tariff Advisory Committee, and Water Act for pollution control etc.
- Provisions for fire-proof doors, number of staircases, fire separation wall, lath plastering on structural members (in fire prone areas) etc. shall be made according to the recommendations of Tariff Advisory Committee.
- Statutory clearance and norms of State Pollution Control Board shall be followed as per Water Act for effluent quality from plant.