



BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT, NEW DELHI.

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TECHNICAL SPECIFICATION FOR CIVIL & STRUCTURAL WORK OF CABLE TRENCH AND CABLE TRESTLE		DATE	20-05-2020	20-05-2020	20-05-2020
		GROUP	TBEM	TBEM	TBEM

CUSTOMER	IOCL
PROJECT	220KV GIS SUBSTATION AT IOCL PANIPAT

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21/5/2020

SECTION - 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENT &
QUANTITIES

SECTION - 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS & QUANTITIES

1.1.0 SCOPE

- 1.1.1 The scope of work under this specification is Civil Works of cable trenches, cable trestle for 220kV GIS Switchyard at IOCL Panipat being executed by BHEL on turnkey basis. The Customer is Indian Oil Corporation Ltd Panipat Refinery.
- 1.1.2 The Civil Works shall generally include, *but not limited to* , following:
- a) Cable trench for LT/HT cables
 - b) Cable trestle at various heights including road/drain/canal crossings
 - c) Modifications in existing cable trestles
 - d) Preparation of fabrication drawing for customer approval
 - e) Supply, Fabrication & erection of cable trestles/drain/canal crossings
 - f) Temporary barricading including scaffolding for safety & protection
 - g) Any other work required for the project.
- 1.1.3 The works to be performed in the above construction includes preparation of bar bending schedules, based on the drawings released for construction and getting the same approved by the Engineer-in-charge plus the execution of the work including providing of all labor, supervision, materials, scaffolding, power, fuel, construction equipment, tools and plants, supplies, transportation, all incidental items necessary for successful completion of the work including contractor's supervision and in strict accordance with the drawings and specifications and with inspection and testing standards. The nature of work shall generally involve excavation in all type of soil including dewatering, shoring, strutting, and filling under and around structures, backfilling with available excavated earth around completed structures, cable trenches with covers, disposal of surplus soil, steel/wooden ply formwork, providing necessary steel embedment and other inserts, structural steel fabrication, erection, painting, concreting, brickwork and finishing etc. and all other works all complete as per detailed technical specification, drawings and directions of Engineer-in-charge.

1.2.0 SPECIFIC TECHNICAL REQUIREMENT

Specific technical requirements for the execution of civil works shall be as per Customer's specification / I.S. Codes/ CPWD Specification. In case of any conflict between these Customer's specification shall prevail.

1.3.0 BILL OF QUANTITIES

The Bill of Quantity cum price schedule shall be as per page 1.3 to page 1.5

The quantities indicated in the 'Bill of Quantity cum price schedule' are indicative and can vary upto any extent, even may get deleted. Contractor shall not be entitled for any claim for any such variation in the quantities.

The provision of Bill of Quantity cum price schedule, specifications and drawings shall be read in conjunction with each other and in case of conflict amongst them, the clarification shall be obtained from the Engineer-in-charge whose decision shall be final and binding.

1.4.0 METHOD OF MEASUREMENT

- i) Excavation shall be measured in cubic meters. The lateral dimensions to be considered for working out excavation quantity shall be the PCC dimension below the footing as per approved drawing. Nothing extra shall be paid for slope cutting, etc. Backfilling & disposal quantities shall be worked out based on the above dimensions only. However the contractor shall maintain the required slope and working space as per the safety /statutory requirement and its cost is deemed to be included in the quoted rate.
- ii) Clause No. 2.1.0 of CPWD Specification Volume-I shall be followed for classification of soils.
- iii) For other items, unless otherwise described the method of measurement as described in 'Method of Measurement of Building and Civil Engineering Works'- IS 1200(Part I to XXV) latest edition of BIS shall be followed.

BILL OF QUANTITY & PRICE SCHEDULE					
Name of Project :			220kV GIS SUBSTATION AT IOCL		
Name of Work :			CABLE TRENCH & CABLE TRESTLE WORK		
S.No.	Description of Item	UNIT	QTY	Unit Rate (Rs)	Amount(Rs)
C1	Earthwork in excavation by mechanical means(Hydraulic excavator)/manual means over areas (exceeding 30cm in depth 1.5m in width as well as 10sqm on plan) including dewatering as necessary of rain water/subsoil seepage water and disposal of excavated earth upto 100m and lift upto 4m, disposed earth to be levelled and neatly dressed. All kinds of soil .	cum	1500	125.95	188925
C2	Earthwork in excavation by mechanical means (Hydraulic excavator)/manual means in foundation trenches or drains (not exceeding 1.5m in width as well as 10sqm on plan) including dewatering as necessary of rain water/subsoil seepage water and dressing of sides and ramming of bottoms, lift upto 3.5m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 100m. All kinds of soil .	cum	2300	166.40	382720
C3	Filling available excavated earth (including rock) in trenches, plinth, sides of foundations, etc., in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead upto 100m and lift upto 3.5m.	cum	1400	125.75	176050
C4	Supplying and filling in plinth with Jamuna/local sand under floors including watering, ramming, consolidating and dressing complete.	cum	50	810.82	40541
C5	Carriage & disposal of surplus excavated earth/rock beyond initial lead by mechanical means not necessarily all the times on pucca roads, including loading, unloading, dressing of excavated material, etc., complete as per specifications -. Lead upto 1 km.	cum	1200	98.34	118008
C6	Carriage & disposal of surplus excavated earth/rock beyond initial lead by mechanical means not necessarily all the times on pucca roads, including loading, unloading, dressing of excavated material, etc., complete as per specifications Lead upto 3 km.	cum	2100	124.51	261471
C7	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work upto plinth level. 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size)	cum	10	4943.80	49438
C8	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work upto plinth level. 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20mm nominal size)	cum	10	4522.52	45225
C9	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work upto plinth level. 1:4:8(1 cement : 4 coarse sand : 8 graded stone aggregate 20mm nominal size)	cum	180	4148.54	746737
C10	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work upto plinth level. 1:4:8(1 cement : 4 coarse sand : 8 graded stone aggregate 40mm nominal size)	cum	20	4148.54	82971
C11	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work , using cement content as per approved design mix, including pumping of concrete to site of laying but excluding the cost of centering,shuttering, finishing and reinforcement, including admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/cum."Excess/ less cement used as per design mix is payable/recoverable separately). All works upto plinth level	cum	20	5887.43	117749
C12	Providing and laying in position machine batched and machine mixed design mix M-20 grade cement concrete for reinforced cement concrete work including road, using cement content as per approved design mix, including pumping of concrete to site of laying but excluding the cost of centering,shuttering, finishing and reinforcement, including admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-in-charge. (Note :- Cement content considered in this item is @ 320 kg/cum."Excess/ less cement used as per design mix is payable/recoverable separately). All works upto plinth level.	cum	1030	5570.40	5737512
C13	Providing and laying in position machine batched and machine mixed design mix M-20 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying but excluding the cost of centering,shuttering, finishing and reinforcement, including admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-in-charge. (Note :- Cement content considered in this item is @ 320 kg/cum."Excess/ less cement used as per design mix is payable/recoverable separately). All works above plinth level upto floor V level	cum	20	6501.16	130023
C14	Add for using extra cement in the items of design mix over and above the specified cement content therein	quintal	620	533.82	330968
C15	Centering and shuttering including strutting, propping, etc., and removal of form at all heights for. Foundations, footings, bases of columns, etc., for mass concrete.	sqm	460	184.42	84833
C16	Centering and shuttering including strutting, propping, etc., and removal of form at all heights for. RCC walls at all levels (any thickness).	sqm	2590	369.24	956332
C17	Centering and shuttering including strutting, propping, etc., and removal of form at all heights for. Columns, Pillars, Piers, Posts and Struts.	sqm	830	454.41	377160
C18	Steel reinforcement -Cold twisted bars /TMT- Excluding supply but including straightening, cutting, bending, binding, (i/c cost of binding wire), placing in position, etc., all labour & material, complete. (Note: Reinf, steel shall be supplied by BHEL free of cost at site. Unloading, storing, watch & ward, handling and testing of material as per FQP is in the scope of the contractor)	kg	65300	11.00	718300
C19	Steel reinforcement -Cold twisted bars /TMT- Fe 500/Fe 500D(To be procured from SAIL,TISCO, IISCO and RINL only) Including supply, straightening, cutting, bending, binding, (i/c cost of binding wire), placing in position, etc., all labour & material, complete.	kg	6600	49.62	327492

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Name of Work :			CABLE TRENCH & CABLE TRESTLE WORK		
S.No.	Description of Item	UNIT	QTY	Unit Rate (Rs)	Amount(Rs)
C20	Brickwork with non modular bricks of class designation 10 in foundation and plinth in: Cement mortar 1:6 (1 cement : 6 coarse sand)	cum	30	4524.10	135723
C21	12 mm cement plaster of mix: 1:5 (1 cement : 5 coarse sand)	sqm	90	154.72	13925
C22	Neat cement punning	sqm	60	39.55	2373
C23	Painting with synthetic enamel paint of approved brand and manufacture of required colour to give an even shade: Two or more coats on new work over an under coat of suitable shade with ordinary paint of approved brand and manufacture.	sqm	1300	74.91	97383
C24A	Supply, fabrication and erection of structural steel with mild steel rolled section / built up section / combination of both conforming to IS:2062, pipes conforming to IS:1161/ IS:1239, chequered plate conforming to IS: 3052, mild steel rounds, monorails, stays, safety chains, ladders, MS grating etc. in columns, beams, gantry girders, trestles, base plates, splice plates, chequered plate flooring, decking and seal plates, steel frame grid over false ceiling, walkway platforms, ladders, stairs, stringers, treads, landings, hand-rails etc including 2 coats of redoxide zinc-chromate primer (one coat at shop and one coat after erection), connection design & preparation of fabrication drgs (on the basis of line diagram issued by BHEL) and obtaining customer approval of the same, supply, fabrication, straightening, cutting, bending, rolling, grinding, machining, drilling, welding, electrodes and other consumables, alignment, erection bolts & nuts (weight of erection bolts, nuts and welds not payable), assembly, edge preparation, preheating (min preheat and interpass temperature of 20o C for welding over 20 mm and upto 40 mm & use of low hydrogen/ radiogenic electrodes), post heating, testing of welders, inspection of welds, visual inspection, non destructive and special testing, rectification and correction of defective welding works, production test plate, inspection and testing, erection scheme, protection against damage in transit, stability of structures, installation of temporary structures, setting column bases, surface preparation by means of manual or mechanical power tools as per IS:1477 part 1, touch-up painting, rectification, dismantling and removal of all temporary structures (weight of temporary structures not payable) etc all complete. - After approval of fabrication drg and BOM and supply of required structural steel	MT	180	41314.00	7436520
C24B	Supply, fabrication and erection of structural steel with mild steel rolled section / built up section / combination of both conforming to IS:2062, pipes conforming to IS:1161/ IS:1239, chequered plate conforming to IS: 3052, mild steel rounds, monorails, stays, safety chains, ladders, MS grating etc. in columns, beams, gantry girders, trestles, base plates, splice plates, chequered plate flooring, decking and seal plates, steel frame grid over false ceiling, walkway platforms, ladders, stairs, stringers, treads, landings, hand-rails etc including 2 coats of redoxide zinc-chromate primer (one coat at shop and one coat after erection), connection design & preparation of fabrication drgs (on the basis of line diagram issued by BHEL) and obtaining customer approval of the same, supply, fabrication, straightening, cutting, bending, rolling, grinding, machining, drilling, welding, electrodes and other consumables, alignment, erection bolts & nuts (weight of erection bolts, nuts and welds not payable), assembly, edge preparation, preheating (min preheat and interpass temperature of 20o C for welding over 20 mm and upto 40 mm & use of low hydrogen/ radiogenic electrodes), post heating, testing of welders, inspection of welds, visual inspection, non destructive and special testing, rectification and correction of defective welding works, production test plate, inspection and testing, erection scheme, protection against damage in transit, stability of structures, installation of temporary structures, setting column bases, surface preparation by means of manual or mechanical power tools as per IS:1477 part 1, touch-up painting, rectification, dismantling and removal of all temporary structures (weight of temporary structures not payable) etc all complete. - After fabrication, erection alignment and completion of work.	MT	180	25617.75	4611195
C25	Extra over above item C24B for blast cleaning of steel structures to near white metal surface (Sa 2 1/2) and applying zinc silicate primer in coats of minimum 25micron (DFT) at shop and 25Micron (DFT) after erection, instead of primer coat of red oxide zinc chromate, including touchup painting etc. all complete.	MT	180	4173.99	751318
C26	Extra over above item C24A for providing and application of two coats of synthetic enamel paint with minimum 50 micron total dry film thickness (DFT) of approved make and shade to achieve an even shade over steel section already having prime coat of different tint to distinguish the same and keeping overall DFT with primer not less than 100 microns including protection and cleaning, scaffolding etc. all complete.	MT	180	1690.05	304209
C27	Structural steelwork welded in built up sections like edge protection angles, pipes, insert plates with lugs & framed work including providing, cutting, hoisting, fixing in position/ embedding in concrete and applying a priming coat of approved steel primer all complete.	kg	15500	51.36	796080
C28	Applying priming coat - With ready mixed red oxide zinc chromate primer of approved brand and manufacture on steel galvanised iron/ steel works.	sqm	1300	28.47	37011
C29	Providing and laying Non Pressure NP-3 class (Medium duty) R.C.C. pipes including collars/spigot jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement : 2 fine sand) including testing of joints etc. complete: 450 mm dia RCC pipes	RM	80	1660.11	132809
C30	Providing and fixing in culvert/road crossing/building PVC pipes conforming to IS : 12818 including jointing with seal in complete 150mm diameter	RM	40	283.20	11328
C31	Supplying & fixing (all dia & length) foundation bolts in position with help of proper templates (to be supplied by contractor) including nuts, washers and template all complete as per drawings & directions of Engr-in-Charge. Weight of the template shall not be measured for payment purpose.	kg	2000	87.19	174380
C32	Extra over item above for providing galvanised bolts (Mass of zinc coating = 610gms/sqm), nuts & washer .	kg	2000	5.88	11760

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S.No.	Description of Item	UNIT	QTY	Unit Rate (Rs)	Amount(Rs)
C33	Fixing (all dia & length) foundation bolts in position with help of proper templates including nuts, washers and template (to be supplied by contractor) all complete as per drawings & directions of Engr-in-Charge. Weight of the template shall not be measured for payment purpose.	kg	2000	9.20	18400
C34	Providing & fixing in position precast cement concrete trench covers/perforated covers/tile wherever necessary at various elevations in all kinds of work including moulding, formwork, mixing, laying out, compacting and curing, storing, transportation, erection without damage, setting in position with cement and sand mortar, grouting etc all as per specs, drawings and directions of Engr-in-Charge but excluding the cost of reinforcement, inserts, edge angles, etc. Grade of concrete shall be M20	cum	200	7697.87	1539574
C35	Grouting of block outs, pockets, foundations, bolts holes and underside of base plates with cement, sand aggregate (of size 6 mm and down) grout 1:1:2 with non-shrink additive and shall be of strength not less than M30 including placing, curing, cleaning, surface preparation, testing, etc. complete with labour, materials, equipment, handling, testing, etc. all complete as per specifications, drawings and instructions of the Engineer.	cum	5	12179.63	60898
C36	Demolishing cement concrete Nominal mix 1:4:8 or leaner mix (i/c equivalent design mix) manually/ by mechanical means including disposal of material within 50 metres lead as per direction of Engineer - in - charge.	cum	5	615.15	3076
C37	Demolishing R.C.C. work manually/ by mechanical means including stacking of steel bars and foundation bolts and disposal of unservicable material within the substation boundary as per direction of site-in-charge.	cum	5	1454.55	7273
C38	Providing corrugated G.S. sheet roofing including vertical / curved surface fixed with polymer coated J or L hooks, bolts and nuts 8 mm diameter with bitumen and G.I. limpet washers or with G.I. limpet washers filled with white lead, including a coat of approved steel primer and two coats of approved paint on overlapping of sheets complete (up to any pitch in horizontal/ vertical or curved surfaces), excluding the cost of purlins, rafters and trusses and including cutting to size and shape wherever required. 0.80 mm thick with zinc coating not less than 275 gm/m ²	sqm	585	709.50	415058
C39	Providing and construction of temporary barricading on (buy back basis) around hot work location on safety point of view as per instruction of EIC. The barricading shall be done with metallic sheet and supporting structures. Height of the barricading shall be sufficient enough to cover all hot jobs even at height. (Measurement shall be as -Clear ht. of barricadex Length). After mutiple uses required at site contractor will take back all materials of barricading.	sqm	400	350.00	140000
	TOTAL				27572748

SECTION - 2

STANDARD TECHNICAL SPECIFICATION
(N.A.)

SECTION - 3

ENCLOSURES TO THE SPECIFICATION

(a) Customer's specification

**GENERAL GUIDELIENS FOR
STRUCTURAL WORK FOR
FOUNDATION WORK, BUIDLING &
POWER EVACUATION FACILITY**

Codes & Standards

IS : 209-1966 - Specification for zinc

IS : 800-1962 - Code of practice for use of structural steel in general building construction.

IS : 802-1978 (Part II) - Code of practice for use of structural steel in overhead transmission line towers.

IS : 1363-1984 (Part 3) - Hexagon head bolts, screws and nuts of product grade 'C'.

IS : 1367-1967 - Technical supply conditions for threaded fasteners (First Revision)

IS : 2016-1967 - Plain washers

IS : 2062-1992 -Steel for general structural purposes Specification.

IS : 2629-1966 - Recommended practice for hot-dip galvanising of iron and steel.

IS : 2633-1972 - Methods of testing weight thickness and uniformity of coating on hot-dip galvanised particles.

IS : 2063-1972 - Single Coil Rectangular Section spring washers for bolts,nuts, screws.

IS : 4759-1968 - Specification for hot-dip zinc containing on structural steel and other allied products.

IS :5358-1969 - Specification for hot-dip galvanised coating on fasteners.

IS : 5613-1976 - Code of practice for design, installation and maintenance of overhead power lines.

IS : 6610-1972 - Heavy washers for steel structures.

IS : 6639-1972 - Hexagonal bolts for steel structures.

IS : 6745-1972 - Methods for determination of weight of zinc coating of zinc coated iron and steel articles.

IS : 12427-1988 - Transmission Tower bolts.

1.0 GENERAL

The scope for supply work covered under this section consists of:

- 1.1** The scope of specification covers design, fabrication, supply, testing and erection of galvanised steel structure for gantry towers, latticed girders , equipment foundation structures, cable racks, trenches , bus duct, piping support, area lighting, installation of all auxiliary panel and other project specific requirements shall be in LSTK contractor's scope. All required materials shall be applicable IS standards. Complete structural work for commissioning of 33 KV power evacuation systems up to existing generation system of PR and PNCP is also in the vendors scope.
- 1.2** Preparation of 'PROTO-MODEL' assembly based on its approved structural drawings, bills of materials and fabrication sketches.
- 1.3** The scope shall include all types of bolts, nuts, step bolts, inserts in concrete, gusset plates, equipment mounting bolts, structure Earthing bolts, foundation bolts, spring washers, fixing plates, angles and bolts for structure mounted or ground mounted marshalling boxes (AC/ DC Marshalling box & equipment control cabinet) and any other items as required to complete the job.
- 1.4** The connection of all structures to their foundations shall be by base plates and embedded anchor/ foundation bolts. All steel structures and anchor/ foundation bolts shall be fully galvanized. The weight of the zinc coating shall be at least 0.610 kg/m². One additional nut shall be provided below the base plate which may be used for the purpose of leveling.
- 1.5** All the structural work for power evacuation with existing power system/Plant at PR and PNC including supporting structure for cable laying from 220KV substation to PR S/S-28 and PNC s/s-9, GIB duct, All type of auxiliary panel/system, outdoor components. It includes foundation work for supports structures of cable system.
- 1.6** The structural adequacy studies of existing system for integration with the new facilities as per project requirements. Any augmentation or reinforcement in the existing system shall also be in the scope of the LSTK contractor including supply of materials.
- 1.7** All structural works for indoor/outdoor cable trenches and cable racks/cable tray. These also include the supporting structure for cable tray/ cable rack for SCAP cables at PR STG control room extension.
- 1.8** All structural works for installation of 220KV GIS Panels, PCC panels, SCAP panels, DGFA panels, RTCC panels, Relay & MMI panels, UPS, charger, battery bank, HVAC auxiliaries, lighting transformer, ACDB, DCDB, MLDB and all other auxiliaries panel for commissioning of 220KV system.
- 1.9** All structural work for installation of EOT crane inside the 220 KV substations.
- 1.10** All structural works for transformer yard, NIFP system, HVWS system, switchyard fencing, all gates, shutters, and doors as applicable
- 1.11** Design, supply, testing, and fabrication of all kinds of structural and reinforcement materials for foundation and building works for complete project.

1.12 The bidder shall develop and submit a FIELD QUALITY PLAN for design, installation and submit Quality Assurance Plan for manufacturing process. All the work shall be strictly executed as per FIELD QUALITY PLAN approved by IOCL, Panipat Refinery which is shown as Annexure-S-3/C-3/2.

1.13 All structural designs shall be approved listed agencies for drawing approval as per clause 10.6 of Section-1 Chapter-1. Cost for vetting of above design, calculations, schemes, drawing etc. to be borne by the bidder. Drawings/documents vetted by mentioned authorities shall bear signature with seal & full name with designation. Bidder to confirm the same in their bid document

2.0 DESIGN REQUIREMENTS

2.1 The steel required for fabrication of structure member shall conform to IS: 2062 - Grade A.

2.2 The zinc required for galvanizing shall be of Zn-99.95% and shall conform to IS: 209-1966

2.3 The plain washers shall conform to IS: 2016-1967. Heavy washers shall conform to IS: 6610-1972. Spring washers for bolts and nuts shall conform to IS: 3063-1972.

2.4 The bolts and nuts shall conform to IS:6639-1972 or IS: 12427-1988. The bolts and nuts shall be of minimum class 5.6.

2.5 All bolts and nuts shall have hexagonal heads. The heads, being forged out of the solid, truly concentric and square with the shanks, must be perfectly straight.

2.6 Fully threaded bolts shall not be used. The length of bolts shall be such that the threaded portion will not extend into the place of contact of the member.

2.7 All bolts shall be threaded as per IS: 1363 (1967) to take full depth of the nut and be threaded enough to permit firm gripping of the member, but no further threaded portion of each bolt shall project through the nut at least 6mm. when fully tightened. All nuts shall fit hand tight to the point where the shank, of the bolt connects to the head. Flat and tapered washers shall be pro-vided where necessary.

2.8 The attachments like 'U' bolt, 'D' shackle, strain plate etc. shall be as per approved drawings.

2.9 Minimum distance from the hole centre to edge shall be 1.5x bolt diameter. Minimum distance between center to center of holes shall be 2.5x bolt diameter.

2.10 The minimum bolt diameter shall be 16 mm.

- 2.11** In order to facilitate inspection and maintenance, the structures shall be provided with climbing devices. Each tower shall be provided with step bolts not less than 16 mm diameter & 175 mm long spaced not more than 450 mm apart, staggered on faces on one leg extending from about 0.5 meters above ground level to the top of the tower. The step bolt shall conform to IS: 10238. Ladders on towers with lighting appliances shall be provided with safety guards.
- 2.12** If luminaries are proposed to be fixed on gantries/ towers, then the proper loading for the same shall be considered while designing. Also holes for fixing the brackets for luminaries should be provided wherever required.
- 2.13** Foundation bolts/ studs shall be designed for the loads for which the structures are designed.

3.0 FABRICATION OF STEEL

- 3.1** The bidder shall bear all the expenditure at all stages on account of loading/ unloading, transportation and other miscellaneous expenses and losses and damages for all materials upto the fabrication yard/ shop and thereafter to the erection site including all other expenses till the erection of work has been completed and accepted. The unit rates shall be deemed to be inclusive of all such incidental expenses and nothing extra shall be payable on any account in this regard.
- 3.2** The fabrication and erection works shall be carried out generally in accordance with IS:802. A reference however may be made to IS:800 in case of non-stipulation of some particular provision in IS:802. All materials shall be completely shop fabricated with proper connection material and erection marks for ready assembly in field.

4.0 ASSEMBLY

- i. The component parts shall be assembled in such a manner that they are neither twisted nor otherwise damaged and shall be so prepared that the specified camber, if any, is provided. In order to minimize distortion in member the component parts shall be positioned by using the clamps, clips, dogs, jigs and other suitable means and fasteners (bolts and welds) shall be placed in a balanced pattern. If the individual components are to be bolted, paralalled and tapered drifts shall be used to align the part so that the bolts can be accurately positioned.
- ii. Before proceeding with mass fabrication the bidder shall fabricate one Proto type structure of each type (i.e. superstructure) for the purpose of checking accuracy and workmanship. This structure should be strictly according to the respective structural drawing and bills of material provided and approved by the IOCL, Panipat Refinery. The bidder shall be solely responsible for preparation and inspection of such PROTO TYPE MODEL assembly.

5.0 BOLTING

- i. Every bolt shall be provided with a spring washer under the nut so that no part of the threaded portion of the bolt is within the thickness of the parts bolted together.
- ii. All steel items, bolts, nuts and washers shall be galvanised.
- iii. 2.0% extra nuts and bolts shall be supplied for erection.

6.0 WELDING

The work shall be done as per approved fabrication drawing which clearly indicate various details of joints to be welded, type of weld, length and size of weld, whether shop or site weld. Symbols for welding on erection and shop drawings shall be according to IS: 813. Efforts shall be made to reduce site welding so as to avoid improper welding due to constructional difficulties.

All the site welding work shall be done by the certified welders only. Copy of the certificates shall be submitted to Engineer In charge prior to start of the jobs. All kind of welding electrodes and other accessories suitable as per project requirements shall be in the scope of LSTK contractor. The applicable test reports to be submitted to Engineer Incharge for approval prior to start of the job.

7.0 FOUNDATION BOLTS

- 7.1** Foundation bolts for the towers and equipment supporting structures and elsewhere shall be embedded in first stage concrete while the foundation is cast. The Bidder shall ensure the proper alignment of these bolts to match the holes in the base plate.
- 7.2** The Bidder shall be responsible for the correct alignment and leveling of all steel work on site to ensure that the towers/ structures are plumb.
- 7.3** All foundation bolts for lattice structures are to be supplied by the bidder.
- 7.4** All foundation bolts shall be fully galvanised so as to achieve 0.61 kg per Sq.m of Zinc Coating as per specification.

8.0 STABILITY OF STRUCTURE

The Bidder 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 bracing and guying to ensure adequate resistance to wind and also to loads due to erection equipment and their operations.

9.0 GROUTING

The method of grouting the column bases shall be subject to approval of IOCL, Panipat Refinery and shall be such as to ensure a complete uniformity of contact over the whole area of the steel base. The Bidder will be fully responsible for the grouting operations.

10.0 GALVANISING

- 10.1** The galvanising shall be done to all the structure members after the fabrication work is completed. The nuts may be tapped or re-run after galvanising. Threads of bolts and nuts

shall have neat fit and can be turned with finger throughout the length of the threads of bolts and they shall be capable of developing full strength of bolts.

- 10.2** Zinc required for galvanising shall have to be arranged by the Bidder. Purity of zinc to be used shall be 99.5% as per IS:209 (latest).
- 10.3** The zinc deposition should not be less than specified per galvanised surface area of the fabricated structure member.
- 10.4** The galvanising of the structure members shall conform to IS:2629-1966 & IS: 4759-1968. All galvenised members shall withstand tests as per IS:2633-1972. The weight of zinc coating shall be determined as per the method stipulated in IS: 2633-1964. Spring washers shall be electro galvanised as per IS:1573-1970
- 10.5** Unless otherwise specified the fabricated structures shall have a minimum overall Zinc coating of 610 gm per sq. m of surface except for plates & sections below 5mm which shall have Zinc coating of 460 gm per sq. m of surface. The average zinc coating for all sections & plates 5mm & above shall be maintained minimum 87 microns and that for sections below 5mm shall be maintained minimum 65 microns.
- 10.6** The foundation bolt shall be galvanized as per IS 1367(Part-XIII)-1983. i.e. 375gms/sqMtr (54Microns). The weight of zinc coating shall be determined as per the method stipulated in IS:2633-1964.
- 10.7** All the stubs, cleats and stub-setting templates shall be fully galvanised

11.0 GENERAL GUIDE-LINE FOR INSPECTION

- 11.1** The fabricated steel work shall be inspected and certified by the IOCL, Panipat Refinery or its authorized representative on sample basis as per approved QAP as satisfactory before it is despatched to the erection site. Such certificate shall not relieve the Bidder of his responsibility regarding adequacy and completeness of fabrication.
- 11.2** Fabricated Structure Members:
 - i. (Visual examination and quantity verification of offered lot.
 - ii. (Sample selection from the offered lot at a ratio of 40 MT (or part thereof) 1 no. for all tests.
 - iii. Dimension, fabrication and triunes verification of structure member from fabrication sketch.
 - iv. Galvanising test of each sample i.e. dip test, hammer test and mass of zinc test.
 - v. Random verification Zinc coating over galvanized surface by Elcometer.
 - vi. Tensile test and bend test of each sample.
 - vii. Chemical composition test of at least one sample per lot offered for inspection.
 - viii. Verification of manufacturer's test certificate for mild steel used in structure members.
- 11.3** Bolts-Nuts, Washers, Accessories, and Attachments etc.: (To be carriedout at manufacture's works.)
 - i. Visual examination and quantity verification of offered lot.
 - ii. Sample selection from the offered lot as per relevant IS for each item.
 - iii. Dimension, fabrication and trueness verification from fabrication sketch.

- iv. Galvanising test of each sample.
- v. Other acceptance tests for respective item as per relevant Indian Standard.

12.0 TEST CERTIFICATE

Copies of all test certificates relating to material procured by the Bidder works shall be forwarded to the IOCL, Panipat Refinery.

13.0 ERECTION

The Bidder should arrange his own erection plant and equipment, welding set, tools and tackles, scaffolding, trestles equipment, heavy equipments like JCBs, Earth movers, Tractor trolleys, Man lifters, hoisting equipments, barricading equipments etc. and any other accessories and ancillaries required for the work.

14.0 SAFETY PRECAUTIONS

The Bidder shall strictly follow at all stages of fabrication, transportation and erection of steel structures, raw materials and other tools and tackles, the stipulations contained in Indian Standard Code for erection for structural steel work – IS:7205.

15.0 Any other structural work that is required for successful completion & commissioning of 220kv GIS Sub-station & Switchyard

GENERAL GUIDELINES FOR CIVIL WORK

Codes & Standards

The following Indian Codes and Standards shall generally be used for design of civil and structural works. In all cases, the latest revisions with amendments, if any, shall be followed.

SP: 6 ISI handbooks for structural engineers

IS: 2062 Specification for Structural Steel (Standard quality)

IS:383 Specification for coarse and fine aggregates from natural sources for concrete

IS: 456 Code of practice for plain and reinforced concrete

IS: 800 Code of practice for general construction in steel

IS: 806 Code of practice for use of steel tubes in general building construction,

IS: 808 Rolled steel beam, channel & angle sections

IS: 813 Scheme of symbols for welding.

IS: 816 Code of practice for use of metal arc welding for general construction in mild steel.

IS: 875 Code of practice for design loads (other than earthquake) for buildings and structures.

IS: 1038 Steel doors, windows and ventilators.

IS: 1080 Code of practice for design and construction of shallow foundations in soils (other than raft, ring and shell).

IS: 1172 Code of basic requirements for water supply, drainage and sanitation.

IS: 1230 Cast iron rain water pipes and fittings.

IS: 1346 Code of practice for water proofing of roofs with bitumen felts.

IS: 1361 Steel windows for industrial buildings.

IS: 1742 Code of practice for Building Drainage

IS: 1893 Criteria for earthquake resistant design of structure

IS: 1904 Code of practice for foundations in soil:-General requirements

IS: 1905 Code of practice for structural safety of buildings

IS: 2065 Code of practice for water supply in buildings

IS: 2074 Ready mixed paint, air drying, red oxide chrome, priming

IS: 2212 Code of practice for brick work

IS: 2470 Code of practice for installation of septic tank

IS: 2527 Code of practice for fixing rain water gutters and down pipes for roof
Drainage

IS: 2911 Code of practice for design & construction of pile foundation

IS: 2950 Code of Practice for design and construction of raft foundations

IS: 2974 Code of Practice for design and construction of machine foundations

IS: 3067 Code of Practice for general design details for preparatory work for damp proofing and water proofing buildings

IS: 3370 Code of Practice for concrete structures for the storage of liquids

IS: 3414 Code of Practice for design and installation of joints in buildings

IS: 3614 Fire check doors & TAC rules

IS: 4326 Code of Practice for earthquake resistant design and construction of buildings

IS: 4971 Recommendations for selection of industrial floor finishes

IS: 5624 Specification for Foundation bolts

IS: 8009 Code of Practice for calculation of settlement of foundations: (parts 1 & 2)

IS: 1829 Code practice for protection of iron and steel (Part I to III) structures for atmosphere corrosion

IS: 13301 Guidelines for design of flexible pavements

IS: 13920 Code practice for ductile detailing of reinforced concrete structure subjected to seismic force

IRC: 37 Guide lines for design of flexible pavements

IRC: 73 Geometric designs of roads

DIN: 4024 Machine foundations: - Flexible supporting structures for machine with rotating masses.

SP 16 Design Aids for Reinforced Concrete to IS: 456-1978.

1.0 GENERAL

The scope of civil work covers the following.

- i. Design, engineering, supply, testing & construction of all civil works as per project requirements complete in all for 220 KV switchyard, GIS system, and power evacuation facilities. All civil works shall also satisfy the general technical specifications specified in other sections of this tender. Civil works shall be designed to the service conditions / loads as specified elsewhere in this specification or as implied as per National / International standards.
- ii. The building, switchyard and all civil works will be provided as per applicable IS standards and OEM requirements.
- iii. The Bidder shall have to obtain required approvals of statutory authorities wherever applicable. All civil, structural and architectural works shall be designed, provided and constructed as per latest editions of Indian Codes and Standards with addendums and supplements as issued by ISI. Wherever Indian Standards are not available/formulated, applicable BS or international standards shall be used. In case of ambiguity between codes, specifications and drawings, the most stringent of them shall govern.
- iv. The contractor shall provide all design, drawings, labor, tools, equipments, material, temporary works, construction plants & machinery, fuel supply, transportation and all other incidental items not specified but as they may be required for complete performance of the works in accordance with approved drawings, specifications & direction of the IOCL.
- v. The work shall be carried out according to design & drawings to be developed by the contractor and approved by IOCL and recommended document approving agencies as listed under clause 10.6 of Section-1 Chapter-1 and based on the tender drawings specified by IOCL to the contractor. For all buildings, structures, foundations etc. necessary layout & details shall be developed by the contractor keeping in view the functional requirement of the substation, switchyard, required facilities & providing enough space to access for operation, use & maintenance based on the inputs provided by IOCL. Certain minimum requirements are indicated here under for guidance purpose only. The tentative layout plan is attached as Anneuxre-S-3/C-3/1. It is the sole responsibility of LSTK contractor to develop the detailed layout plan for complete project as per applicable guidance of CEA and HVPNL.
- vi. The GELO plan of complete 220 KV system shall be prepared by LSTK contractor and get approved from HVPNL prior to start of the job. All required co-ordination laisioning for GELO approval is in the scope of LSTK contractor.
- vii. All materials including cement, reinforcement steel, structural steel etc. shall be arranged by the Contractor.
- viii. All the design and drawings shall be submitted in three sets of hard copy and soft copy. Drawing shall be submitted in 'AutoCAD' format. Submitted design and drawings will be property of IOCL. Also design basis document for civil and architectural work shall be submitted for approval. 3D model based on architectural drawing with all possible views shall be prepared and submitted.
- ix. The bidder shall develop and submit a FIELD QUALITY PLAN for design, installation and construction procedures and the interfaces between them. All the work shall be strictly executed as per FIELD QUALITY PLAN approved by IOCL, Panipat Refinery & Approved technical specification of IOCL, Panipat Refinery for civil works. All testing required shall be arranged by the Contractor at his own cost. A provisional FIELD QUALITY PLAN is attached as Annexure-S-3/C-3/2.
- x. 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.

- xi. The finished ground level (FGL) with a tolerance of (+/-) 100mm shall be decided by the IOCL. 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 IOCL. The Contractor shall provide all assistance in instruments, materials and personnel to IOCL for checking the detailed layout and shall be solely responsible for the correctness of the layout and levels.
- xii. In general, the site will be handed over by IOCL to bidder "As is where is basis". Before quoting, contractor should visit the site and familiarize with all site related issues/data.
- xiii. 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 IS standards following best engineering practices.
- xiv. All the civil works covered under the said scheme shall be constructed under the supervision of experienced degree holder should have the minimum experience of 2 years/diploma holder of minimum experience for 5 years.

2.0 SCOPE OF WORK

The scope of work under this contract shall include design and construction of all the items mentioned hereunder, but not limited to, which are required for satisfactory & successful completion and commissioning of 220KV GIS (INDOOR) Substation & switchyard at place in Panipat Refinery, complete power evacuation system at both PR and PNCP.

The scope of civil work (Lumsum Turnkey Contract) shall include but shall not limited to the following,

- Carrying out Geotechnical investigation ,Topographical survey / Soil Investigation in conjunction with the tentative soil test report attached with this tender as Annexure- S-2/C-1/9.
- Dismantling of existing structures, drain, piping work (above and over ground), disposal of debris, cleaning of site etc.
- Proper rerouting of cable trench/ product pipeline/sewer line / OWS line/manhole as per site requirement & instruction of EIC.
- Construction of temporary barricading around hot work location on safety point of view as per instruction of EIC.
- Complete design and engineering of 220/33 kV GIS indoor Substation building Civil & Structural works. Substation building shall have ground floor & first floor including HVAC room, Battery room, ECS & load Manager Room, SCADA room, Relay MMI room, UPS & charger room, DGFAP room, Engineering room, Operator room. Tentative layout of rooms is attached as Annexure- S-3/C-3/1.
- Development of walkway connectivity between existing sub-station (SS No.: 63) to new 220 GIS switchgear building at first floor level with required elevations for road crossings for operational requirements. All kinds of modification, repair works in existing sub-station shall also be in the scope of LSKT contractors.
- Foundation for switchyard structures, gantry towers, isolators, lightening arrestor, CVTs and supporting structure of GIB (gas insulated bus duct) & NIFPES (nitrogen injection fire prevention and Extinguishing system), H.V.W.S (high velocity water spray system) Cable cellar fire water sprinkler system etc.
- Foundation for lighting poles, junction box, panels, control cubicles & AC Kiosks of equipments (wherever required).
- Foundation for 4 Nos 220/33kV,50/ 65 MVA Transformer and all its accessories with

required number of Firewall, Common Burnt oil pit and its track up to road.(Minimum dimension for transformer bay is attached with lay out).

- The construction of buildings, fire walls shall be in compliance with OISD-173.
- Construction of operating platform with stairs & hand rail in front of isolators and other equipment (where necessary).
- Indoor & outdoor RCC Cable trenches (Suitable for Power & control cable, OFC cable) along with RCC covers, overhead cable racks including RCC Box culverts for road crossings.
- Laying of RCC roads with load bearing capacity of heavy equipment movement and shall provide required access from all directions as required in line with OISD and IE rules. Any culvert shall have load bearing capacity for heavy equipment movement.
- Septic tank with soak pit, Drainage system. Drain crossing including drainage pipes, manholes.
- Foundation and supporting structure for complete fire water network inside the 220KV substation & switchyard.
- Complete design and engineering for drinking water supply system with water cooling facility at 220KV substation.
- Site surfacing, Anti weed and Gravelling as per technical specification.
- Fencing & Boundary wall for the Substation along with gates as per approved layout.
- All civil works for power evacuation with existing power plant/ system at PR and PNC. It includes preparation of cut-outs for cable entries in existing sub-stations of required size and numbers, all associated brick works, sealing works, painting works, in existing sub-station building shall also be in the scope of LSTK contractor.
- Extension of existing existing control room of PR and construction of room of approximate dimension of 8 m X 8 m with height similar to control room floor (approximate 10 M height) for installation of SCAP panel. Bidder shall develop complete room including its foundations, RCC super-structures, false floor and false ceiling.
- Preparation of cable rack support foundation as per site requirement up to PR & PNC generating system.
- All kinds of civil foundation works to be carried out for laying of 33KV power cable and control cable up to existing 33KV system.
- General electrical lay out and CLO with floor plan to be submitted with bid.
- Painting & Stencilling of GIS building & switchyard as per specification given in Annexure- S-3/C-3/3 for painting
- Any other civil work that is required for successful completion & commissioning of 220 KV GIS & Switch yard.
- All civil foundation and building designs shall be approved by listed approving agencies as listed in the clause 10.6 of Section-1 Chapter-1.

3.0 GEOTECHNICAL INVESTIGATION:

The soil test report for the nearby area of the construction site is attached along with the tender as Annexure-S-2/C-1/9 for reference.

The soil test report attached with the tender is indicative and the Contractor, shall perform a detailed soil investigation to arrive at sufficiently accurate conclusion regarding general as well as specific information about the soil profile and the necessary soil parameters of the

site, in order to design and construct the foundation of the various structures safely and rationally.

A report to the effect shall be submitted by the Contractor for Employer's specific approval giving details regarding data proposed to be utilized for the design. All the required cost of soil test shall be in LSTK contractor's scope.

3.1 SCOPE

This specification covers all the work required for detailed soil investigation and preparation of a detailed report. The work shall include mobilization 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 starting from 0.5M from existing ground level 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 Employer.

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

3.1.1 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 15meter depth into virgin soil or to refusal whichever occurs earlier shall be drilled. Total area of substation plot (including of Switchyard and Future area) shall be considered for arriving at number of bore holes to be drilled. In any case number of boreholes shall not be less than five and shall not exceed twenty. 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 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.

3.1.2 TRIAL PITS

Trial pits shall be carried out at minimum one location per hectare as directed by the Employer. In case hard rock is encountered trial pit test need no to be carried out. Total area of substation plot (including of Switchyard and Future area) shall be considered for arriving at number of Trial Pit to be excavated. Minimum number of trial pits shall be five and maximum number shall be ten. The trial pits shall be 2 m x 2 m in size extending to 4 m depths, or as specified by the Employer. Undisturbed samples shall be taken from the trial pits as per the direction of the Employer.

3.1.3 ELECTRICAL RESISTIVITY TEST

The resistivity of earth varies over a wide range depending on its moisture content, temperature, salt content and compactness. Therefore earth resistivity test shall be conducted preferably during the dry season in order to get conservative results.

3.1.4 TEST LOCATION

In the evaluation of earth resistivity for the substations, at least eight test directions shall be chosen from the centre of the substation to cover the entire area including the future area. The number of test points shall be as per approved drawing.

3.1.5 PRINCIPLE OF TEST

Wenner's four electrode method shall be used. In this method, four small electrodes shall be buried in four small holes in the earth along a straight line at equal intervals. A test current (I) by earth resistivity tester shall be passed between two outer electrodes and the voltage difference (V) between the two inner electrodes shall be measured. The test current (I) thus flowing into the earth, produces an electric field proportional to its density and to the resistivity of the soil. The voltage (V) measured between the inner electrodes is proportional to the field. Consequently, the resistivity will be proportional to the ratio of the voltage to current. Thus the resistivity shall be calculated from the following equation.

$$\rho_a = \frac{4\pi AR}{1 + \frac{2A}{\sqrt{(A^2 + 4B^2)}} - \frac{2A}{\sqrt{(4A^2 + 4B^2)}}}$$

Where,

ρ_a apparent resistivity of the soil in Ω - m

R is the measured resistance in Ω

A is the distance between adjacent electrodes in metres

B is the depth of the electrodes in m

3.1.6 TEST PROCEDURE

In the selected test point and chosen direction, four electrodes with insulated connecting wires shall be driven into the earth along a straight line of equal intervals (a). The depth of the electrodes in the earth shall be of the order of 15 cm to 20 cm. The megger shall be placed on a steady and approximately level base, the link between terminals P1 and C1 shall be opened and the four electrodes connected to the instrument terminals. An appropriate range on the instrument shall be selected to obtain clear readings avoiding the two ends of the scale as far as possible.

Resistivity shall be calculated by substituting the value of R in the above equation. The test shall be repeated in a chosen direction with a number of different electrode spacing, increasing from 2m to 50m preferably in the steps of 2, 5, 10, 15, 25 and 50m. When the spacing is increased gradually from low values, at a stage, it may be found that the resistivity reading is more or less constant irrespective of the increase in the electrode spacing. The resistivity for this spacing is noted and taken as the resistivity for that direction. In a similar manner, resistivity for at least eight equally spaced directions from the centre of the test points shall be measured. These measurements shall be repeated for all test points.

NOTES:

- Soil resistivity points shall preferably be one number in each 100mx100m grid and number of test points shall be such that the entire substation including the future area is covered.
- Average resistivity value of all eight directions shall be considered for design of
- earthing system.
- Soil resistivity measurement may be done in dry season. Small amount of water may be applied at electrodes for making proper contact between the electrodes and soil.

3.1.7 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. Plate load test shall be conducted at two locations to be decided during detailed engineering at the proposed foundation depth below finished ground level for determining the bearing capacity.

Undisturbed tube samples shall be collected at 0.5 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 v/s Settlement shall be kept as specified in IS: 1888.

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

3.1.8 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.

3.1.9 BACK FILLING OF BORE HOLES

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

3.1.10 LABORATORY TEST

The laboratory tests shall be carried out at any Govt. Approved agencies/NABL accredited laboratories progressively during the field work after sufficient number of samples has reached the laboratory in order that the test results of the initial bore holes can be made use of in planning the later stages of the field investigation and quantum of laboratory tests.

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 down in the relevant I.S. Codes.

The following laboratory tests shall be carried out

- Visual and Engineering Classification
- Liquid limit, plastic limit and shrinkage limit for C-Ø soils.
- Natural moisture content, bulk density and specific gravity.
- Grain size distribution.
- Swell pressure and free swell index determination.
- California bearing ratio.
- 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:

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

3.1.11 TEST RESULTS AND REPORTS

The Contractor shall submit the detailed report in four (4) copies wherein information regarding the geological detail of the site, summarized observations and test data, bore logs, and conclusions and recommendations on the type of foundations with supporting calculations & relevant standard references 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 site test data shall bear the signatures of the Investigation Agency, Vendor and also site representative of Employer.

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

- A plan showing the locations of the exploration work i.e. bore holes, trial pits, Plate load test etc.
- 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 summarized strata wise as well as 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.

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 Employer. The observations and recommendations shall include but not limited to the following:

- i) 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.
- ii) 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.
- iii) 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 2.5.
- iv) Recommendation of liquefaction characteristics of soil and possible remedies shall be provided.
- v) Recommendations regarding slope of excavations and dewatering schemes, if required.
- vi) 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.
- vii) If expansive soil is met with, recommendations on removal or detainment 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.
- viii) Recommendations for additional investigations beyond the scope of the present work, if considered such investigation as necessary.

- ix) In case of foundation in rocky strata, type of foundation and recommendation regarding rock anchoring etc. should also be given based on RMR value

4.0 GENERAL SITE DESCRIPTION

The substation site is generally levelled. To achieve formation level which generally is fixed at higher level than its surroundings, earth filling shall be required. Tentative quantity of earth filling has been indicated but may vary as per site requirement based on contouring and surroundings. The bidders are advised to visit the site before quoting.

- 4.1** The successful bidder shall use the above soil parameters for designing the foundations of tower/equipment structures, buildings etc. Minimum depth of foundations in natural ground designed on above parameters shall not be less than 1.0m excluding lean concrete.

4.2 SITE PREPARATION

The site as available shall be handed over to the successful bidder. Clearing the site from bushes/trees including their roots shall be carried out by the successful bidder without any extra cost to IOCL PANIPAT. The IOCL PANIPAT, if required, shall arrange necessary permission for cutting of trees from the concerned authorities. The Contractor shall hand over the wood of trees to IOCL PANIPAT.

The Contractor shall prepare the `**CONTOURS**` of land at suitable intervals. The spot levels shall be taken at a distance not more than 3.0M intervals. To have a fair idea about the topography of the area, the contours at new sub-stations shall extend sufficient distance (approx. 50M) beyond the land. On submission of contour plan by the successful bidder and based on the surroundings, drainage condition etc., the IOCL PANIPAT shall fix the Formation Level(s) of the sub-stations except for the substations where bays are proposed for which the formation level shall remain same as that of the existing level of that sub-station. The contractor, as per specifications shall carry out necessary earth cutting/filling in layers, compaction, levelling and dressing to reach the desired formation level.

The contractor at his own cost shall make the layout and levels of all structures/buildings as per the general grid of the plot and the Benchmark given by the concerned EIC/Executing Department.

The permanent Benchmark and all the change points shall be established at the proposed site and the same shall be got authenticated before taking any further levels. The contractor shall provide all help including instruments, materials and personnel to the EIC/Executing Department or his representative for checking the detailed layout and shall solely be responsible for the correctness of the layouts and levels.

4.3 SCOPE

This clause covers the design, engineering, supply of labour, material, T&P and execution of civil items including dismantling of the existing foundations/structures/roads wherever required, clearing the site, site preparation, supply and compaction of fill material to achieve formation level, foundations, excavation and compaction of backfill for foundation, roads, trenches including trenches below floors in buildings etc., complete in all respects.

4.4 WATER SUPPLY

Please refer clause 5.2 of Section-1 Chapter-1 for water supply provisions.

4.5 GENERAL

4.5.1 Material including excavated material unsuitable for founding of foundations shall be removed and replaced by suitable fill material and the same is required to be got approved from the IOCL PANIPAT.

4.5.2 Fill/Backfill material around foundations or other works shall be free from harmful salts viz. sulphates, chlorides and or any organic/inorganic materials. The Fill/Backfill material should be compacted as described under clause 3.4.

4.6 EXCAVATION AND BACKFILL

4.6.1 Excavation and backfill for foundations shall be in accordance with the relevant IS code and as per approved design/drawings.

4.6.2 Whenever water table/seepage water is met during excavation, it shall be dewatered and foundation pit shall be maintained dry i.e. free of water during the excavation, concreting and back filling. No extra payment on this count shall be admissible.

4.6.3 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 placements of embankment material. The vertical faces shall measure not more than 1.0 m in height.

4.6.4 Embankments adjacent to abutments, culverts, retaining walls and similar structures shall be constructed by compacting the material not exceeding 15cm in thickness of loose material before compaction in successive uniform horizontal layers. Each layer shall be compacted as required by means of mechanical means i.e. rollers, vibrators etc. as approved by the IOCL PANIPAT. Rocks larger than 10 cm shall not be placed in embankment adjacent to structures.

4.6.5 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 measurements and compacted to the full width specified. The upper surface of the embankment shall be shaped so as to provide complete drainage of surface water at all times.

4.6.6 In case the switchyard area needs leveling & dressing only, to maintain the final formation level as fixed by IOCL PANIPAT, same shall be done with utmost care and with proper compaction.

4.6.7 If the top crest of earth (30 cm depth or as per soil investigation report whichever is maximum) contains harmful salts and organic/inorganic materials, it shall be scraped and

disposed off at a place outside substation as directed by EIC.

4.6.8 COMPACTION

- 4.7.1** The method and equipment used to compact the fill material shall be suitable to achieve the density that will give the allowable soil bearing pressure required for the foundations, roads etc. In each layer of fill material. Each layer of earth embankment when compacted shall be as close to optimum moisture content as practicable. Embankment material that does not contain sufficient moisture to obtain proper compaction shall be wetted. If the material contains 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 rock fills. No compaction shall be carried out in rainy season/during rains.
- 4.7.2** At all times, the unfinished construction shall have adequate drainage. Upon completion of the road surface course, adjacent shoulders shall be given a final shaping, true alignment and grade.
- 4.7.3** The density to which fill materials shall be compacted shall be as per relevant IS and as per direction of IOCL PANIPAT. 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 Optimum Moisture Content (OMC). The sub-grade for the roads and embankment filling shall be compacted to minimum 95% of the Standard Proctor's density at OMC.

4.7 EARTH WORK FOR ACHIEVING FORMATION GROUND LEVEL (FGL)

To maintain the formation level (FL) as fixed by IOCL PANIPAT, earth filling/cutting or both filling/cutting may be required. Before earth work is started, the site shall be cleared from bushes/trees including roots, existing structures etc. by the successful bidder.

In case earth is to be imported (earth filling), the area from where the earth is to be imported should be pre-determined so as to ensure good quality of earth i.e. earth imported should be free from shrubs, ranks, vegetation, grass, brushwood, stone shingle and boulders (longer than 75mm in any direction), organic or any other foreign matter. Earth containing deleterious materials salt peter earth etc. shall not be used for filling. All clods and lumps of earth exceeding 8cm in any direction shall be broken or removed before the earth is used for filling.

In case the earth work is required in cutting, the cut earth shall be spread in sub-station areas requiring filling and the surplus earth, if any shall be disposed of to a suitable undisputed place outside the substation. The successful bidder shall be responsible in case some dispute arises on account of disposal of earth at a disputed site.

The work for earth filling/cutting and spreading of earth shall include site clearance, laying of earth in layers (as per specification briefly brought out under compaction), dressing, carriage, lead, loading and unloading, watering and compaction with roller including supply of earth etc. as per specification complete for the substation as a whole, including under roads.

5.0 SITE SURFACING

5.1 SCOPE OF WORK

The contractor shall furnish all labour, equipment and materials required for complete performance of the work in accordance with the drawings, specifications and directions of the EIC/Executing department.

Stone spreading along with cement concrete layer shall be done in areas presently in the scope of the scheme. Stone spreading only shall, however, be provided in the areas (bays) kept for future expansion. In the existing sub-stations where cement concrete base has not been laid under gravel, only gravel shall be laid in that sub-station.

5.2 GENERAL REQUIREMENT

5.2.1 The material required for site surfacing/gravel filling should be free from all types of organic materials and shall be of standard approved quality as directed by the EIC/Executing department.

5.2.2 The material to be used for stone filling/site surfacing shall be 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	% <i>passing by weight</i>
63mm	100
40mm	85-100
20mm	0-10 (up to 90% retained on sieve)

b) **Hardness**

Abrasion Value (IS: 2386 Part-IV) – not more than 50%

Impact value (IS: 2386 Part-IV) – not more than 45%

5.2.3 The Contractor, after all the structures and equipment have been erected and accepted, the surface of the switchyard area shall be maintained, rolled/compacted to the lines and grades in accordance with the requirements and direction of the EIC/Executing department. The sub grade shall be consolidated by using 3 ton roller with suitable water sprinklers 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.

5.2.4 Areas where the EIC/Executive Department is satisfied that proper filling of the base course material by normal rolling equipment is not possible due to closely laid foundations and structures, the filling of the base course material shall be compacted by hand. Due care shall be exercised to avoid any damage to the foundations, structures, equipments (Cable trench or Cable) during rolling compaction or otherwise.

5.2.5 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.

5.2.6 100mm thick base layer of cement concrete in 1:4:8 (1 cement: 4 fine aggregates: 8 coarse aggregate nominal size 20MM) conforming to zone-II as per IS:583 shall be provided in the areas

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 1:4:8. A layer of cement slurry of mix 1:4 (1 cement: 4 fine aggregates) shall be laid uniformly over cement concrete layer. The cement consumption for cement slurry shall not be less than 150kg per 100 sq.m.

- 5.2.7** A final layer of 100mm thick uncrushed/crushed/broken stone of 20mm nominal single ungraded size as per site requirement shall be spread uniformly over cement concrete layer after curing is complete.
- 5.2.8** Generally site surfacing will be restricted up to 2.0m beyond the last structure/equipment foundation. However, depending upon the site requirement, the same shall be carried out as per instructions of EIC/Executing department. To hold the stone (bajri) wherever required, a toe wall of 115mm thick, 300mm deep (1:4) shall be provided. Top of wall shall be 25mm above top of bajri. All visible portion of toe wall shall be plastered and cement painted.

6.0 SITE DRAINAGE

6.1 SCOPE OF WORK

Adequate site drainage system shall be provided by the Contractor within the switchyard fencing under the present scope including Substation building & 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. Outfall point shall be got approved from EIC/Executing department before commencement of construction. The contractor shall obtain rainfall data and design the storm water drainage system including culverts, ditches, drains etc. to accommodate the most intense rainfall that is likely to occur over the catchments area in one hour period on an average of once per ten years. While designing the drainage system following points shall taken care of:

- 6.2** The surface of the switchyard shall be sloped to prevent pounding of water.
- 6.3** Longitudinal slope shall generally be not less than 1 in 1000. However, keeping in view the discharge, the same can be increased to 1:2000.
- 6.4** Open surface drains shall be construed in first class brick masonry in 1:4 cement sand mix laid over 100mm thick PCC of 1:4:8 (1cement; 4 coarse aggregates; 8 stone aggregate 20mm nominal size). The side walls shall be plastered with 1:5 cement sand mix.
- 6.5** The trapezoidal drains, if proposed shall have 300mm bottom width and sides slope of 1 horizontal; 1.5 vertical. For design of lined drain IS: 10430 and for construction of cast-in-situ cement lining IS: 3873 shall be followed.
- 6.6** Drain shall be constructed on one/both sides of roads as per site requirement. In the switchyard maximum spacing between two drains shall not be more than 100 meter. It will be ensured that no area is left un-drained.
- 6.7** The side wall(s) of the drains as per site conditions shall be 25mm above the gravel level to prevent spilling gravels. Suitable mild steel grating be provided for drainage of surface water. 25mm thick RCC tiles be placed over grating openings.

- 6.8** RCC pipe drains shall be provided in area of switch yard where movement of crane will be necessary in operating phase of the substation.
- 6.9** For pipe drains including road crossings, RCC concrete pipe of class NP3 shall be used. For design of RCC pipes for drains and culverts, IS: 456 and IS: 783 shall be followed.
- 6.10** Pipe drains shall be connected through manholes at an interval of max. 30m.
- 6.11** Sum pit of suitable size to hold water for 5 minutes discharge has to be constructed within the substation boundary at suitable site(s) as per IOCL PANIPAT drawings & directions of EIC/Executing Department.
- 6.12** The drainage scheme and associated drawings shall be developed by the successful bidder and shall be got approved from IOCL PANIPAT before commencement of work.
- 6.13** Two non clog pumps (of reputed make) of suitable capacity (depending upon maximum discharge and capable of lifting particle size 65mm) shall be provided at sump pit-cum-pump chamber by the contractor without any extra cost. All required cabling and power supply provision shall be in the scope of LSTK contractor.

7.0 ROAD, CULVERTS AND PCC PAVEMENT/PARKING

Latest specifications & relevant standard as adopted by IOCL PANIPAT for construction of roads and pavement shall be followed. Finished top (crest) of roads shall be as per tender drawings & levels shall match with the levels fixed by the IOCL PANIPAT.

7.1 SCOPE OF WORK

This clause covers the supply of labour and material for executing the work for the road & design, engineering, supply of labour and material for providing culverts within the substation fencing including approach road from main Public road to the sub-station main entry gate(s) as contained in the General Electric layout (GELO)/Civil layout (CLO) or as per requirement of the Sub-Station covered under the said scheme.

- 7.2** The constructions of roads as per approved drawings, complete in all respect including earth filling, earth cutting. However, layout of roads shall be as per General Electric layout (GELO)/Civil layout plan of the Sub-Station.
- 7.3** Adequate turning space for vehicles shall be provided and bend radii may be set accordingly.
- 7.4** All substation roads shall be constructed to permit transportation of all heavy equipment. The main road leading to GIS Building/switch yard/colony shall have a minimum 6m width with shoulder on either side (Refer tentative electrical layout as Annexure-S-3/C-3/1). The roads within the substation shall be as per General Electric layout (GELO)/Civil layout (CLO) and as per above referred drawing. The shoulders/footpath/side-walk should be provided with pre-cast kerbs on either side of the road. The top edge of the kerbs shall be battered. The kerb stones with top 20cm wide shall be laid with their length running parallel to the road edge, true in line and gradient at a distance of 30cm from the road edge to allow for the channel and shall project about 12.5cm above the latter. The channel stones with top 30cm wide shall be laid in position in camber with finished road surface and with sufficient slope towards the road gully chamber. The joints of kerb and channel stones shall be staggered and shall not be more than 10mm. Wherever specified all joints shall be filled with mortar 1:6 (1 cement: 6 coarse sand) and pointed with mortar 1:2 (1 cement:2 fine sand) which shall be cured for 7 days. The kerb should be painted as per directions of EIC/Executing Department.

- 7.5** The necessary drainage openings of specified sizes shall be made through the kerb as per drawings or as directed by the EIC/Executing Department for connecting to storm water drains.
- 7.6** Top of the shoulders/footpath/side-walk shall be provided with 20mm thick precast chequered tiles made in ordinary grey cement without chips laid on bed of 100mm coarse sand, PCC 1:8:16 (100mm thick) and 20mm thick bed of cement coarse sand mortar 1:3 with neat cement slurry between joints as per CPWD specifications.
- 7.7** Adequate provision shall be made for road drainage.
- 7.8** The rate of camber on a cement concrete surfacing shall be 1 in 72 unless otherwise provided.
- 7.9** The base sub-grade is to be consolidated with power road roller of 8 Tons to 12 Tons (Roller shall pass a minimum of 5 runs on sub-grade). The roller shall run over the sub-grade till the soil is evenly and densely consolidated and behaves as elastic mass. All undulations in the surface that develop due to rolling shall be made good with quarry spoils and sub grade is re-rolled.
- 7.10** The coarse aggregate used shall be crushed or broken stone or any naturally occurring aggregates such as kankar, laterites of suitable quality shall conform to the physical requirements as given below:

Los Angeles Abrasion value	(Max) 30% (IS: 2386 (Part-IV))
Aggregate Impact Value	(Max) 30% (IS: 2386 (Part-IV) or IS: 5640)
Flakiness Index	(Max) 10% (IS: 2386 (Part-I))

The crushed or broken stone shall be hard, durable and free from excess flat, longated, soft and disintegrated particles, the 100mm thick & 75mm thick. Soling aggregates shall conform to following grading respectively.

GRADE SIZE	SIEVE DESIGNATION	% BY WT. PASSING
95 to 45	125mm	100
	90mm	90-100
	63mm	25-60
	45mm	0-15
	22.4 mm	0-5
63 to 45	90mm	100
	63mm	90-100
	53mm	25-75
	45mm	0-15
	22.4mm	0-5
13.2	13.2 mm	100
	11.2 mm	95-100
	5.6mm	15-35
	180 micron	0.1

- 7.11** The base shall be constructed, to have as nearly as practicable a uniform bearing power throughout its entire width and to conform to the line, grade and cross-section, shown in the drawing enclosed with the document. Where existing road is to be widened every precaution shall be taken to ensure that there would be no differential settlement between the old surface and the newly

added strip.

- 7.12** The base course shall be extended on either side to at least 15 cm (for switch yard roads) beyond the edge of the concrete pavement. The base course shall be prepared at least 2 days in advance of concreting.
- 7.13** The side forms shall be made of metal of approved section having a thickness not less than 5 mm and shall have a depth equal to the specified thickness of the slab. They shall be provided with an efficient locking device to ensure continuity of line and level through joints and with steel pins to hold them in position. Building up of forms shall not be permitted. Flexible or curved forms of proper radius shall be used for curves of 30 meters radius or less. Forms shall not deflect more than 6mm. when tested as a simple beam with a span of 3 meters and a load equal to that which is expected upon them during construction. Forms shall be at least 7.5 cm wide at the base and shall be free from warp, bends or kinks. The top of the form shall not vary from a 3 meters straight edge by more than 3 mm at any point and the side of the form by more than 6 mm.
- 7.14** The base under the form shall be compacted and cut to grade so that the forms, when set, shall be uniformly supported for their entire length and at the specified elevation. Surface found to be below established grade at the form line shall be filled to grade in lifts of 12mm or less and thoroughly re-levelled or tamped.
- 7.15** Forms shall be set over length presenting 2 days work in advance of the point where concrete is being proposed to be placed and shall be cleaned and oiled prior to the placing of concrete. Forms shall remain in place for at least 12 hours after placing the concrete. If the air temperature is below 100C at any time during 12 hours period from the time the concrete is placed, forms shall not be removed until 30 hours after placing of the concrete. While using the device, care shall be taken not to damage the edge of the concrete or of the form. Forms shall be cleaned for reuse immediately after striking. They shall be handled with care and in no circumstances shall be dropped or struck with heavy hammers to remove adhering concrete.
- 7.16** After the base has been approved by the EIC/Executing Department, it shall be sprinkled with water and kept moist to prevent the absorption of water from the concrete. If so required by the Executive Engineer/ Civil Works Division, it shall be saturated with water previous night for not less than 6 hours previous to placing of the concrete. The method of sprinkling of water shall not be such as to form mud or pools of water. No concrete shall be placed around man-holes for other structures until they have been brought to the required grade and camber.
- 7.17** The concrete to be placed shall conform to M-20 grade design mix. For small works, nominal mix of 1:1½ :3 may be used for which specific approval shall be obtained by the successful bidder. The concrete shall be distributed to such depth that when consolidated and finished, the slab thickness obtained is equal at all points and no surface is below the specified level at any point. The uncompacted concrete will be placed keeping the surface slightly higher than the top of the forms; the amount of surcharge depending upon the consistency of the concrete.
- 7.18** The concrete shall be deposited on the prepared base for the required width, in such a manner as to require as little re-handling as possible. Concrete shall be placed at the working face as provided in the code. Necessary hand-spreading shall be done with shovels and not with rakes.
- 7.19** For large works, concrete shall be compacted by vibrators. However, for small works hand-tamping shall be allowed at the discretion of the EIC/Executing Department.
- 7.20** The slab is laid continuously in strips/alternate between longitudinal joints. Ends of slabs should be painted with bitumen before the intermediate bays are filled in.
- 7.21** After belting and as soon as surplus water, if any, has risen to the surface, the pavement shall be

given a broom finish, with an approved steel or fibre broom not less than 50cm wide. The broom shall be pulled gently over the surface of the pavement from edge to edge. Adjacent strokes shall be slightly overlapped. Brooming shall be perpendicular to the centre line of the pavement and so executed that the corrugations thus produced will be uniform in character and width, and not more than 1.5mm deep. Brooming shall be completed before the concrete reaches such a stage that the surface is likely to be torn or unduly roughened by the operation. The broomed surface shall be free from porous or rough spots, irregularities depression etc.

- 7.22** Immediately after the final set has taken place, the surface of the finished concrete shall be kept covered with moist gunny bags for the first 24 hours. The gunny bags shall then be removed and the grooves in the transverse expansion and contraction joints shall be sealed temporarily. The surface shall then be cured for at least 14 days by pounding to a depth of about 7.5 cm or by covering with not less than 7.5cm layer of wet earth. The earth cover shall be kept wet continuously during the whole curing period. At the expiry of the curing period, the surface shall be cleaned of all earth etc.
- 7.23** Forms shall not be removed from freshly placed concrete until it has set for at least 24 hours. They shall be so carefully removed and in such a manner that no damage will be done to the edge of the pavement. After the forms have been removed, the ends of all joints shall be cleaned, after which the sides of the slab shall be covered with earth to the level of the top of the slab.
- 7.24** The finished concrete road shall not be opened to traffic till after the expiry of 4 weeks and till all the joints have been sealed, as specified above.
- 7.25** The expansion joints shall not be more than 20mm. For filling the joints, either pre- moulded or poured types of fillers as described below may be used.
(a) Sand 60%; asphalt 30%; saw-dust 7%; cement 3%.
(b) 80kg of hot bitumen; 1 kg cement; 0.25 cum of coarse sand.
- 7.26** Joints should not be sealed while the concrete is still green or when it is damp. The sealing compound shall be heated until it is fluid enough to pour easily into the joint. Rubberised compositions shall not be heated above 1800. Preparation of base, lying of concrete/joints etc. shall conform to the Indian Standard Specifications.
- 7.27** The finished surface shall be uniform and conform to the lines, grades and typical X-section shown in the approved drawing
- 7.28** Cement concrete paving/parking shall be provided on front, rear & sides, if any of GIS Building as per layout drawing. The concrete blocks shall be of size 4'x6'. The blocks shall be casted in situ alternatively but after 48hrs. No gap is to be left between the panels. Top surface be left rough but should be in level. Suitable slope of earth for drainage of rainwater be provided.
- 7.29** RCC pipe culvert of suitable size shall be provided at appropriate location(s) under the approach road(s) leading to substation. The culverts shall be of one or multiple pipes (600 or 750mm i/d or higher size NP-4 class) as per drainage requirement National/State Highway Authority. The exact location and no. of culverts shall be decided by the EIC/Executing Department (Tentative position is given in layout). The design of culvert shall be as per IRC standards for class 'A' loading. The design data, contours and details required for design of culvert shall be submitted by the successful bidder along with the design/drawing to IOCL PANIPAT for approval.

8.0 TRANSFORMER FOUNDATION

8.1 TRANSFORMER FOUNDATION (50/65 MVA)

As per scope, 50/ 65 MVA Transformer is proposed to be installed. However, the plinth of the Transformer shall be designed assuming placement of 100MVA T/F for future use. For this

purpose, the Design Data of IOCL PANIPAT shall be used by bidder as transformer is also in scope of LSTK bidder.

The transformer foundation plinth for placing the transformer shall be of RCC having minimum Grade M-20 laid on base concrete (1:4:8) of minimum thickness 100mm. Foundation shall be designed for the equipment load requirements of transformer including impact load equivalent to 15% of total transformer load including oil etc. or total Jacking Load whichever is more. The top of plinth i.e. top of rail level shall match with height of tractor-trailer used for transporting the transformer (minimum 750-mm from top of road). The plinth shall extend upto edge of road for perfect movement from trailer to plinth and vice-versa. Suitable arrangement for shifting the transformer from trailer like jacking etc. wherever required shall be made in plinth and in front of plinth on the road.

The space between the rail tracts of the transformer plinth, if any shall be suitably filled with compacted sand and 50-mm thick PCC of grade 1:2:4 laid on 75-mm thick base concrete (1:5:10) placed over compacted earth filling. The top of PCC shall be minimum 300-mm above the formation level of switchyard. Adequate drainage outlets shall be provided and necessary slopes given to drain off rain water/oil.

The deep beam/wall having rails at top shall be of minimum thickness as 300 mm and suitably restrained at ends by beam/wall of same thickness.

The rails shall be fresh, first quality 52-kg/meter medium manganese steel as per Indian railway specification T-12-64 and its subsequent revisions. Suitable arrangement shall be made to maintain the rail gauge.

Suitable foundations shall be provided for all auxiliary equipment of the transformer like radiators, fan supports etc. as required. The work of Transformer foundation shall be taken in hand only after approval of transfer equipment drawing and the transformer plinth foundation shall match the equipment drawing.

For NIFPES fire fighting system, the successful bidder shall develop design & foundation drawings as per manufacturer drawing(s) as approved by IOCL PANIPAT and submit the same for approval of IOCL PANIPAT.

8.2 PARTICULAR SPECIFICATION

The cable trench to transformer shall be as per trench layout plan. The cables leading to various components of transformer shall pass through GI pipes supported suitably in transformer pit.

8.3 Emergency Oil Evacuation System:

Design & construction of Emergency Oil Evacuation System shall be suitable to the type of fire protection & emergency oil drainage system selected.

9.0 FIRE PROTECTION WALLS

Fire protection walls in order to protect against the effects of radiant heat and flying debris from an adjacent fire for 50/65 MVA Transformers shall be designed & provided. The partitions meant to reduce the noise level of the transformers, shall have the same fire resistance if the partitions are also used as fire walls.

9.1 A minimum of 2 meters clearance shall be provided between the equipments and fire walls.

9.2 Fire protection wall shall be provided as per design and drawing at location marked in approved layout plan. The wall shall be of RCC column and beam framework with BB masonry minimum 650 mm (Cm 1:3).

9.3 The height of wall shall be minimum 600mm more than the height of bushing/conservator

(which may higher).

- 9.4** The wall shall have a minimum fire resistance of 2 hours.

10.0 CABLE & PIPE TRENCHES

10.1 SCOPE OF WORK

The contractor shall construct various sizes of cable trenches proposed in the switch yard and inside the GIS Building & as per requirements of power evacuation cabling route upto PNCP as per project requirements. The layout and size of cable trenches shall be as per approved Floor plan/trench layout plan.

- 10.2** Trenches shall be reinforced cement concrete of M-20 grade concrete. MS angle 50x50x6mm welded with GI flat 50x6mm – 75mm long @1 meter c/c to hold the angle shall be provided on top of the trench walls for protection of the edges.
- 10.3** RCC cable trenches and precast removable RCC covers enclosed by suitable MS angles for edge protection in respect of switch yard trenches (with lifting arrangement) shall be designed to withstand self weight of top slab + concentrated load of 150kg at center of span on each panel.
- 10.4** 6mm thick chequered plates with lifting arrangement the bottom of which shall be welded with minimum size of MS Angle 65x65x6 mm for holding the plates shall be provided over the indoor cable trenches.
- 10.5** Medium weight channels (ISMC) of 75x40mm or suitable sizes shall be provided @ 600mm across the indoor cable trenches to support the chequered plates. The length of chequered plates shall be 600mm except at the ends/bends.
- 10.6** The cables shall be placed on hard wood supported on steel racks of MS Angles 50x50x6 (grouted in the RCC walls) or as per suitable size spaced 1.0-m c/c. The ends of the horizontal MS angles should be fixed with suitable angle (by welding a 90°) to hold the cables. All the racks (MS angles, flats etc.) shall be galvanized (conforming to IS 2629-1985 and IS 4759-1968 and withstand tests as per IS 2633-1986). The galvanizing shall be done after fabrication work is complete. However for touch-ups of damaged spots, cold galvanizing be done with paints/sprays such as ZINKOTE -20 Zinc rich paint or Zinc metal spray after cleaning the damaged spots of rust, oil, grease, dirt, moisture, water etc.
- 10.7** The top of trenches shall be kept at least 25mm above the gravel level. The top of cable trench shall be such that the surface rain water does not enter the trench.
- 10.8** All metal parts inside the trench shall be connected to the earthing system.
- 10.9** Trench wall shall not foul with the foundations. Cable trenches shall be blocked at the ends (if required for future extensions) with brick masonry 1:6 in cement sand mortar and this brick masonry work shall be plastered from both sides with cement sand mortar 1:4.
- 10.10** The trench bed shall have a slope of 1/500 along the run & 1/250 perpendicular to the run. In case straight length exceeds 30m, suitable expansion joint shall be provided at appropriate space. The expansion joint shall run through vertical wall and base of trench. All expansion joints shall be provided with approved quality PVC water stops of approx. 230x5 mm size.

- 10.11** Suitable box culvert (Single span or multi spans) shall be provided for any road crossing and it shall be design in such a way that it can take minimum load as per IRC standard. The box culvert shall extend 1.5 m on each side of road and shall have 230-mm wide, 500mm high brick parapet wall at ends. If required, the bed of trench on both sides of culvert shall have to be lowered in slope, in 1.5 m length to meet the bed of culvert.
- 10.12** Necessary sumps shall be provided at suitable places as per direction of EIC and each sump shall be provided with pumps of 1 HP capacity with all accessories shall be supplied for pumping out water collected in the cable trenches. Cable trenches shall not be used as storm water drains. Man hole shall be provided at interval of not more than 30 meters. This clause shall be applicable as per site requirement.

11.0 FOUNDATION/RCC CONSTRUCTION (GENERAL)

11.1 SCOPE OF WORK

Work covered under this clause comprises the design, engineering, supply and construction of foundations and other RCC constructions for switchyard structures, equipment supports, trenches, drains, jacking pad, crane hoisting, pulling block, control cables, bus supports, transformers marshalling kiosks, auxiliary equipment system buildings, Fire fighting system, cable rack, power evacuation facility or for any other equipment or service and any other foundation required to complete the work. This clause is as well applicable to other RCC constructions.

- 11.2** In case of overlapping of foundations in switchyard area, deeper foundation shall be constructed first. The foundations resting on filled up soil, the fill material under foundation/trenches shall be such that the maximum pressure from the footing transferred through fill material will not exceed the allowable soil bearing pressure of original undistributed soil.
- 11.3** In case earth filling is involved due to high fixation of formation level, all foundation shall rest below virgin ground level and the minimum depth of all foundations below virgin ground level excluding lean concrete shall not be less than 1000mm.
- 11.4** All the properties of concrete regarding its strength under compression, tension, shear, punching and bond strength etc. as well as workmanship will conform to IS:456.
- 11.5** The concrete used as lean concrete or base concrete under the structure/equipment/trench/walls etc. foundations shall be 1:4:8; minimum 100 mm thick or more as per drawing (in case thickness is mentioned less than 100mm, it shall be considered as 100mm). The aggregate size shall be 20mm nominal for 100mm thickness and 40mm nominal for thickness more than 100mm. Base concrete shall be well compacted. The top surface of base concrete shall be leveled before placing the reinforcement. During excavation if excavation exceeds than the required depth or if any loose pocket of earth is met below the base then the loose earth shall be removed or excavation depth be increased till normal hard soil is met as per satisfaction of EIC/Executing Department. This extra depth shall be filled with lean concrete. No extra shall be payable an account of this extra excavation and lean concrete.
- 11.6** 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.
- 11.7** The Switch Yard foundations shall be minimum 100mm above the finished ground level or as per the manufacturers design. The plinth level of the substation building shall be 600mm minimum above the finished ground level. Based on the general topography of the

surrounding area IOCL PANIPAT shall, however, fix the plinth level of building.

- 11.8** 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 or pile foundation may be required based on soil/sub-soil conditions and superimposed loads. Bidder to ensure the proper design requirement accordingly.
- 11.9** The cement concrete used shall conform to IS: 456:2000 (Latest revision). Concrete of minimum grade M-20 (irrespective of any grade mentioned on the drawings) shall be used for all structural load bearing members. The mix-design (conforming to IS- Standards) shall be done prior to start of work, as per specifications, got approved from IOCL PANIPAT and shall be used for the construction, provided there is no change in the source and the quality of materials. The source of materials shall be intimated to the IOCL PANIPAT and shall be ensured that Mix design is with the materials from intimated source only and it is not changed during construction. In case source of material changes or quality of material differs from the earlier approved parameters the Mix design shall be done again.
- 11.10** The Coarse aggregate used shall be of 20 mm graded or two types of single size aggregate mixed in some fixed ratio to have graded 20mm aggregate. The Coarse aggregate shall conform to IS: 383.
- 11.11** Grading of Fine aggregate shall conform to Zone-II of Table - 4 of IS: 383 and shall be free from deleterious materials.
- 11.12** The environmental exposure condition considered for mix design shall be MILD.
- 11.13** For Mix-design, the degree of quality control shall be considered as FAIR.
- 11.14** The Water cement ratio shall be minimum 0.50 and maximum 0.55.
- 11.15** The minimum slump shall be 25mm and maximum 75mm.
- 11.16** For Volumetric use of ingredients for concrete mix, the contractor shall intimate the size of measuring boxes along with the Mix-design.
- 11.17** Ordinary Portland Cement (OPC) of Grade 43 conforming to IS: 8112 manufactured by major cement manufacturer shall be used, as mentioned in FQP attached as annexure-S-3/C-3/2.
- 11.18** The water used for preparing concrete and for curing purpose shall be fresh, clean and free from oil, acids and alkalis, organic materials or suspended or other deleterious substances. Saltish or brackish water shall not be used. Water used for construction & curing etc. shall be conforming to requirements of IS: 456 Clause 5.4. Contractor shall arrange at his own cost sufficient quantity and good quality water for construction and curing and other purposes.
- 11.19** No admixtures shall be used except water proofing cement additives conforming to IS 2645 with the approval of the IOCL PANIPAT.
- 11.20** Reinforcement steel (including TMT) Bars manufactured by main producers or their authorized re-rollers in India or abroad shall be used and certificates in this regard shall be submitted by the Contractor to the entire satisfaction of the IOCL PANIPAT. The steel used shall conform to IS:1786 for deformed and cold twisted bars. Required grade of steel shall be Fe-415. All reinforcement shall be clean and free from loose mill scale, dust, loose rust and coats of paint, oil or other coating, which may destroy or reduce bond with concrete. Reinforcement bars should be fresh. Bidder shall supply, fabricate and place reinforcement to shapes and dimensions as indicated on the drawings or as required to carry out the intent of drawings and

specifications. Adequate nos. of chairs, spacers of required size shall be provided to ensure the proper placement of reinforcement. The reinforcement bars crossing one another should be tied together at every intersection with two strands of annealed steel wires 0.9 to 1.6 mm thick twisted and tied to make the skeleton of the steel work rigid so that the reinforcement does not get displaced during concrete placement.

- 11.21** All the reinforcement steel should be placed/ stacked at site store on raised (at least 0.5 metre from near surroundings) pucca/brick platform or reinforcement steel should be placed on MS/GI sheets. The reinforcement steel after stacking should be covered with Tarpaulin to avoid corrosion. Immediately before concreting (portion of reinforcement to be embedded in concrete) shall be painted with cement slurry after removing any rust/corrosion/any other foreign material. Overlaps in more than 30% of bars will not be allowed at a section. Fabricated Reinforcement bars shall be placed in position as shown in the drawing or as directed by EIC/Executing Department.
- 11.22** The bars crossing one another shall be tied together at every intersection with two strands of annealed steel wires 0.9 to 1.6mm dia. twisted and tied to make the skeleton of steel work rigid so that reinforcement does not get displaced during placement of concrete.
- 11.23** Two types of steel shall not be used.
- 11.24** All the foundation bolts used for equipment foundations & for main gantry tower foundations shall be galvanized.
- 11.25** The foundation bolts shall be embedded in concrete during concreting and no grout holes shall be left for this purpose.
- 11.26** Excavation shall extend minimum 150 mm around foundation (from RCC portion and not from lean concrete).
- 11.27** Proper shuttering & shoring shall be provided to support the excavated earth face to avoid falling of earth. No extra charges shall be admissible for the removal of fallen earth in the pit, once excavated.
- 11.28** 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 combination thereof. The raft/spread footing/pile foundations as may be required based on soil/sub soil condition and superimposed loads shall be provided.
- 11.29** If pile foundations are adopted, the same shall be cast-in-situ bored or pre cast or under reamed type as per relevant parts of IS:2911. Only RCC piles shall be provided. To establish the pile design capacity, necessary initial load tests shall be carried out by the successful bidder at his cost. Only after the design capacities of piles have been established, the successful bidder shall take up the job of piling. Routine tests for the piles shall also be conducted as per IS:2911. All the testing work shall be planned in such a way that these shall not cause any delay in project completion.

12.0 MIXING, PLACING AND COMPACTION OF CONCRETE

- 12.1** The concrete shall be mixed in a mechanical mixer. The mixer shall comply with IS: 1791 & 12119. The mixer shall be fitted with water measuring devices.
- 12.2** Mixing shall be continued until there is uniform distribution of material and the mix is uniform in colour and consistency. If there is segregation after unloading from mixer, the concrete should be re-mixed, but in no case the mixing shall be done close to the foundation, or place of

work but in case it is not possible the concrete may be mixed at the nearest convenient place. From mixer, concrete shall be put on pucca platform or steel troughs, which shall be leak proof to avoid any loss of water/slurry. The concrete shall be transported from the place of mixing to the place of final deposit as rapidly as practicable, which shall prevent the segregation before any setting commences.

- 12.3** Proper shuttering shall be used for the construction of all type of PCC/RCC works. Shuttering shall be rigidly tightened so that there are no distortions in the shape. Shuttering shall be made sufficiently strong to with stand all the loads and vibrations. Vibrators shall be used to ensure thorough compaction.
- 12.4** After the shuttering has been removed, if the concrete surface is found to be slightly damaged, same shall be repaired with rich cement sand mortar to the satisfaction of the IOCL PANIPAT's representative before the foundation pits are back-filled.

13.0 CURING

The concrete after setting for 24 hours shall be cured by keeping the concrete wet continuously for a period of 10 days (minimum) after laying. The foundation be back filled with selected good earth free from harmful salts, organic material, sprinkled with necessary amount of water and well consolidated in layers not exceeding 200 mm of consolidated thickness after a minimum period of 72 hours and thereafter both backfilled earth and exposed top shall be kept wet for the remainder of the prescribed curing time. The uncovered concrete portion above the backfilled earth or vertical columns etc. shall be kept wet by providing empty cement jute bags dipped in water fully wrapped around the concrete for curing and ensuring that the bags are kept wet by the frequent pouring of water on them. In case Portland Pozzolona cement has been used, curing period shall be increased by EIC/Executive Department

14.0 DISMANTLING

The contractor wherever required, shall carry out dismantling & disposal of PCC/RCC upto a lead of 15 Km or as directed by the EIC/Executive Department, to make space for the proposed structures in the new proposed bays of the Sub- Station.

15.0 DESIGN

- 15.1** All the foundations except walls of GIS Building etc. shall be of Reinforced Cement Concrete. The design & construction of RCC structures shall be carried out as per IS:456-2000 using minimum grade of concrete as M-20. Higher grade of concrete than specified above may be used by the contractor without any additional cost to the IOCL PANIPAT with proper mix design.
- 15.2** Limit state method of design shall be adopted unless specified otherwise in the specification/IS Codes.
- 15.3** For design and construction of steel-concrete composite beams IS: 11384 shall be followed.
- 15.4** For detailing of reinforcement, IS: 2502 and SP: 34 shall be followed. Two layers of reinforcement (on inner and outer shall be provided for wall & slab sections) having thickness of 150 mm and above. Clear cover to reinforcement towards the earth face shall be minimum 50 mm and for other components, same shall be as per IS:456.

- 15.5** The procedure used for design of the foundations shall be the most critical loading combination

of 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. The contractor, for approval of drawings shall submit detailed design calculations along with drawings to the recommended agency as per clause 10.6 of section-1 chapter-1.

- 15.6** Designer shall consider sub-soil water pressure that may be encountered, following relevant standard strictly.
- 15.7** 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 without extra cost to the IOCL PANIPAT.
- 15.8** RCC column shall be provided with rigid connection at the base.
- 15.9** All sub-structures shall be checked for sliding and overturning stability during both construction and operating conditions for various combinations of loads. Factor 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. In case of trench passing above the footing base then for overturning only dead weight of trench shall be considered.
- 15.10** Earth pressure for all underground structures shall be calculated using coefficient of earth pressure at rest, co-efficient of active or passive earth pressure (whichever is applicable). However, for the design of sub-structures of any underground enclosures, earth pressure at rest shall be considered.
- 15.11** In addition to earth pressure and ground water pressure etc. a surcharge load of $2T/sq. m$ shall 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 or otherwise.
- 15.12** Following conditions shall be considered for the design of water tank in pumps house, channels, sumps and trenches and other underground structures.
- a) Full water pressure from inside and no earth pressure and 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 from outside and no water pressure from inside
 - c) For any water retaining structure or any member submerged in water the minimum grade and concrete shall be M-25.
 - d) 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 super imposed loadings.
- 15.13** Base slab of the any underground enclosure like water storage tank shall also be designed for empty condition during construction and maintenance stages with maximum ground water table (GWT) at 2.0 m. below ground level. Minimum factor of safety of 1.5 against buoyancy shall be ensured ignoring the super-imposed loading. Intermediate dividing piers of such enclosures shall be designed considering water in one pump sump only & the other pumps sump being empty for maintenance.

- 15.14** The foundations shall be proportioned so that the estimated total and differential movements of the foundations are greater than the movements that the structure or equipment is designed to accommodate.
- 15.15** The foundations of transformer/reactor shall be of block type foundation. Minimum reinforcement shall be governed by IS: 2974 and IS:456-2000.
- 15.16** 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.

16.0 OTHER FOUNDATIONS

- 16.1** All foundations shall be designed in accordance with the provisions of the relevant parts of latest revisions of Indian Standards IS: 456 and other relevant Indian Standards.
- 16.2** Type of foundation system i.e. isolated footing or raft etc. shall be decided based on the load intensity and soil strata.

17.0 BUILDINGS

18.1 GENERAL SCOPE

The scope of construction of GIS Building or any other building shall include providing anti-termite treatment, plinth protection DPC of building, sanitary, water supply, triple layered Sintex/Diplast polyvinyl tanks, electrification including supply and providing of LED light fittings, VAM based HVAC system, ceiling fans, T-5, 28W 4ft. long LED tubes with fittings, modular switches, boxes, electric wire, flooring, finishing items including acrylic emulsion (interior) and whether proof (exterior acrylic paint), anodized aluminium doors/windows/ventilators frames provided with 5.0mm thick glass, steel jail, fire doors, indoor cable trenches with covers in control room/battery room/ACDB/DCDB rooms etc. etc. complete in all respect as per IOCL PANIPAT project requirement. Scope shall also cover any other item(s) required for the completion of building which has/have not been mentioned in the specification or in the drawings but are essential for completion of the building. The switchgear building shall suitable designed to accommodate GIS switchgear and all other auxiliaries as per scope of this project and available area. The tentative layout plan and available area is indicated in annexure-S-3/C-3/1. The drawings, detail layout plan shall be submitted by successful bidder during construction. All CEA/IE rule based requirement for a 220 KV switchgear building shall be ensured by Bidder while designing and construction of the building

GIS & Control Room Building shall be RCC Framed Structure having GF + FF shall be made of RCC frame structure of minimum concrete grade of M25 and Room for electrical installations must be designed such that no water can penetrate and such that condensation is kept to a minimum. The details of the same areas (minimum) under.

Name of floor	Functional purpose	Dimension (m)	Approximate carpet area (m²)
Ground Floor	HVAC Room	15 X 9	135
	Battery Room	15 X 8	120
	Lighting Trafo & MLDB Room	15 X 5	75
	Store Room	11 X 8	88
First Floor	220KV GIS Bay (Panel cut-out)	25 X 6	150
	415V PCC (Panel Cut out)	17 X 2	34
	ECS & Load Manager Room	15 X 10	150

	SCADA Room	15 X 10	150
	Relay MMI Room	15 X 10	150
	UPS & Charger Room	13 X 15	195
	DGAF Panel Room	8 X 7	56
	Engineering Room	8 X 7	56
	Operator Room	8 X 7	56
	Toilet	4 X 4	16
Extension of PR control room	SCAP ROOM	8 X 8	64

Note:

- (1) Certain minimum requirements are indicated above for 220 KV GIS (Indoor) for guidance purpose only and minimum required. However, bidder shall design and accordingly may increase and/ or add any other room/ facility required for successful execution of the project for complete system requirement for 220KV indoor GIS.
- (2) Area for toilet block, passage, stair cabin at the terrace and other necessary as required shall be added.
- (3) Dimension of complete GIS building is taken as 67 m X 30 m. This the minimum & indicative Requirement, however bidder may take more area as per final approved dimension of equipments.
- (4) **Any changes in the dimensions during detailed engineering shall be submitted to Engineer in-charge for approval prior to start of the job.**

IOCL PANIPAT reserves the right to alter the finishing schedule and specifications. Such changes will have no additional financial implication whatsoever on IOCL PANIPAT. Further, it is informed to the bidders that the drawings for construction of 220 Substation switch house buildings is being constructed for the 1st time, therefore, changes if any in the drawings issued with the bid documents shall be carried out by the bidder at no additional cost to IOCL PANIPAT.

18.2 WATER SPRINKLER SYSTEM FOR CABLE CELLAR FOR FIRE FIGHTING: Suitable automatic water sprinkler system for cable cellar as per OISD/CEA/IS standards. The cable galleries shall have number of rows of cable trays and each row will have number of tiers of cable trays. Each of the cable rows shall be provided with a network of water distribution piping and nozzles. The distribution network shall consist of distribution header for each row of cable tray and on these headers drop pipes shall be provided so as to cover all the tiers. In case of fire in the cable gallery, addressable multi-sensor detector supplemented with linear heat sensing cable of digital type shall be used for detection of fire. Upon detection of fire MVW spray system shall be brought into operation by automatically opening of deluge valve, which shall allow the projectors located in that area to direct water in the form of spray, which will cut off oxygen supply and extinguish the fire. As per TAC regulations the density of spray water system in cable galleries shall be 12.2 lpm/m² of the surface area for spray system. The pressure at the hydraulically most remote projector in the network shall not be less than 2.8 bar.

As an abundant safety measure, fixed fire extinguishing system with deluge facility using water spray may be applied for cable galleries and cable tunnels.

The water spray system consists of a number of spray nozzles mounted on piping network covering the complete span of cable trays laid horizontally and vertically. To avoid total flooding, cable galleries and tunnels may be divided into a number of zones. Each zone is controlled by one deluge valve assembly connected to detection network. When fire occurs in a particular zone, detection unit in that zone will actuate and corresponding deluge valve will open and spray water

- 18.3 SMOKE DETECTION AND FIRE ALARM SYSTEM:** An effective fire / smoke Detection system shall be installed. Alarm / annunciation system shall be provided in Control Room / Manned Substation to facilitate appropriate action. Performance / efficacy of such system shall be checked periodically and documented. Selection of fire fighting equipment should be governed by OISD/NFPA/CEA standards. The provided system shall be integrated with existing fire alarm system. The LSTK contractor shall ensure the compatibility of newly offered system with existing fire alarm system. Collection of all data, selection of equipment and system for integration is in LSTK contractor's scope. Any hardware required in existing system shall also be in the scope of LSTK contractor.

18.4 STORM WATER DRAINAGE FOR ALL BUILDINGS

The building drains 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.

PVC rain water down comers as mentioned in clause 16.15 shall be provided to drain off the rain water from the roof. These shall be suitably concealed with masonry work or cement concrete jalis or cladding material. The number and size of down comers shall be governed by IS: 1742 and IS: 2527.

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

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

18.5 MATERIALS

The brief requirement regarding various materials to be used for construction of building are detailed below or specified in respective drawings. However, materials not specifically mentioned in the specifications/drawings, the same shall also conform to the relevant IS codes and got approved from the IOCL PANIPAT before being used. The contractor shall remove from site any material not conforming of IS Standards or rejected by the representative of IOCL PANIPAT/EIC/Executing Department.

18.6 BRICKS AND TILES

The bricks used shall be first Class bricks of nominal size (230x110x70) mm so that every four courses shall measure 30.48 cm in height. A tolerance upto $\pm 80\text{mm}$ in length $\pm 40\text{mm}$ in width and $\pm 40\text{mm}$ in thickness/height shall be permitted per 20 bricks. The bricks shall be made from good brick earth free from efflorescence/kankar, thoroughly burnt and uniform deep red colour, regular in size and shape with parallel faces and sharp corners, uniform in colour, free from flaws etc, and shall have all the qualities of a good brick. Bricks and tiles shall have ringing sound when struck with each other.

Bricks shall have a minimum crushing strength of 105 kg/per sq. cm and shall not absorb water more than 20% of its own dry weight after 24 hours immersion in cold water.

For tile terracing and tile facing, size of tile shall be (230x110x30) mm having permissible tolerance of IS Standards for length, width & height $\pm 40\text{mm}$.

18.7 SAND (FOR MASONRY MORTAR & PLASTER)

Sand for masonry work and plaster shall preferably consist of natural sand, However crushed

stone sand or crushed gravel sand or a combination of any of them be used. Sand shall be hard, durable, clear and free from harmful impurities like iron pigments, mica salts, coal or other organic impurities. Grading of sand for use in masonry mortar shall be conforming to IS: 2116 and for use in plaster shall conform to IS: 1542 tabulated as below:

IS Sieve Designation	Percent passing by mass	
	For Mortar	For Plaster
9.0 mm	-	100
4.75 mm	100	95 to 100
2.36 mm	90 to 100	95 to 100
1.18 mm	70 to 100	90 to 100
600 micron	40 to 100	80 to 100
300 micron	5 to 70	20 to 65
150 micron	0 to 15	0 to 50

The maximum quantities of clay, fine silt, fine dust and organic impurities shall not exceed limits described in IS: 2386 (Part II). Clay, fine dust and silt in natural sand or crushed gravel sand or crushed stone sand not more than 5% by mass.

18.8 BRICK WORK

All brickwork shall strictly be according the specifications and notes specified in the drawings. All bricks shall be soaked in stacks by spraying clean water at regular intervals to keep them wet to the satisfaction of EIC/Executive Department Each brick shall be set (with frog upwards) with bed and vertical joints completely filled with mortar. Thickness of mortar joint shall be 6.25 mm and shall not be more than 9.4 mm. For exposed brickwork, bed joint will be 7.81 mm thick and vertical joint 6.28 mm.

All brickwork shall be true in plumb, straight edge, for exposed brickwork or face work bricks shall be selected for purpose. The face joints shall be duly raked to minimum depth of 13 mm when mortar is green for providing key to plaster or pointing. The mortar used for brick work/ plasterwork shall be machine mixed only.

All fixtures, doors/windows/CI pipes, outlet for water, hold fasts etc. which are required to be built/laid in brickwork shall be embedded simultaneously. Each day work done shall not be more than 1m in height and no portion of the work shall be left more than 1m lower than the other. The height of brick courses shall be kept uniform.

All the half brick thick walls shall be provided with 2 numbers- 6 mm bars at every fourth layer.

18.9 DAMP PROOF COURSE

On outer walls horizontal DPC shall be provided at level with plinth protection and on inner face vertical DPC 20 mm thick, shall be provided. On all inner walls horizontal DPC shall be provided at floor/plinth level.

Horizontal DPC shall consist of cement concrete (1:1½:3) 50 mm thick. Edge of DPC shall be straight, even and vertical. It shall be cured for at least 7 days, after which it shall be allowed to dry. Vertical DPC shall consist of two layers of plaster (1:3) with total thickness of 20 mm. Hot bitumen shall be applied over dried up surface in thin layer.

18.8 FLOORING

The flooring of GIS Building except battery room and toilet shall be of precast terrazzo/vitrified tiles (as detailed in the working drawing or mentioned here below). Anti-skid tile 300x300x7.7mm flooring in toilets and pantry and Acid-resistance tiles shall be provided above 40mm thick PCC (1:2:4) flooring in battery room.

Before flooring work is taken up, works such as laying of services which otherwise would affect the laying of floors, plastering of all inside & outside walls, ceilings, fixing of doors and window frames in place and all heavy work in room may be completed.

The base layer for all floors shall be of 100-mm thick sand and 100 mm thick cement concrete 1:4:8 laid on sand. The sand for base filling shall be clean and dry, free from clay clods and other harmful impurities such as iron pigments alkalis, coal and lignite, materials finer than 75 microns. Sand shall be of particle size ranging from 1.18 mm to 150 micron. The fineness modulus shall vary from 0.8 to 1.0. Generally sand fit for plastering is fit for sand filling under floor.

The pre cast terrazzo tiles of 300x300x25mm minimum thickness (the finished thickness of the top upper layer shall be 10mm) in 50% white & 50% ordinary grey cement with marble chip conforming to IS: 1237-1980 and pre- polished granite stone (slab) flooring as approved by IOCL PANIPAT shall be laid on 20 mm thick bed of cement coarse sand mortar 1:3. The mortar shall be evenly spread over the base for two rows of tiles and about three to five meters in length. The top of mortar shall be kept rough so that cement slurry can be absorbed. Neat cement slurry of honey like consistency shall be spread over the mortar bed @ 5 kg per sq. meter. The joints shall be kept as thin as possible (not exceeding 1.5 mm) and filled with neat cement slurry, treads of steps and landing, if any. The floor shall be kept wet or flooded with water and protected against damage due to traffic or any other cause, for at least seven days after finishing the tiles.

After the tiles are cured and have dried up, these shall be ground evenly with machine fitted with special rapid cutting grit blocks (carborundum stone) of coarse grade (No. 60) till the marble chips are evenly exposed and the floor is smooth. After the first grinding, the surface shall be thoroughly washed to remove all grinding mud and covered with a grout of cement and colouring matter in same mix and proportion as the topping in order to fill any pin holes that appear. The surface shall be allowed to cure for 5 to 7 days and then rubbed with machine fitted with fine grit blocks (No.120). The surface is cleaned and repaired as before and allowed to cure again for 3 to 5 days. Finally the third grinding shall be done with machine fitted with fine grade grit blocks (No.320) to get even and smooth surface without pinholes. The finished surface should show the marble chips evenly exposed.

Where use of machine for polishing is not feasible or possible, rubbing and polishing shall be done by hand, in the same manner as specified for machine polishing except that carborundum stone of coarse grade (No. 60) shall be used for the 1st rubbing, stone of medium grade (No. 80) for second rubbing and stone of fine grade (No. 120) for final rubbing and polishing.

After the final polish either by machine or by hand, oxalic acid shall be dusted over the surface @ 33 gm per square meter sprinkled with water and rubbed hard with a nemdah block (Pad of Woolen rags). The following day, the floor shall be wiped with a moist rag and dried with a soft cloth and finished clean.

Anti skid floor tiles of reputed makes such as Somany, Kajaria, Nitco etc. having minimum 300x300 mm nominal size and 7.7 mm thick preferably in Beige colour shall be provided in the toilets. The tiles shall conform to relevant EN/IS codes. The tiles shall conform to relevant EN/IS codes. The tiles & the colour scheme shall be got approved from the IOCL PANIPAT.

Entire area around the Switch house building and GIS blocks shall be provided with 100mm thick RCC 8mm tor @ 300C/C both ways in M-25 grade cement concrete paver laid over 100mm thick 1:4:8 upto 2 meter from the outer edge of the building.

18.9 SKIRTING

Matching pre-cast terrazzo tiles 300x150x25mm made in 50% white & 50% grey cement conforming to IS: 1237-1980 shall be used in areas provided with pre-cast terrazzo tile flooring. The minimum finished thickness of tiles shall be 12.5 mm. Tile skirting and dado shall be fixed only after laying the tiles in the floor. The portion of the wall to be covered with skirting and dado shall be left unplastered. The wall surface shall be evenly and uniformly covered with about 10 mm thick backing of cement coarse sand mortar 1:3. However, in the case of skirting, the tiles may be directly fixed without application of back as a separate course. Before the backing mortar has hardened, the back of each tile to be fixed shall be covered with a thin layer of neat cement paste and the tile gently tapped against the wall with a wooden mallet. The fixing shall be done from the bottom of the wall upwards. All the tile faces shall be set in conformity with one another and shall be truly vertical. The sides of the tiles shall be coated with grey or white cement slurry with or without pigment to match the shade of tiles and butt jointed. The joints shall be as thin as possible.

Tiles shall be ground and polished as for flooring by hand.

In case of vitrified tiles, the skirting shall also be of same make, colour and style. The vitrified tiles for flooring shall be of size 600x600mm 1st quality of approved make viz. Nitco, Kajaria, Somany, Orient, Jonson and laid in any pattern as specified over base of 20mm thick cement coarse sand mortar 1:4 for flooring and 12mm thick for skirting including jointing with white cement slurry mixed with pigment to match the shade of tile.

In toilets and pantries, the skirting/dado shall be of 1st quality tiles of 6.7mm thick 200x200 mm size of reputed makes such as Somany, Kajaria, Nitco etc. and should go upto 6'-9" high from floor level. The tiles shall conform to relevant EN/IS codes. The tiles & the colour scheme shall be got approved from the IOCL PANIPAT. Skirting/Daddo colour and style should match with the flooring. The tiles shall be fixed over 20mm thickness cement mortar 1:4 including jointing with white cement slurry mixed with pigment to match the shade of tile completely.

18.10 DOORS/WINDOWS

The contractor shall provide & fix Aluminum chowkhats/doors /windows/ ventilators (single & double leaf) consisting frame work including vertical styles, top rails, lock (middle) rails and bottom rails with metal fastener & screws fitted with nuts & bolts or using rawl plugs & screws as per IOCL PANIPAT drawings. The Aluminum section to be used shall be of 10 gauge (3mm) anodized (15 micron) of reputed makes such as HINDALCO/JINDAL conforming to IS: 1968-1983. The doors & windows shall be fitted with 5.0 mm thick glass of reputed make like TATA FLOAT/SAINT GOBBAIN, high- class rubber gasket & aluminum beading complete so to make the glass airtight. The toilet doors shall, however, be fitted with 12mm thick three layered medium density particle pre-laminated board (NOVAPAN/KIT/DECCO) panels of appropriate size with aluminum beading to make it airtight. The door/floor springs, locks (six lever or Godrej or equivalent), 1st quality aluminum handles/tower bolts/stoppers with rubber cushion, screws etc. shall be of 1st quality ISI make as approved by EIC/Executing Department. However plug of minimum 5mm depth shall be provided on the top and bottom of the styles of window and door frames.

18.11 ROLLING SHUTTERS

GI Rolling shutters with suitable operating arrangement according to size & weight shall be provided in buildings to facilitate handling and transportation of equipment.

18.12 TOILET & SANITARY FIXTURES AND RAIN WATER PIPES

The specification of different items, which are to be used for plumbing, sanitation & Water supply etc. in are given below, the same shall be used during detailed engineering, unless otherwise mentioned else where in the tender.

S.No.	Items	Description
1	Wall hung Water Closet	Coloured vitreous china extended wall mounting water closet of approved size and shape including providing & fixing white vitreous china cistern with dual flush fitting, of flushing capacity 3 litre/6 litre (adjustable to 4 litre/8 litres), including seat cover, and cistern fittings, nuts, bolts and gasket etc complete.
2	Squatting Pan	(Indian type W.C. pan) (white vitreous china Orissa pattern W.C. pan of size 580x440mm with integral type foot rests) shall be with 100mm sand cast iron P or S trap. 10 litre low level white P.V.C flushing cistern with manually controlled device (handle lever) conforming to IS:7231, with all fittings and fixtures complete including cutting and making good the walls and floors wherever required.
3	Wash Basin	Providing and fixing coloured wash basin counter type of (approximate size 630x450mm size under counter or over counter type), in case flat bash hand is required the approximate size shall be 550x400mm and shall be provided with C.P. close basin mixer (ISI approved) with Cl. Brackets taps with battery based infrared sensor, 32mm C.P. brass waste and bottle trap of standard pattern, including painting of fittings and brackets, cutting and making good the walls wherever required. Other details shall be as per the drawings.
4	Urinal	White vitreous china battery based infrared sensor operated urinal of approx. size 610 x 390 x 370 mm having pre & post flushing with water (250 ml & 500 ml consumption), having water inlet from back side, including fixing to wall with suitable brackets all as per manufacturers specification and direction of Engineer in charge.
5	Urinal partition	10mm thk toughened glass partition with frosted film to be fixed in position for urinals on appropriate stainless steel patch fittings of desired shape and size
6	Bib cock	C.P. brass short body and long body bib cock 15mm nominal bore shall be of approved quality conforming to IS: 8931.
7	Angle valve	C.P. brass angle valve of 15mm nominal bore provided and fixed in position for basin and cistern points of approved quality conforming IS :8931.
8	Towel rail	C.P. brass towel rail of approved make of 600mm length, 25mm dia with a pair of brackets or flanges provided and fixed to wall beside each wash basin/set of wash basin with necessary screws, plugs, etc.

9	Mirror	6mm thick bevelled edge mirror approximate size 1000x600mm made of superior glass of approved make complete with a backing of 6 mm thick water proof hard board fixed to wooden cleats with 25mm dia SS studs, washers etc complete for each wash basin.
10	Hooks	Double type coat & hat hooks with flanges, fixed to wall / shutter, etc. with necessary screws, washers & plugs.
11	Liquid soap holder	C.P. brass liquid soap holder of approved make fixed with each wash basin to the wall with necessary CP brackets, CP screws, washers, plugs etc.
12	C.P. Brass or S.S. cockroach trap	Approved C.P. Brass cockroach trap shall be provided in the Kitchen, Toilets and pantry
13	Floor traps	PVC floor traps of self cleansing design shall be provided & fixed in position with 100 mm dia. inlet and 75mm dia. outlet of approved make, including making connection with PVC soil/waste pipes using rubber gaskets, embedding the trap in 150 mm thick PCC 1:2:4.
14	Internal Soil, waste and vent pipe	Un-plasticised rigid PVC pipes of 75mm for waste & 110mm dia for soil shall be provided conforming to IS:13592 type B and all its fittings like bends, sockets, door bend, Y- tee etc. as per requirement with seal ring conforming to IS: 5382 including jointing with cement solvent conforms to IS:14182. All underground or under floor pipes shall be encased with 1:3:6 concrete. Minimum concrete cover shall be 75 mm thk.
15	Rain Water Pipe and fittings	<ul style="list-style-type: none"> a) Un-plasticised rigid PVC rain water pipes of required dia shall be provided and fixed on the wall face conforming to IS: 13592 type A as per requirement including jointing with seal ring conforming to IS: 5382 leaving 10mm gap for thermal expansion single socketed pipes including all fittings like bends, bat clamps gratings etc. b) Un-plasticised PVC Moulded fittings/accessories including suitable dia. bend & shoes shall be provided and fixed for un-plasticised rigid PVC rain water pipes conforming to IS:13592 type A including jointing with seal ring conforming to IS: 5382 leaving 10mm gap for thermal expansion. c) Clips of approved design shall be provided and fixed to Un-plasticised PVC rain water pipes by means of 50x50x50mm hard wood plugs, screwed with MS screws of required length including cutting brick work and fixing in cement mortar 1:4 (1 cement : 4 coarse sand) and making good the wall etc

16	Internal & External water supply	<p>a) All CPVC pipes and fittings shall conform to IS:15778</p> <p>b) All internal CPVC pipe shall be concealed including cutting of chases and making good the wall.</p> <p>c) Wherever CPVC pipes are buried the same shall be provided and laid in position including trenching, sand cushion and refilling, etc. For trenching, sand cushion and refilling refer CPWD specification applicable for external piping work.</p> <p>d) All internal CPVC pipe shall be concealed including cutting of chases and making good the wall.</p> <p>e) ISI approved CPVC ball valve, non return valves shall be provided and fixed in position as per requirement and direction of Engineer in charge.</p>
17	Water storage tanks	Polyethylene water storage tanks conform to IS: 12701 shall be provided of approved brand and manufacture with cover and suitable locking arrangement, float valve and making necessary holes for inlet, outlet and overflow pipes. Capacity of water tank shall be 2x1500 litres for control room, 2X2000 litres for Transit Camp.
18	Sluice valve chamber	Masonry chamber for sluice valve shall be 600x600mm size in plan and depth 750mm, or matching with the site condition inside with 50 class designation brick work in cement mortar 1:5 (1 cement : 5 fine sand) with CI surface box 100 mm. Top diameter, 160 mm bottom dia and 180 mm deep (inside) with chained lid and RCC top slab 1:2:4 mix (1cement : 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) necessary excavation foundation concrete 1:5:10 (1 cement : 5 fine sand : 10 graded stone aggregate 40 mm nominal size) and inside plastering with cement mortar 1:3 (1 cement : 3 coarse sand) 12 mm thick finished with a floating coat of neat cement complete as per standard
19	External Sewerage	Glazed stoneware pipes of 100 & 150mm diameter grade 'A' shall be provided, laid and jointed with stiff mixture of cement mortar in the proportion of 1:1 (1cement :1 fine sand) including testing of joints etc. complete. SW pipes shall be encased with Cement concrete 1:5:10 (1 cement: 5 coarse sand: 10 graded stone aggregate 40 mm nominal size) including bed concrete as per CPWD standard design and CPWD specifications. In case of non- availability of SW Pipe, contractor may use UPVC Pipe of similar dia with the prior approval of EIC without any financial implication to IOCL.
20	Gully trap	100x100 mm or 150x100 mm size P type Square- mouth S.W. gully trap class SP1 complete with C.I. grating brick masonry chamber and water tight C.I. cover frame of 300 x300 mm size (inside), the weight of cover to be not less than 4.50 kg and frame to be not less than 2.70 kg as per standard design. FPS Bricks class designation 75 shall be provided for brick masonry chamber.

21	Manholes	<p>FPS brick masonry manhole shall be constructed in cement mortar 1:4 (1 cement :4 coarse sand) RCC top slab with 1:2:4 mix (1 cement : 2coarse sand : 4 graded stone aggregate 20 mm nominal size) foundation concrete 1:4:8 mix (1cement : 4 coarse sand :8 graded stone aggregate 40 mm nominal size) inside plastering 12 mm thick with cement mortar 1:3 (1 cement : 3 coarse sand) finished with floating coat of neat cement and making channels in cement concrete 1:2:4 (1 cement: 2 coarse sand :4 graded stone aggregate 20 mm nominal size) finished with a floating coat of neat Cement complete as per standard design. The size and depth of manhole shall be suitably decided based on requirement of layout in line with CPWD specification.</p> <p>(a) Inside size shall be 90 x 80 cm and 60 cm deep including CI Cover with frame (light duty) 455 x 610 mm internal dimensions total weight of cover and frame shall not be less than 38 kg (weight of cover 23 kg and weight of frame 15 kg) and shall be constructed with F.P.S. bricks with class designation 75.</p> <p>(b) Inside size shall be 120 x 90 cm and 90 cm or more deep including CI cover with frame (medium duty) 500mm internal diameter total weight of cover and frame to be not less than 116 kg (weight of cover 58 kg and weight of frame 58 kg) with FPS Bricks class designation 75.</p>
22	Foot Rest	<p>Orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS : 10910, on 12 mm dia steel bar conforming to IS: 1786, having minimum cross section as 23 mmx25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufacture's permanent identification mark to be visible even after fixing, fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size) complete.</p>
23	Road Gully Chamber	<p>Brick Masonry road gully chamber of 50x45x60cm shall be provided with FPS brick with cement mortar 1:4 including 500x450mm pre cast RCC cover Horizontal/vertical grating with frame complete.</p>

18.13 ELECTRICAL ITEMS IN CONTROL ROOM AND OTHER BUILDINGS

The lighting of GIS building, the switchyard including indoor & outdoor shall be LED type only and the part of tender. The luminaires and fixtures shall be of approved make only and the light provision shall be done as per lux level requirements provided in OISD standards.

The wiring shall be recessed/ concealed conduit wiring. Heavy duty PVC conduits of 20/25/30mm size and wires 2.5/4/6 sq. mm copper for circuit wiring & 1.5 sq. mm copper for earth including wiring for sub-mains, modular switch boards, junction boxes, switches/sockets 5 Amp, 5/16 Amp and 16 Amp, 240V indoor and outdoor receptacle, electronic step regulator mounted on the switch boards, provision for telephone wires including telephone junction boxes/tap blocks, sockets.

Depth of inspection/junction boxes shall be 80 mm in ceiling and 28 mm on wall surface which may vary as per requirement of modular switches/regulator.

All the split/window ACs, ceiling fans, LED lights etc. shall be of reputed company as per approved make list (like LG/Samsung/Hitachi/Videocon/Crompton/Philips/Osram etc). All switches, fittings, sockets, fans shall be of latest modular design and of reputed make like Crompton, Havel's, Philips etc. All the material shall conform to latest IS specification as ISI marked. All the electrical fitting including ACs, fans shall be as per electrical drawing to be provided by the IOCL PANIPAT or developed by the successful bidder. The items not provided herein but are required to be provided as per drawing requirement or site requirement shall be provided by the successful bidder without and extra cost to the IOCL PANIPAT.

18.14 ROOFING

On top of RCC slab of building, terracing shall be done with tile brick paving. The top surface of RCC slab when thoroughly dry shall be painted uniformly with bitumen of penetration 80/25, hot cut back bitumen, the quantity of bitumen shall be 1.7 kg per sq. m of roof surface. Immediately after painting dry, clean sharp coarse sand shall be evenly sprayed and leveled over the surface after bitumen is still hot.

Over the layer of bitumen the good soil with optimum moisture content shall be laid on roof to requisite thickness and slope, well compacted. After laying the mud surface shall be given a coat of mud plaster 25 mm thick and allowed to dry. Over the mud plaster flat tile bricks shall be laid using the minimum amount of plain mud mortar as bedding. The tiles shall be laid close to each other; the thickness of joints shall not be less than 6 mm and more than 12 mm in width. After tiles are well set and bedding mortar has dried joints of tiles shall be grouted with cement mortar of mix 1:3 (1 cement: 3 fine sand) such that all the joints of tiles are completely filled with mortar and the joints should be finished neatly by providing flush pointing in 1:3 cement mortar (1 cement: 3 sand). The surface shall be cured for at least 7 days. The tiles surface as completed shall be even and true to slopes of 1 in 48.

18.15 GLAZING & ITS THICKNESS

Minimum thickness of glazing shall be 6.0 mm. Glazing shall have fire rating of minimum 1 hour.

18.16 FALSE CEILING

The Luxanol / Interarch False Ceiling shall be provided in all air-conditioned area. Insulation ducting material / painting shall be as per applicable standards.

Providing and Fixing Luxalon (Hunter Douglas) made Techstyle panel type FALSE CEILING with using Install standard 15/16" T-Grid, level and square, per code standards. T-Grid must

be installed at a height 1-1/8" above finished ceiling height (Flange of T-Grid should lay on top flange of wall channel for proper height). Fasten Tees to top of wall channel on proper centers (24" or 48") with pop rivet. T Grid module to be 24" x 24" for 2x2 Techstyle panel, 24" x 48" for 2x4 panel, and 48" x 48" for 4x4 panel. (Note: Recommend using standard double-web grid. Do not recommend using single-web grid, without flange cap). Position all fixtures in place (lights, air, etc.) in accordance with project requirements, in the same manner as required for standard lay-in tile ceilings. For other panel sizes, lay out grid to meet code requirements and finished panel size as per detailed drawing in proper line & level section shall be fastened to the internal grid in such a way that no nail/screw shall be visible including all cost of fixtures & fastenings, materials, scaffolding required for satisfactory completion of works etc.

18.17 FALSE FLOORING

False flooring shall be providing at first floor whenever required as per system requirement.

18.18 STATUTORY RULES

Vender shall comply with all the applicable statutory rules pertaining to factory acts, safety rules of OISD & CEA.

18.19 SWITCH – YARD FENCING AND GATE

Fencing & Gates shall be provided for Switchyard area as per General Electrical Layout Plan and any other specified area as per project requirements. The design shall be as per drawings attached with the tender. Refer item no. 16.6 for specification on brickwork and item no. 16.8-16.10 for exterior emulsion on toe wall.

Chain link fence fabric shall of size 75mm; coated wire shall be of 3.15mm dia having zinc coating after weaving. The chain link fabric shall be fixed to the intermediate parts and at top & bottom of fence by welding/fixing 50x6mm M.S. flat all through its length.

All structural steel manufactured by TISCO, SAIL, IISCO and RASHTRIYA ISPAT (primary manufacturers) shall conform to IS: 20621786 shall only be used. The bidders shall, however, be allowed to use Amba steel, Rathi steel, Kamdhenu steel, Barnala steel, P.R.S steel, Shidbali steel (manufactured by secondary manufacturers) only after obtaining non-availability certificate from the primary manufacturers. Before using secondary steel, the selected bidder would require to conduct all physical & chemical tests (lot wise & dia. wise) to establish its conformity to IS Standards conforming to IS 2062.

The barbed wire shall consist of two splices per reel. The barbed wire shall be formed by twisting two line wires, one containing barbs. The barbed wire shall be of 12 SW G galvanized steel with its weight 155-186 gm/m length of wire. Distance between two barbs shall be 75mm. The barbs shall carry four points and shall be formed by twisting two point wires, each two turn tightly round one line wire making altogether 4 complete turn. The barbs shall be finished in such a way that four points are set and locked at right angles to each other. The barbs shall have a length of not less than 13mm and not more than 18mm. The points shall be sharp and well pointed.

Fasteners – Single strand aluminium or galvanized steel, wire conforming to requirements for fence fabric 4mm diameter.

Tension wires - Single strand, high tensile, galvanized steel wire 4mm diameter.

Fittings and Hardware – Cast aluminium alloy or galvanized steel malleable or ductile steel. Cast iron D-Clamp to be drop forged with bolt, Check nut, thimble and other material

required for stretching the Barbed wire complete in all respect.

Generally the drawing attached with the tender shall be applicable. However, if due to difference of levels between formation level and Switchyard and outside, normal foundations have to be changed in some portion and retaining wall have to be provided below due to site requirements. Successful bidder for approval before execution will submit the suitable design. Nothing extra shall be payable on this account.

All the structural steel shall be galvanized (conforming to IS 2629 -1985 and IS 4759- 1968 and withstand tests as per IS 2633-1986). The galvanizing shall be done after fabrication work is complete. However for touch-ups of damaged spots, cold galvanizing be done with paints/sprays such as ZINKOTE -20 Zinc rich paint or Zinc metal spray after cleaning the damaged spots of rust, oil, grease, dirt, moisture, water etc.

18.0 BOUNDARY WALL INCLUDING BARBED WIRE FENCING/GRILLS- (IF REQUIRED)

- 18.1** Boundary wall shall be provided on the front, sides & back side along with main entrance gate(s) as per project requirements. Refer for specification on brickwork and exterior weather proof emulsion paint on boundary wall. Weep holes as per site requirement are to be provided.

All the structural steel/grill on top of wall shall be painted with 1st quality black enamel paint (as mentioned in the architectural drawing) after priming coat of red oxide. Refer specification for paint application etc.

- 18.2** PCC posts, angles, grills, flats, barbed wire fencing etc. shall be as per approved project drawings. All the structural steel & barbed wire shall be galvanized (conforming to IS 2629-1985 and IS 4759-1968 and withstand tests as per IS 2633-1986).The galvanizing shall be done after fabrication work is complete. However for touch-ups of damaged spots, cold galvanizing be done with paints/sprays such as ZINKOTE -20 Zinc rich paint or Zinc metal spray after cleaning the damaged spots of rust, oil, grease, dirt, moisture, water etc.

- 19.0** After completion of civil works, a completion plan giving all details of foundations, trenches, culverts, fencing, building etc. as built shall be submitted with original tracing.

- 20.0** Any material or activity not covered under the specifications or drawings shall be, as governed by relevant IS specification/National Building Code of India.

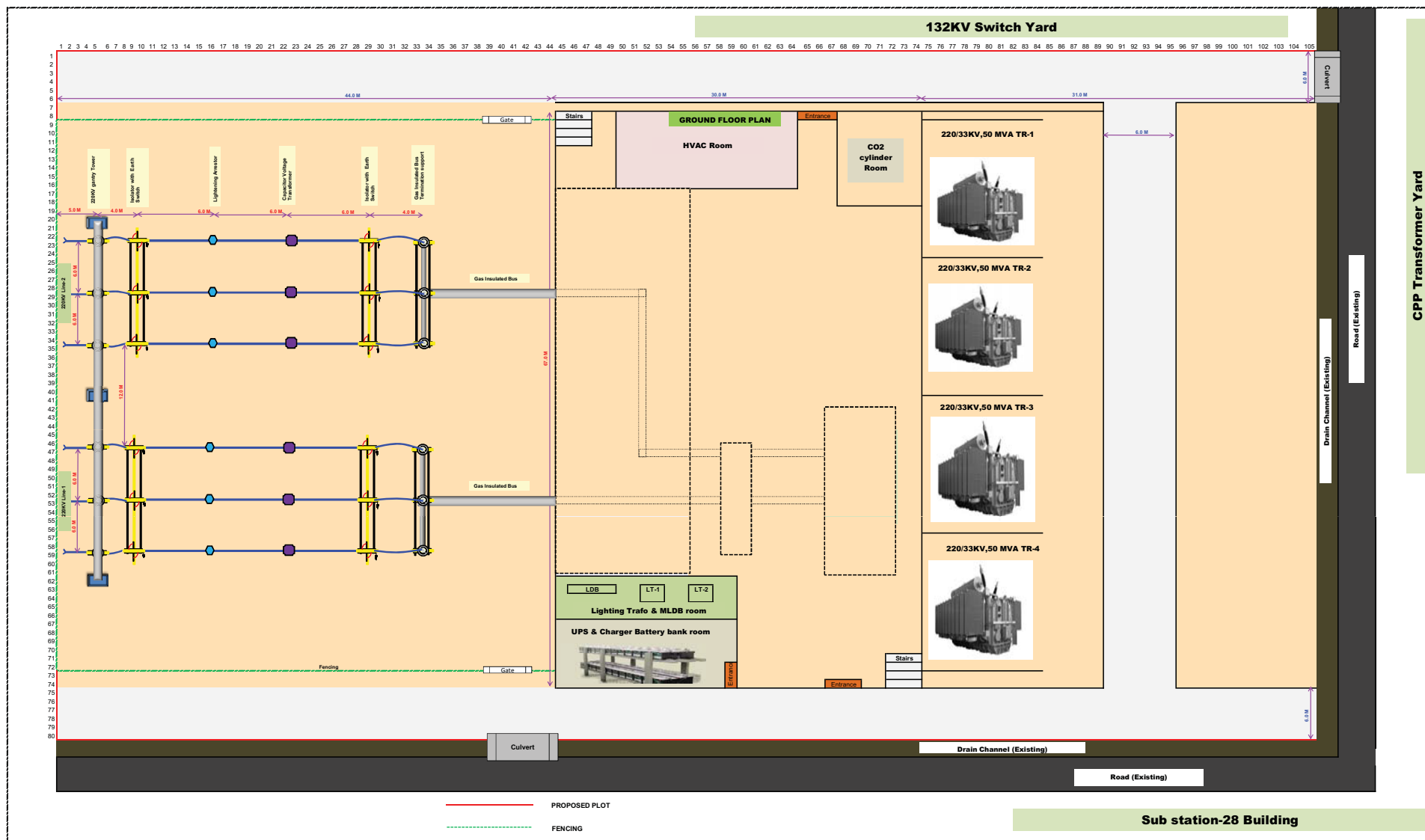
21.0 GENERAL

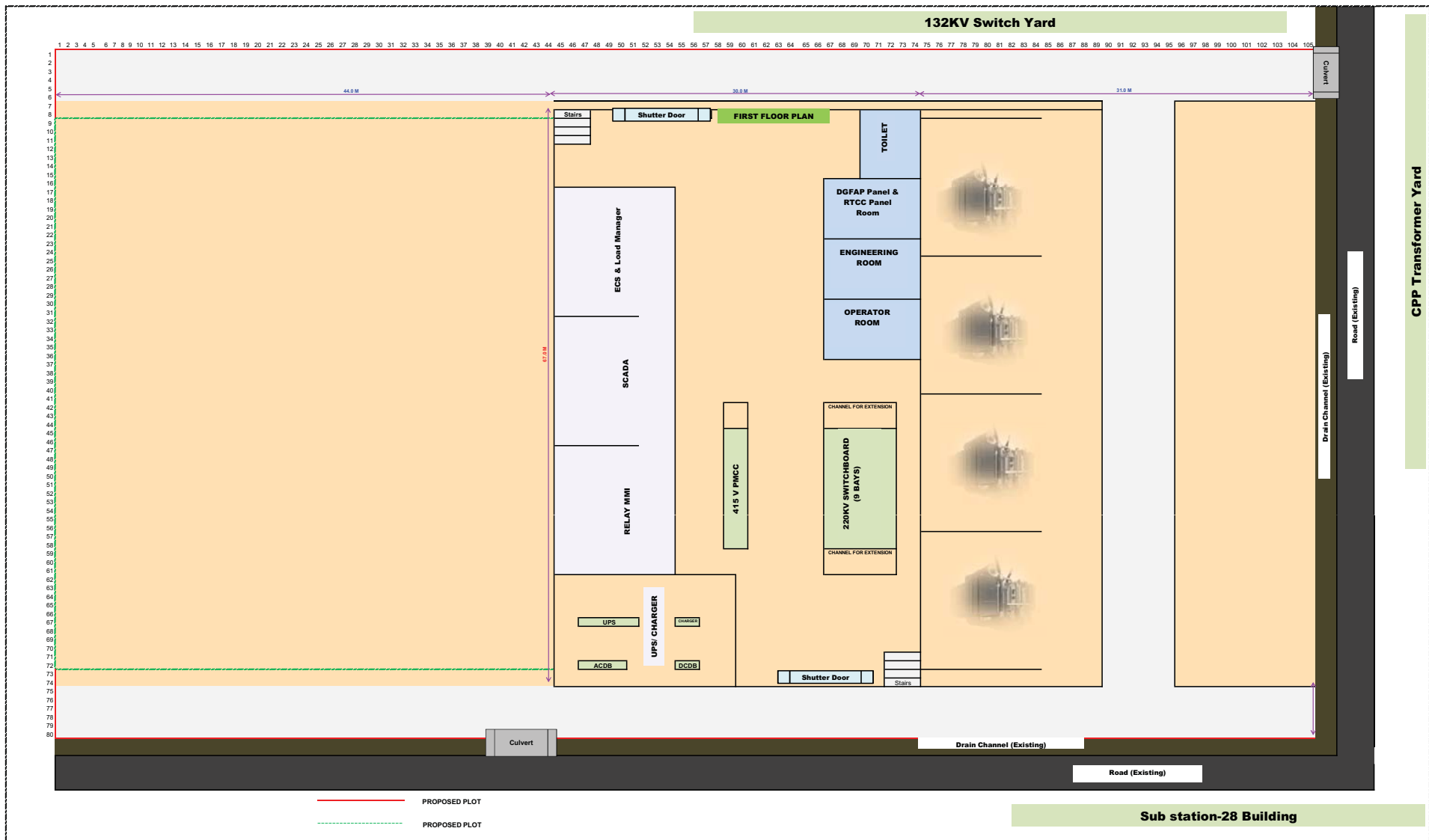
The work shall be carried out by specialists in the trade. Workers shall be provided with gum boots and hand gloves. Minimum overlaps of 100mm shall be given at the ends and sides of the strips of the felts/tissue and properly bonded with bitumen. Joints in the successive layers of the fibre glass based felt/tissue shall be staggered. There shall be no air pockets. Corners shall be treated flush without any air pockets or voids.

- a. The materials and the sub-contractors executing the work shall be duly approved by the EIC/Executing Department.
- b. Adequate covering shall be provided during work to avoid splashing or staining of adjacent works and surfaces. Any surface or work splashed or stained shall be thoroughly cleaned to the full satisfaction of the EIC/Executing Department.

22.0 SPECIAL NOTE

- 22.1** Fully galvanized angles, flat, nut & bolts etc. shall be used in all the items covered under this scheme. Galvanizing of the steel section shall confirm to IS 2629-1985 and IS 4759-1968. All galvanizing members shall withstand test as per IS 2633-1986. The galvanizing shall be done after all fabrication work is completed, except that the nuts may be tapped or re-run after galvanizing. Threads of the bolts and nuts shall have a neat fit and shall be such that they can be turned with finger throughout the length of the threads of bolts and they shall be capable of developing full strength of the bolts.
- 22.2** Care must be taken to avoid gap between foundation top and structure's base plate. In case, the gap is unavoidable, it shall be filled with Dr. Fixit Pidigrout 10M.
- 22.3** The successful bidder shall get the mix design conforming of M-20 grade of concrete with OPC of grade 43 conforming to IS: 8112 manufactured by major cement manufacturers done within the time specified during detailed engineering and approved by E-I-C. In the meanwhile, the successful bidder may use nominal mix 1:1½:3 with proportion of materials as defined in table 9 of IS:456: 2000.
- 23.0 Any other civil work that is required for successful completion & commissioning of 220kv GIS Sub-station & Switchyard, 33 KV power evacuation system.**





Annexure-S-3/C-3/2

Note: The arrangement of resources for execution of the field quality plan including sampling, transportation, testing, reporting is in LSTK contractor's scope including all associated costs.

(A) TENTATIVE FIELD QUALITY PLAN FOR CIVIL WORKS OF IOCL, PANIPAT REFINERY PROJECTS: Detailed field quality plan shall be prepared and submitted during detailed engineering for approval of Engineer In-charge.

S.N.	Component/Operation & Description of Test	Sampling Plan With Basis	Ref. Document & Acceptance Norm	Testing Agency	Remarks
1	MATERIAL				
A	CEMENT				
(i)	Fineness	As per mix Design requirement	IS: 456, IS: 269 IS: 8112, IS: 1226, IS: 1489	Govt. Approved Lab	The tests for cement Coarse aggregates, Fine aggregate shall be conducted during Mix design for Concrete. Mix design shall be subject to approval by IOCL, Panipat
(ii)	Compressive Strength				
(iii)	Initial & final setting time				
(iv)	Soundness				
(v)	Chemical Composition of Cement				
B	COARSE AGGREGATES				
(I)	Determination of Particle size (Sieve Analysis)	As per mix Design requirement	IS: 383, IS: 2386, IS: 456	Govt. Approved Lab	In case of change of source of coarse & Fine aggregates, mix Design should be revised.
(ii)	Flakiness Index				
(iii)	Crushing Value				
(iv)	Specific Gravity				
(v)	Bulk Density				
(vi)	Absorption Value				
(vii)	Moisture Content				
(viii)	Soundness of Aggregate				
(ix)	Presence of deleterious materials.				
C	FINE AGGREGATE				
(I)	Gradation /Determination of Particle size	As per mix Design requirement	IS: 383, IS: 2386, IS:456		
(ii)	Specific Gravity and				

	density.				
(iii)	Moisture content				
(iv)	Absorption Value				
(v)	Bulking				
(vi)	Silt Content Test				
(vii)	Presence of deleterious materials				
D BRICKS					
(i)	Dimensional tolerance				
(ii)	Compressive Strength				
(iii)	Water Absorption				
(iv)	Efflorescence	Random	As per relevant IS. IOCL, PANIPAT REFINERY Specs. Is: 3495 (Part-I to IV)	Govt. Approved Lab	To be approved by IOCL, Panipat Refinery
E WATER					
(i)	Cleanliness (Visual Check)	Random	IS: 456,IS: 3025 and Specification. The Water used for mixing concrete shall be fresh, clean and free from oil, acids and	Contractor / IOCL, Panipat Refinery	
(ii)	Chemical and physical properties of water for checking its suitability for construction proposes.	One sample per source	alkalis, organic materials, or other deleterious materials IS: 456,IS: 3025 and IOCL, Panipat Refinery Specification	Govt. Approved Lab	Each source to be Approved by IOCL, Panipat Refinery
F REINFORCEMENT STEEL					
(i)	Identification & size	Random		Contractor Should produce manufacturer's test	
(ii)	Chemical Analysis Test	One sample per Heat		Certificate. i.e. from approved Manufacturer.	
(iii)	Tensile Test		IS: 432,IS:1139,IS: 1786 & IOCL, Panipat Refinery Specification		Approved by IOCL, Panipat Refinery
(iv)	Yield stress\proof stress				
(v)	Percentage Elongation	One sample per		Govt. Approved Lab	
(vi)	Bend/Re-bend Test	Each size			

(vii)	Reverse Bend Test for HYSD wire				
2	WORKS				
	GANTRY/EQUIPMENT FOUNDATION/CABLE TRENCH				
A	BEFORE EXCAVATION				
(i)	Checking of pegs location as Per line and alignment	100% on each Location	IS: 4091,IS:3764 & IOCL, Panipat Refinery Approved Drawing/ specification	Contractor (100%)	Approved by IOCL, Panipat Refinery post sample checking.
(ii)	Checking of pit making as per Drawing & RL	100% on each Location			
B	EXCAVATION				
(i)	Dimensional conformity	Each location	IS: 4091,IS:3764 & IOCL, Panipat Refinery Approved drawing/specification.	Contractor	Approval by IOCL, Panipat Refinery (1) Foundations will not be placed on filled up soil (2) Minimum depth of foundation will be 750 mm in Virgin soil.
(ii)	Verticality/slopes & Square ness of each pit			Contractor	
(iii)	Verification of classification of foundation wherever applicable.			Joint inspection By IOCL, Panipat Refinery and Contractor (sample basis)	
C	FOUNDATION BOLT/METALLIC INSERTS				
(i)	Check for proper identification of foundation bolts w.r.t. type of foundation	100% on each Location	As per approved drawings	Contractor	
(ii)	Visual check for mechanical damage and galvanising/painting if applicable for metallic insert				

(iii)	Alignment & Level				
(iv)	Grouting/Underpinning of foundation base plate				
D	P.C.C. Padding				
	PCC Padding	For all locations	IS:456, IOCL, Panipat Refinery Approved Foundation Drawing & specification	Contractor (100%) Joint inspection By IOCL, Panipat Refinery and Contractor (sample basis.)	Approval by IOCL, Panipat Refinery
E	SHUTTERING (Form work)				
(i)	Check for materials, breakage Or damage	100%	IS: 456, IOCL, Panipat Refinery Specification/ approved drawings.	Contractor (100%) Joint inspection By IOCL, Panipat Refinery and Contractor (sample basis.)	Approval by IOCL, Panipat Refinery
(ii)	Check for plumb, alignment Parallelism, square ness and equidistance from stub				
(iii)	Dimensional check				
(iv)	Check for level & height				
(v)	Check for rigidity of frame/tightness				
(vi)	Cleaning and oiling				
(vii)	Diagonal bracing if required as Per drawings/site conditions.				
(viii)	Checking of joints to avoid undue loss of cement slurry				
F	PLACEMENT OF REINFORCEMENT STEEL.				

(i)	Check the steel bars for rust, cracks, surface flaws, laminate etc. (Visual check)	100%	IS: 456, IOCL, Panipat Refinery Specification/ approved drawings.	Contractor (100%) Joint inspection By IOCL, Panipat Refinery and Contractor (sample basis.)	Approval by IOCL, Panipat Refinery
(ii)	Check as per the bar bending Schedule before placement of Concrete				
(iii)	Check cutting tolerance for bars as per check List/drawings. Check whether all bent bars and lap lengths are as per approved bar bending schedule				
(iv)	Check whether all joints & crossing of bars are tied properly with right gauge & annealed wire as per specification.				
(v)	Check for proper cover distance spacing of bars, spacers, & chairs after the reinforcement cage has been put inside the formwork.				
(vi)	Check whether lapping of bars are tied properly with right gauge and annealed wire as per specification.				
G PILE FOUNDATION (Additional Tests)					
(i)	Check of centre line of pile group	Each pile group	IS:2911 & IOCL, Panipat Refinery approved pile foundation Drawings/ Specification.	Contractor (100%) Joint inspection By IOCL, Panipat	Checklist to be prepared And signed jointly
(ii)	Check pile location	Each pile			
(iii)	Temporary casing tube & permanent line also check thickness of liner				

	material (if applicable)			Refinery and Contractor (sample basis.)	
(iv)	Bentonite slurry (if applicable)				
(v)	Pile depth, level, size and alignment				
(vi)	Chipping of pile head	Each pile			
(vii)	Pile load testing				
(viii)	Standard Penetration Test	As per IOCL, Panipat Refinery BOQ/Specification			
(ix)	Anchor bolts if applicable	As per IOCL, Panipat Refinery BOQ/Specification IS:2911	IOCL, Panipat Refinery approved pile foundation Drawings/ Specification.		
(a)	Level, centre to centre distance of bolts.	100% on each Location			
(b)	Visual check for galvanizing				
3	STRUCTURAL STEEL		IS: 1786 / IOCL, Panipat Refinery Specification	MTC (Mill's Test certificate) Acceptable, Occasional lab test for a lot 30 to 40 MT or part there for each type.	Approval by IOCL, Panipat Refinery
4	CONCRETING				
A	Approval of mix design	For each grade of Concrete.	IS: 456, IOCL, Panipat Refinery approved Specification	Contractor	
B	Batching, mixing & placing of concrete and compacting	Each Mix.	IS: 456, IOCL, Panipat Refinery Specification/ Approved drawings.	Contractor	Approval by IOCL, Panipat Refinery
C	Fixing of chimney column: check for width/length squareness,	100%	IS:456, IS:2502 and as per approved drawings	Contractor (100%) Joint	

	parallelism & equidistance			inspection By IOCL, Panipat Refinery and Contractor (sample basis.)	
D	CONCRETING TESTING				
(i)	Slump test	One sample per foundation	IS:456,IS:516, IS:1199 And IOCL, Panipat Refinery Specification	Contractor (100%) Joint inspection By IOCL, Panipat Refinery and Contractor (sample basis.)	Results to be recorded and signed Jointly
(ii)	Check for quantities for cement, fine aggregate, coarse aggregate and water while batching	100% on all locations			
E	CONCRETE CUBE TESTING				
(i)	Compressive Strength	Sample (Consisting of minimum 3 cubes) (i) For Footing column & plinth beam shall be tested for 28 days strength. (ii) For slab, 2 sample to be collected for 7days & 28 days strength test.	Is:1199,IS:456, IS:516	Govt. Approved lab	To be witnessed & Approved by IOCL, Panipat Refinery
F	Check finishing, dimensional conformity and workmanship before & after box removal	100%	IS:456, IS:516, IS:1199	Contractor (100%) Joint inspection By IOCL, Panipat Refinery and	Approval by IOCL, Panipat Refinery

				Contractor (sample basis.)	
5	BACKFILLING				
(i)	Check for thickness of Layer & watering	100%	IOCL, Panipat Refinery Specification	Govt. Approved lab	To be witnessed & Approved by IOCL, Panipat Refinery
(ii)	Visual check for correction/ramming				
(iii)	Compaction test (Percentage of Max dry density)				
6	BRICK-WORK				
(i)	Mortar mix/proportion	Random	IS:2250, IOCL, Panipat Refinery Specification	Contractor (100%) Joint inspection By IOCL, Panipat Refinery and Contractor (sample basis.)	Approval by IOCL, Panipat Refinery
(ii)	Plumb & Alignment				
(iii)	Joints				
7	PLASTERING				
(i)	Plastering thickness and evenness	Random	IOCL, Panipat Refinery Specification	Contractor (100%) Joint inspection	Approval by IOCL, Panipat Refinery
(ii)	Mortar mix proportion				
8	CURING FOR CONCRETE, MASONRY, PLASTERING ETC.	100% on all locations	IS 5613 & IOCL, Panipat Refinery Specification	By IOCL, Panipat Refinery and Contractor (sample basis.)	Approval by IOCL, Panipat Refinery
9	SITE SURFACING				
(i)	Leveling	100%	IOCL, Panipat Refinery Specification	Contractor	Approval by IOCL,

(ii)	Soil Sterilization				Panipat Refinery
(iii)	Spraying of chemicals				
(iv)	Grading of 20/40/60 mm Stone	One sample	IS:383 & 2386 and IOCL, Panipat Refinery Specification		
(v)	Compacted thickness of 20/40/60 mm stone layers as applicable	Random	IOCL, Panipat Refinery Specification		
10	DOORS & WINDOWS				
(i)	Fabrication	100	as per approved drawings & IOCL, Panipat Refinery Specification	Contractor	Approval by IOCL, Panipat Refinery
(ii)	Alignment, operation of shutters	100	Smooth opening, closing & alignment	Contractor	
(iii)	Glass and Glazing	Random	Proper Placement /breakage/Looseness, thickness	Joint inspection By IOCL, Panipat Refinery and Contractor	
11	PAINTING				
(i)	Preparation of the surface	Random	IOCL, Panipat Refinery Specification	Contractor (100%) Joint inspection By IOCL, Panipat Refinery and Contractor (sample basis.)	Approval by IOCL, Panipat Refinery
(ii)	Quality of material	100%	Approved brand as per contract		
(iii)	Application of no. of coats	Random	IOCL, Panipat Refinery Specification		
12	FLOORING	100%	IOCL, Panipat Refinery Specification	Contractor	Approval by IOCL, Panipat Refinery
13	TERRAZZO TILES OR VITRIFIED TILES	One Test /Lot	As per IS:1237/ IOCL, Panipat Refinery Specification	Govt. Approved lab	To be witnessed & Approved by IOCL, Panipat Refinery
14	FALSE FLOORING	100%	IOCL, Panipat Refinery Specification	Contractor (100%) Joint inspection	Approval by IOCL, Panipat Refinery

				By IOCL, Panipat Refinery and Contractor (sample basis.)	
15	FALSE CEILING	100%	IOCL, Panipat Refinery Specification	Contractor (100%) Joint inspection By IOCL, Panipat Refinery and Contractor (sample basis.)	Approval by IOCL, Panipat Refinery
16	WATER PROOFING/ROOF TREATMENT	Random	IOCL, Panipat Refinery Specification	Contractor (100%) Joint inspection By IOCL, Panipat Refinery and Contractor (sample basis.)	Approval by IOCL, Panipat Refinery
17	PLUMBING & SANITATION	Random	IOCL, Panipat Refinery Specification	Joint inspection By IOCL, Panipat Refinery and Contractor	Joint inspection By IOCL, Panipat Refinery and Contractor
18	ROADS				
A	CEMENT CONCRETE PAVEMENT				
	COARSE AGGREGATE				
(i)	Loss Angles, abrasion value or aggregate impact	One sample per 100 cum or part thereof or change of	As per IS:2386 (Part-I & IV)	Govt. Approved lab	Approval by IOCL, Panipat Refinery

	value, flakiness index.	source			
(ii)	Deleterious material		As per IS:2386 (Part-II)		
(iii)	Moisture content		As per IS:2386 (Part-III)		
FINE AGGREGATE					
(i)	Silt content	One test per 15 cum or part thereof.	IOCL, Panipat Refinery Specification	Contactor	Approval by IOCL, Panipat Refinery
(ii)	Gradation of sand		As per IS:2386 (Part-II)		
(iii)	Deleterious material		As per IS:2386 (Part-II)	Govt. Approved Lab	Approval by IOCL, Panipat Refinery
(iv)	Moisture content		As per IS:2386 (Part-III)		
(v)	Mix aggregate	One test per 15 cum or part thereof.	As per IS:2386 (Part-I)	Govt. Approved Lab	Approval by IOCL, Panipat Refinery
(vi)	Flextural strength	One test consisting of 8 specimen for 30 cum or part thereof.	As per IS:526		
19 FENCING AND GATES					
(i)	Height of fencing	Random	IOCL, Panipat Refinery Specification/ Approved drawings	Joint inspection By IOCL, Panipat Refinery and Contractor	Approval by IOCL, Panipat Refinery
(ii)	Spacing of fencing posts				
(iii)	Site surfacing and gravel spreading				

Note:

1. IOCL, Panipat Refinery Specification shall mean IOCL, Panipat Refinery technical specification, approved drawings, data sheets and law provisions applicable for the specific contract.
2. Acceptance criteria and permissible limits shall be as per relevant Indian Standards and / or prevalent code of practice / IOCL, Panipat Refinery Specification. It is clarified that the tests indicated at column 2 of this FQP i.e. against column "component

operation & Description of test “, are only generally required to be conducted. However IOCL, Panipat Refinery reserves the right to carry-out any additional tests without any additional cost to bidder at any stage if the situation so warrants.

3. Test performed in government approved lab shall be witnessed by IOCL approved Third party inspecting agency (TPI) AND/OR IOCL Panipat Refinery representative.
4. Bidder shall give minimum 30 days notice to IOCL Panipat refinery before performing any test at Government approved lab.
5. All TPI charges as well as cost of lab test shall bear by bidder.
6. All the testing & measuring equipments used by the contractor for testing are required to be calibrated. A copy of valid calibration report shall be retained by IOCL, Panipat Refinery based on the joint inspection.
7. Overall project quality & construction quality is the sole responsibility of bidder and bidder shall ensure for 100% compliance.
8. Classification of foundations shall be approved by IOCL, Panipat Refinery based on the joint inspection report & Soil investigation reports.

(C) RECORD OF QUALITY CHECKS

SHEET NO. OF FQP	CHECK NO.	RESULTS ACHIEVED OK / NOT OK	DRAWING / DOCUMENT REFERENCE	FORMAT OF RECORD	INSPECTED BY SIGN. & DATE	CLEARED BY SIGN. & DATE	REMARKS	
Note: Any protocol made is to be numbered & mentioned in “Format of Record” column.								
		SYSTEM	SUB-SYSTEM	AREA	FQP NO.			
PROJECT					REV. NO.			
UNIT					LOG SHEET NO.			
RATING					SHEET		SHEETS	

STANDARD SPECIFICATION
FOR
PAINTING WORKS

GENERAL

1.1 SCOPE

- This Construction specification covers the requirements for painting of all equipments, piping, steel structures, Switchgear building etc. It also explains the method of surface preparation, painting systems, procedure for painting and inspection requirements.
- Stenciling job of 220KV GIS as well as outdoor switchyard is also in the scope of bidder.
- This Specification shall be applied to painting& Stenciling work for this Project. The Contractor shall complete the work in all respects with the best quality of materials and workmanship and in accordance with the best engineering practice and instructions from IOCL Panipat Refinery.
- This standard specification shall not apply to the following painting work.
 - (a) Painting to be carried out based on manufacturer's specification.
 - (b) Repainting.
 - (c) Painting of temporary installation.
 - (d) Painting using methods other than general methods such as brushing and spraying.
 - (e) Coating and Lining.

1.2 Specific Job Requirements

Where specific job requirements are in contradiction to this specification, specific job requirement shall govern.

1.3 Codes and standards

- The applicable codes and standards reference in this specification shall be as follows:

S.N.	Codes & Standard	Remarks
1	ASTM	American Standard Test Methods for Paints and coating.
2	ASA.A 13.1-1981	Scheme for identification of piping system.
3	Steel structure painting council (SSPC-SP)	American Standard.
4	Swedish standards institution (SIS-05-5900-1967)	surface preparation
5	IS-101	Methods of test for ready mix paints and enamels
6	IS-2379:1990	Pipe line identification color code.
7	NACE	national association of Corrosion Engineers, USA
8	SSPC-SP2 /ST2	Manual/ Hand cleaning (loose rust/mill scale, dirt & oil etc)
9	SSPC-SP3/ ST3	Mechanical or Power tool cleaning (chipping, de-scaling, wire brushing.
10	SSPC-SP-5 /Sa 3 / NACE#1	White metal, blast cleaning to white metal cleanliness.
11	SSPC-SP10/ Sa 2 ½/ NACE#2:	Near white metal, blast cleaning to near white metal cleanliness.

- If there is any conflict between the requirements of the above mentioned codes and standards and this specification, the requirements of this Specification shall prevail. All conflicts shall be referred to IOCL, Panipat Refinery for resolution before proceeding with the work.

1.4 Definition

For the purpose of this standard specification, the following definitions shall be applied.

- (a) **Plant facilities:** Facilities which comprise various types of plants related to energy, chemical industry and protection of environment etc. These include equipment (e.g. towers, columns, vessels, including combustion equipment), machines, piping, storage tanks, steel frames, stacks, ducts, electrical equipment, instrumentation equipment etc.
- (b) **Substrata surface:** Surface of items to be painted, which, however, have not yet been prepared for painting.
- (c) **Painting surface:** Substrata surface prepared to receive paint or paint film-surface to receive subsequent or additional coating.
- (d) **Painting system:** Combination of paint films, including surface preparation, from prime coating to finish coating, in order to satisfy the intended purpose and effectiveness of painting.

1.5 Qualification

Persons who are engaged in painting work shall be fully trained and shall have the qualification of the employer. Certificate, or qualification issued by Authorities are desirable.

1. PAINTING SURFACES

2.1 Surfaces to be painted

The exposed surfaces of the following equipments/ items shall be painted.

- (a) Exposed surface of:
 - Structural steel for pipe racks, equipment supporting structure etc.
 - All Piping and Equipments such as columns, vessels, tanks, heat exchangers etc, . (Insulated & un-insulated, and C.S.& S.S).
 - Steel piping and pipe supports
 - Ladders, handrails, platforms, stairways etc.
 - Instrument and electrical panel boards
 - Valve, relief valves
- (b) Surfaces of rotating machinery and the like, except for rotating and sliding contact surfaces.
- (c) Part or entire surfaces of items, requiring rust and corrosion protection.
- (d) External surfaces of stainless steel equipment, storage tanks, piping etc. to be covered with hot insulation materials, of which operating temperature is upto 500°C.

2.2 Surface not to be painted

The surfaces of the following shall not be painted:

- Internal surfaces of pipes, equipment, etc. and internal surfaces of closed steel structures which do not require chemical, acid and alkali resistance.
- Surface of steel structures to be fire-proofed with concrete or mortar covering.
- Surfaces of steel structures embedded or in contact with concrete or mortar.
- Interior wall surfaces of furnaces, boilers, etc. heating tubes and portions with heat resistant treatment.
- Materials with high resistance to corrosion, such as stainless steel and anti weathering steel, except the stainless steel surface of equipment, storage tanks, piping etc. to be covered with hot insulation materials, of which operating temp. is upto 500°C.
- Galvanised steel materials such as gratings, piping, handrails etc.
- Friction surfaces to be connected with high tensile strength bolts.

- All imported equipments shall be duly final painted before despatch to site, incase of any damage touch up will be carried out at site as per painting procedure. In case of indigenous, equipment shall be applied primer at shop and final paint at site as per painting specification enclosed.
- High Pressure Steam Piping not to be painted.

2. PAINTING SCHEME

Painting system for Equipment, Piping and Steel structures

- Painting system for Equipment, Piping & Steel structure - listed in **Annexure-B**
- In case painting system is not applicable due to special environment such as salt water immersion, chemical exposure, chemical immersion etc. Vendors specification or practice may be applicable subject to IOCL, Panipat Refinery's prior written approval.
- The final colour shall be as per IOCL Colour code system which will be given to successful bidder at the time detail engineering. Ground colour shall be applied through out the length of pipes., and on metal cladded insulated lines, minimum 2 M long portion should be painted. Colour bands shall be applied in the following points.
 - (a) At battery limit points.
 - (b) At start and terminating points.
 - (c) At intersection points, change of direction points, junction joints of service, appliances, Midway of Piping section, near valves, across culverts, etc.
 - (d) For long stretch piping, at 50 metres interval.
- Minimum width of the colour band shall be as follows :
 - (a) 3" NB and below -- 75 mm.
 - (b) Above 3" NB upto 6" NB -- NB X 25 mm.
 - (c) Above 6" NB upto 12" OD -- NB X 18 mm.
 - (d) Above 12" OD -- NB X 15 mm.

The relative width of the first colour band to the subsequent band shall be 4:1.

- Flow direction shall be indicated by an arrow in the above locations. Colours of arrow shall be black or white in contrast to the colour on which they are superimposed.
- Product name shall be marked at pump inlet, outlet and battery limits. Line number shall be stencilled in black or white on all the pipe lines in more than one location. Size of the letter shall be 40 mm to 150 mm as per the size of pipe. Equipment number shall be stencilled in all equipments in black or white letters of 150 mm size.
- DOR to be marked on all motors. Motor & pump Tag to be painted on motor foundation. Motor ammeter, All pressure gauge, temperature gauge to be marked as green, yellow and red band of scale.
- Equipment name , capacity, ratings to be stenciled on all the equipments like GIS, transformers, outdoor switchyard equipments, HV/ LV switchgears, ACDB, MLDB, PDB, LDB, UPS ACDB & DCDB etc. The detail of source and load to be provided both at sending and receiving end of the feeders system. Every earth pit to be marked with a distinct number and as directed by EIC including details of last test value, date and next due date. Danger board pain may be required as per IE rules/ CEA rules. All stenciling work to be done with yellow back ground and black letters. Emergency feeders/ exit/ light details to be painted with red.
- Wherever deemed required by Process Department or safety, pipes handling hazardous substances will be given hazard marking of 30 mm wide diagonal stripes of Black and Golden Yellow as per IS : 2379.
- Identification Markings on Equipment / Piping. Equipment tag Numbers shall be Stenciled / neatly painted using normal 'Arial' Lettering Style on all equipment and piping (Both

insulated & uninsulated) after completion of all paint works. Lettering colour shall be either BLACK or WHITE, depending upon the background, so as to obtain good contrast.

- IOCL, Panipat Refinery shall specify location & Sizes shall be:

Columns, Vessels, Heaters	:	150 mm
Pumps and other M/c	:	50 mm
Piping	:	OD / 2 with Maximum 100 MM.
Storage Tanks (As per Drawings)		

3. PAINTING PROCEDURE

4.1 Treatment prior to surface preparation

The following work shall be carried out prior to surface preparation.

- (a) Remove slag, flux and spatter adhered to weld and steel surfaces.
- (b) Where substances such as grease and machine oil are found on the surface, remove them with cleaning solvent or other appropriate methods.
- (c) Remove excessive rust and dirt using appropriate methods.

4.2 Surface Preparation

- Surface preparation shall be carried out by appropriate methods that will ensure the required grade of finish. Procedure and degree of surface preparation are shown in **Annexure-A**

One or more of the following methods of surface preparation shall be followed, depending on the condition of steel surface, to achieve maximum durability.

- (a) Shot Blasting as per SA 2 .5
- (b) Mechanical or power tool cleaning (as specific requirement).
- (c) High pressure water blast cleaning with or without abrasives.
- Restrictions concerning surface preparation and protective measures :
 - (d) In case of rain or bad weather, surface preparation shall not be carried out outdoors.
 - (e) When the surface substrata are wet, preparation shall not be carried out.
 - (f) When the relative humidity is 89 % or higher, surface preparation shall not, in principle, be carried out.
 - (g) When surface preparation is carried out during the night or in dark locations (inside of tanks, etc.), proper lighting arrangements shall be made to check the extent of rust removal from the surface.
 - (h) When blast cleaning is to be carried out at the job site, appropriate protective measures shall be taken to ensure prevention of adverse effect of dust on adjacent work or environmental pollution in the surrounding area.
 - (i) Iron grids used for blasting shall be approved by concerned before commencement of work.
- Surface shall be air-blast cleaned by using A1203 particles, chilled cast iron or malleable iron, or by sand blasting where grit blasting is not possible.
- Surface preparation is considered very important since the performance of any paint system is directly related to the level of surface preparation adopted prior to painting.

4.3 Treatment after surface preparation

After the completion of surface preparation, the surfaces are to be checked for the following prior to commencement of painting.

- When rusting occurs after completion of surface preparation, surface preparation of the rusted area shall be carried out again, by using appropriate methods, prior to painting.
- The painting surface shall be fully cleaned of mill scale, rust, and loose dust accumulated on the surface, due to the surface preparation work.
- The painting surfaces (cleaning of which has already been completed) shall be kept clean in such a way as to prevent the adherence of grease, oil, dust and other detrimental materials until the painting work is started.

4.4 PAINTING

- **Protection**

Contractor shall fully protect all equipments, piping, walls, floors and other surfaces from damage and contamination, and shall provide the necessary protection required to fully protect all surfaces from dust, paint droppings, paint mist, other contaminants during the process of painting work. Care shall be taken to protect all stainless steel surfaces from Zinc Paint.

- **Mixing of paint**

- a. Paint shall be thoroughly stirred before use.
- b. For multi-liquid type paint, the specified mixing ratio and pot life shall be observed.

- **Application**

- a. Painting shall be done either by brushing or by spraying.
- b. Painting tools, suitable for the paint work shall be used according to manufacturer's recommendation and as per work location, environment, shape of the items to be painted, and condition of surface to be painted.
- c. Each coat shall be painted in the order specified in the painting system. During painting, the overcoat intervals and films thickness specified shall be maintained as per manufacturer's recommendations and according to the properties and performance of the paint.
- d. Where each coat is applied successively, such continuous painting work shall be carried out after the lapse of specified drying time and drying of previous film has been confirmed.

- **Restrictions**

Unless special measures are taken, painting shall not be carried out under the following conditions:

- a. When the painting surfaces are moist or likely to become moist due to rain, snow, dew or frost.
- b. When the temperature during painting is 4.4°C or lower and is not suitable for drying and hardening of paint.
- c. When the relative humidity is 89 % or more.
- d. When the temperature of painting surfaces is high and defects such as air bubbles may occur in the paint film.
- e. When a strong wind is blowing and foreign materials such as sand may adhere to the paint film.

4. FIELD SAFETY AND HYGINE

- Industrial hygiene and safe working practice in connection with the painting work shall be strictly followed to avoid potential hazards to health and of fire.
- Special care shall be taken with regard to the following matters:
- When surfaces are to be prepared by blast cleaning or with the use of power tools, protectors such as goggles, mask etc. shall be used.

- When painting work is to be carried out using organic solvent in an almost airtight environment, appropriate ventilating and lighting equipments shall be provided. Additionally, appropriate protectors such as gas masks etc. shall be worn.
- Monitor for any fire around the work location and extinguish the fire prior to work, if observed.

5. FIELD STORAGE AND CONTROL OF PAINT

- As a rule, paint shall be stored in a well-ventilated room, constructed to the appropriate standard of fire resistance.
- All paint and thinner shall be stored in such a way that the manufacturer's labels can be readily identified.
- Paint stocks shall be controlled so that they can be used within their effective period of use.
- For storage areas, provide prescribed protective measure and signs. Paint exceeding the prescribed quantity shall not be stored.
- Care shall be taken while storing and handling to avoid breakage or marked deformation of containers.
- When paint is stored outdoors, it shall be protected by using plastic/tin sheets or other appropriate measures, in order to prevent damage to containers or changes in the quality of the paint.
- When paint is temporarily stored in the working area, the amount equivalent to one day's use or less shall be stored. Paint shall be protected from rain, snow etc, using plastic/tin sheets.

6. INSPECTION

- **Inspection of surface preparation**
The prepared surfaces shall be compared with the standard photographs of SIS, IS or SSPC. Where the prepared surfaces are found to be equivalent to those indicated in the above standard photographs, they shall be deemed acceptable.
- **Appearance of paint film**
Paint film shall be visually checked with regard to the following:
 - (a) Unfinished surface, drips, wrinkles, blistering, peeling, cracking, crawling, Discoloring, stains, pinholes and spraydust.
 - (b) Where there are no marked defects in appearance, the paint film shall be deemed acceptable.
- **Paint film thickness (DFT)**
 - a. Film thickness shall be measured with appropriate measuring instruments, duly calibrated. Contractor shall provide measuring instruments of appropriate ranges for measuring the dry film thickness.
 - b. As a rule, film thickness shall be measured at the shop or field for the total dry film thickness (DFT).
- **Number of measurements and measured values :**
 - a. The number and position of measurements shall be determined with due consideration given to the size and shape of items to be painted.
 - b. Measurements shall be carried out three times at each measuring point. The average of three measurements shall be taken as the measured value for the item concerned.

- **Acceptance (DFT)**

When the measured values satisfy the following requirements, they shall be deemed acceptable:

- (a) Average of measured film thickness is 90 % or more of prescribed film thickness.
- (b) Minimum of measured film thickness is 80% or more of the prescribed film thickness.

7. TRANSPORTATION

(a) Painted product shall not be moved or transported until the required curing period has elapsed.

(b) Painted products shall be handled, moved or transported in such a manner as not to damage the paint film. Appropriate protective measures shall be taken, to avoid damage to the paint film during transportation and storing.

8. RECORDS

- Contractor shall submit the batch test certificates of each batch of paints to IOCL for review prior to commencement of painting.
- A report shall be maintained of all the stage wise inspection carried out, showing type of surface preparation, DFT of primer, intermediate and final coats. The report, duly signed by the Contractor's inspector/ IOCL site engineer shall be submitted to IOCL, on completion of final inspection.

Table for Surface Preparation

SL. NO.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)				REMARKS
		SWEDISH STANDARD SIS-05-5900	SSPC-SP USA	NACE, USA	BRITISH STANDARD BS-4232;	
1	Manual or hand tool cleaning Removal of loose rust, loose mill scale and loose paint, chipping, scrapping, sanding and wire brushing. Surface should have a faint metallic sheen	ST.2	SSPC-SP-2	--	--	This method is applied when the surface is exposed to normal atmospheric conditions when other methods cannot be adopted and also for spot cleaning during maintenance painting.
2	Mechanical or power tool cleaning Removal of loose rust, loose mill scale and loose paint to degree specified by power tool chipping, descaling, sanding, wire brushing and grinding, after removal of dust, surface should have a pronounced metallic sheen.	ST.3	SSPC-SP-3	--	--	
3	Blast cleaning (air & water) There are four common grades of blast cleaning					
3.1	White metal Blast cleaning to white metal cleanliness. Removal of all visible rust. Mill scale, paint & foreign matter 100% cleanliness with desired surface profile.	SA 3	SSPC-SP-5	NACE#1	First Quality	Where extremely clean surface can be expected for prolong life of paint system.
3.2	Near white metal Blast cleaning to near white metal cleanliness, until at least 95% of each element of surface area is free of all visible residues with desired surface profile	SA 2½	SSPC-SP-10	NACE#2	Second Quality	The minimum requirement for chemically resistant paint systems such as epoxy, vinyl, Polyurethane based and inorganic zinc silicate paints also for conventional

						paint systems used under fairly corrosive condition to obtain desired life of paints
3.3	Commercial Blast Blast cleaning until at least two-third of each element of surface area is free of all visible residues with desired surface profile.	SA 2	SSPC-SP-6	NO.3	Third Quality	For steel required to be painted with conventional paints for exposure to mildly corrosive atmosphere for longer life of the paint systems.
3.4	Brush-off Blast Blast cleaning to white metal cleanliness, removal of all visible rust, mill scale, paint & foreign matter. Surface profile is not so important	SA 1	SSPC-SP-7	NO.4		

PAINT SYSTEMS

The paint system should vary with type of environment envisaged in and around the plants. Three types of environment as given below are considered for selection of paint system. The paint system is also given for specific requirements.

PRIMERS & FINISH COATS COVERED IN TABLE NOS. 1.0 TO 15.0**PRIMERS**

P-2	:	Chlorinated rubber zinc Phosphate Primer
P-4	:	Etch Primer/Wash Primer
P-6	:	Epoxy Zinc Phosphate Primer

FINISH COATS/PAINTS

F-2	:	Acrylic – Polyurethane finish paint
F-3	:	Chlorinated Rubber finish paint
F-6	:	High Build Epoxy finish coating
F-7	:	High build Coal Tar epoxy coating
F-8	:	Self priming surface Tolerant High Build epoxy coating.
F-9	:	Inorganic Zinc Silicate coating
F-11	:	Heat resistant synthetic medium based Aluminium paint
F-12	:	Heat resistant Silicone Aluminium paint.
F-14	:	Specially formulated polyamine cured coal for Epoxy coating.
F-15	:	Epoxy phenolic coating
F-16A	:	Epoxy Siloxane Coating : Amercoat 738
F-16B	:	Epoxy Siloxane Coating Berger 938

TABLE 1.0 : PRE-ERECTION /PRE-FABRICATION & SHOP PRIMING FOR CARBON STEEL, LOW TEMPERATURE CARBON STEEL & LOW ALLOY STEEL, STEEL UNINSULATED AND INSULATED STRUCTURES, PIPING & EQUIPMENT ETC.

Sl. No.	Design Temperature in °C	Surface preparation	Paint system	Total DFT in Microns (min.)	Remarks
1	-90 to 400	SSPC-SP-10	1 coat of F-9	65-75	No overcoating is to be done.
2	401 to 500	SSPC-SP-10	1 coat of F-12	40-50	Finish coat at site.

TABLE 2.0: REPAIR OF PRE-ERECTION/PRE-FABRICATION & SHOP PRIMING AFTER ERECTION/WELDING FOR CARBON STEEL, LOW TEMPERATURE CARBON STEEL & LOW ALLOW STEEL UNINSULATED AND INSULATED ITEMS IN ALL ENVIRONMENTS.

Sl. No.	Design Temp. in °C	Surface Preparation	Paint System	Total DFT in Microns (min.)	Remark
1	-90 to 400	SSPC-SP-3 (for repair only) SSPC-SP-10	1 coat of F-9	65-75	For damaged area of more than 5x5 CM
2	401 to 500	SSPC-SP-3 (for repair only) SSPC-SP-10	2 coat of F-12	40-50	

TABLE 3.0 : FIELD PAINT SYSTEM FOR NORMAL CORROSIVE ENVIRONMENT (FOR CARBON STEEL, LOW TEMPERATURE CARBON STEEL & LOW ALLOY STEEL) IN OFFSITE AREAS FOR UNINSULATED STRUCTURES, PIPING, EQUIPMENT, FLARE LINES ETC.,

Sl.	Design	Surface Preparation	Paint system		Total DFT in Microns (min.)	Remarks
	Temperature in °C		Field primer	Finish paint		
1	-90 to -15	SSPC-SP-10	Repair of pre-fabrication primer 1 coat of F-9 @ 65-75µ DFT/coat	None	65-75	No over coating to be done. Follow repair procedure only on damage areas of pre-erection/ pre-fabrication primer/ Coating F-9
2	-14 to 60	SSPC-SP-10	Repair of pre-fabrication primer 1 coat of F-9 @ 65-75µ DFT/coat + 2 coats of P-2 @ 40µ DFT/Coat 2x40=80	2 coats of F-3 @ 40µ DFT/ Coat 2x40=80	225	
3	61 to 80	SSPC-SP-10	Repair of pre-fabrication primer 1 coat of F-9 @ 65-75µ DFT/coat + 2 coats of P-6 @ 40µ DFT/Coat 2x40=80	1 coat of F-6 @ 100µ DFT/Coat	245	
4	81 to 250	SSPC-SP-10	Repair of pre-fabrication primer 1 coat of F-9 @ 65-75µ DFT/coat	3 coats of F-12 @ 20µ DFT/Coat 3x20=60	125	
5	251 to 400	SSPC-SP-10	Repair of pre-fabrication primer 1 coat of F-9 @ 65-75µ DFT/coat	2 coats of F-12 @ 20µ DFT/Coat 2x20=40	105	
6	401 to 500	SSPC-SP-10	Repair as per 7.2.2.	2 coats of F-12 @ 20µ DFT/Coat 2x20=40	80	

TABLE 4.0 FIELD PAINT SYSTEMS FOR CORROSIVE ENVIRONMENT (FOR CARBON STEEL, LOW TEMPERATURE CARBON STEEL & LOW ALLOY STEEL) IN PLANT AREA:

For all corrosive areas above ground where H₂ S, SO₂ fumes or spillages of acid/Alkali/Salt are likely to come in contact with surfaces such as external surfaces of un-insulated columns, vessels, heat exchangers, blowers, piping, pumps, towers, compressors, and structural steel etc.

Sl. No.	Design Temperature in °C	Surface Preparation	Paint System		Total DFT in Microns (min.)	Remarks
			Field Primer	Finish Paint		
1	-90 to -15	SSPC-SP-10	Repair of pre-fabrication primer 1 coat of F-9 @ 65-75µ DFT/coat	None	65-75	Repair of pre-erection / pre-fabrication primer shall be done wherever damage is Observed. Surface preparation is required only for repairing of damaged pre-erection/ fabrication primer.
2	-14 to 80	SSPC-SP-10	Repair of pre-fabrication primer 1 coat of F-9 @ 65-75µ DFT/coat + 1 coats of P-6 @ 40µ DFT/coat	1 coat of F-6 @ 100µ DFT/coat + 1 coat of F-2 @ 40µ DFT/coat.	245	
3	81 to 400	SSPC-SP-10	Repair of pre-fabrication primer 1 coat of F-9 @ 65-75µ DFT/coat	2 coats of F-12 @ 20µ DFT/coat 2x20=40	105	
4	401 to 500	SSPC-SP-10	Repair as per 7.2.2.	2 coats of F-12 @ 20µ DFT/coat 2x20=40	80	

TABLE 5.0 : FIELD PAINT SYSTEM FOR HIGHLY CORROSIVE AREAS IN PLANT AREA (FOR CARBON STEEL, LOW TEMPERATURE CARBON STEEL & LOW ALLOY STEEL) EXTERNAL SURFACES OF UNINSULATED COLUMNS, VESSELS, HEAT EXCHANGERS, BLOWERS, PIPING, PUMPS, TOWERS, COMPRESSORS, STRUCTURAL STEEL ETC.

Exposed to spillage or fumes of HCL, H₂SO₄, salty water, water impingement, chloride etc.

Sl. No.	Design Temperature in °C	Surface Preparation	Paint System		Total DFT In Microns (min.)	Remarks
			Field Primer	Finish Paint		
1	-90 to -15	SSPC-SP-10	Repair of pre-fabrication primer 1 coat of F-9 @ 65-75µ DFT/coat	None	65-75	Repair procedure of pre-erection/fabrication primer shall be followed. No overcoating is allowed. Surface preparation is required only for repairing of damaged pre-erection/fabrication primer.
2	-14 to 80	SSPC-SP-10	Repair of pre-fabrication primer 1 coat of F-9 @ 65-75µ DFT/coat + 1 coats of P-6 @ 40µ DFT/Coat	2 coats of F-6 @ 100µ DFT/Coat= 2x100=200 + 1 coat of F-2 @ 40µ DFT/coat.	345	
3	81 to 400	SSPC-SP-10	Repair of pre-fabrication primer 1 coat of F-9 @ 65-75µ DFT/coat	2 coats of F-12 @ 20µ DFT/Coat 2x20=40	105	
4	401 to 500	SSPC-SP-10	Repair as per 7.2.2.	2 coats of F-12 @ 20µ DFT/Coat 2x20=40	80	

TABLE 6.0: FIELD PAINT SYSTEM FOR CARBON STEEL STORAGE TANK
(EXTERNAL) FOR ALL ENVIRONMENTS.

Sl. No.	Design Temperature In °C	Surface Preparation	Paint System		Total DFT in Microns (min.)	Remarks
			Field Primer	Finish Paint		
External shell, wind girders apparatuses, roof tops of all above ground tank including top side of floating roof of open tank as well as covered floating roof tank and associated structural works, rolling and stationary ladders, spiral stairways, hand rails for all environments for crude oil, LDO, HSD, ATF, Kerosene, Gasoline, motor spirit, DM water, firewater, raw water, potable water, acids, alkalies solvents and chemicals etc.						
1	-14 to 80	SSPC-SP-10	1 coat of F-9* @ 65-75µ DFT/coat + 1 coats of P-6 @ 40µ DFT/coat 65+40=105	1 coat of F-6 @ 100µ DFT/coat + 2 coats of F-2 @ 40µ DFT/coat 2x40=80	245	F-6 should be suitable for occasional water immersion
2	81 to 500	SSPC-SP-10	1 coat of F-9* @ 65-75µ DFT/coat	2 coats of F-12 @ 20µ DFT/coat 2x20=40	105	
External surfaces of bottom plate (soil side) for all storage tanks.						
1	-14 TO 80	SSPC-SP-10	1 Coat of F-9* @ 65-75µ DFT/coat	3 coats of F-7 @ 100µ DFT/coat 3x100=300	365	F-7 should be suitable for immersion service of the products given

* Same as pre-erection/ pre-fabrication primer.

TABLE 7.0 : FIELD PAINT SYSTEM FOR CARBON STEEL AND ALLOY STEEL STORAGE TANKS (INTERNAL)

Sl. No.	Design Temperature in °C	Surface Preparation	Paint System		Total DFT in Microns (min)	Remarks
			Field Primer	Finish Paint		
Internal surfaces of underside of floating roof, internal surface of cone roof, bottom plate, roof structures, structural steel, ladders, supports for storing crude oil, LDO, and HSD (Excluding white oil products)						
1	-14 to 80	SSPC-SP-10	1 Coat of F-9 @ 65-75µ DFT/Coat	3 Coats of F-7 @ 100µ DFT/ Coat 3x100=300	365	F-7 should be Suitable for Immersion the Service of products given.
Bare shell of inside floating roof tanks and cone roof tanks for products mentioned above						
1	-14 to 80	SSPC-SP-10	Phosphating treatment with phosphating chemicals(2 coats)	2 Coats @ 10µ 2X10=20	20	
Floating cone roof tanks for petroleum products such as ATF, Gasoline, Naptha, Kerosene, Motor spirit, inside of bottom plate, underside of floating roof and shell above maximum liquid level and structural steel, ladders etc.						
1	-14 to 80	SSPC-SP-10	1 Coat of F-9 @ 65-75µ DFT/Coat	3 Coats of F-6 @ 100µ DFT/ Coat 3X100=300	365	F-6 should be Suitable for Immersion of service petroleum products like ATF, Kerosene petrol etc
Bare shell of inside of floating cone roof tanks for products mentioned above.						
1	-14 to 80	SSPC-SP-10	1 Coat of F-9 @ 65-75µ DFT/Coat	None	65-75	No over coating Is allowed. Same as per pre-erection primer, if any.
Internal protection of fixed roof type storage tanks for potable water: Inside of shell, under side of roof and roof structure inside surface, bottom plate and structural steel works, ladders, walkways, platforms etc.						
1	-14 to 80	SSPC-SP-10	2 Coats of F-6 @ 40µ DFT/ coat 2X40=80	2 Coats of F-6 @ 100µ DFT/ Coat 2X100=200	280	F-6 shall be Suitable for immersion service.
D.M. (Demineralised water) and hydrochloric acid (HCL): Internal shell, bottom plate & all accessories						
1	-14 to 60	SSPC-SP-10	Natural Rubber lining as per SMMS specifications 6-06-204			
EG tanks (internal shell, bottom plate roof and all accessories)						
1	All	SSPC-SP-10	3 coats vinyl chloride co-		225	

			polymer Amercoat 23 @ 75μ /Coat			
Inside pontoon and inside of double deck of all floating roofs.						
1	-14 to 80	SSPC-SP-10	1 Coat of F-8 @ 100μ DFT/Coat		200	
Internal surfaces of amine & sour water storage tanks						
1	-14 TO 80	SSPC-SP-10	1 Coat of F-9 @ 65-75μ DFT/Coat	2 coats of F-15 @ 75μ DFT/coat 2x75 = 150	215-225	

TABLE 8.0 : COATING SYSTEM FOR EXTERNAL SIDE OF UNDERGROUND CARBON STEEL PLANT PIPING AND TANKS

Sl. No.	Design Temperature in °C	Surface Preparation	Paint System		Total DFT in Microns (min.)	
			Field Primer	Finish Paint		
Carbon steel plant piping (underground)						
(a)	Yard coating					
1	25 to 60	SSPC-SP-10	1 coat of synthetic fast drying primer type-B as per AWWA-C-203 (1991)	4 mm thick coaltar coating wrapping as per AWWA-C-203 in 2 layers of each 2 mm thickness.	4 mm	CTE coating shall confirm to 120/5 as per BS:4164
(b)	Over the Ditch Coating					
1	25 to 60	SSPC-SP-10	1 coat of synthetic fast drying primer type-B as per AWWA-C-203 (1991)	2 layers of coaltar based tape coating as per EIL Standard Spec.No. 6-79-012 Rev.0	4 mm	
Carbon steel plant piping (underground).						
1	61 to 400	SSPC-SP-10	1 Coat of F-9 @ 65-75µ DFT/coat	None	65-75	
External side of un-insulated underground storage tanks:						
1	-40 to 80	SSPC-SP-10	1 Coat of F-9 @ 65-75µ DFT/coat	3 coats of F-7 @ 100µ DFT/coat 3x100=300	365	
2	-90 to 41 81 to 400 °C	SSPC-SP-10	1 Coat of F-9 @ 65-75µ DFT/coat	2 coats of F-16A/B @75 microns DFT/coat = 2x75=150	215-225	

TABLE 9.0 : PAINTING UNDER INSULATION FOR INSULATED (HOT, COLD & SAFETY) CARBON STEEL, LOW ALLOW STEEL, LOW TEMPERATURE CARBON STEEL & STAINLESS STEEL PIPING, STORAGE TANKS AND EQUIPMENTS IN ALL ENVIRONMENT.

EQUIPMENTS IN ALL ENVIRONMENT.						
Sl. No.	Design Temperature in °C	Surface Preparation	Paint system		Total DFT in Microns (min.)	Remarks
			Primer	Finish Paint		
Insulated carbon steel, low allow steel and LTCS piping and equipment & tanks						
1	-45 to 125	SSPC-SP-10	Repair of pre-fabrication primer F-9 @ 65-75µ DFT.	2 coats of F-14 @125µ DFT/coat = 2x125=250 OR 3 coats of F-15= 3x80=240	315	For other temperature ranges no painting is required under insulation
2	Operating temperature – 45 to 125°C but design temperature 126-400°C	SSPC-SP-10	Repair of pre-fabrication primer F-9 @65-75µ DFT	2 Coats of F-12 @20µ DFT/coat 3x20=60	105 – 115	
Insulated stainless steel including Alloy-20 piping						
1	Below 0°C to all minus temperature	Aluminum sheeting with aluminum foil and “Chloride free mineral sealant coating barium chromate” shall be applied.				If the piping & equipments are already erected than surface shall be prepared by cleaning with emery paper and wash/flush with chloride free DM water followed by wiping with organic solvent. No pre-erection primer to be applied. Amercoat 738 from Ameron , USA (Goodlass Nerolac paints) and Berger 938 from Berger paints are available for this temperature range.
2	0 to 120	SSPC-SP-10 (15-25µ surface profile)	None	2 coats of F-14 @125µ DFT/COAT 2x125=250 or 3 coats of F-15 = 3x80=240	250 or 240	
3	121 to 500	SSPC-SP-10	None	3 coats of F-12 @20µ DFT/COAT 3x20=60 or 1 coat of Poly Siloxane coating @ 75 microns DFT/coat	60	
4	501 to 600	SSPC-SP-10	None	1 coat of Poly Siloxane coating @	150	

				150μ		
				DFT/coat		
5	Cyclic service-196 to 480 excepting -45 to 120	SSPC-SP-10	None	1 coat of Amercoat 738 @ 150μ DFT/coat	150	
No painting is required for insulated monel, incoloy and nickel lines.						

TABLE 10.0 : INTERNAL PROTECTION OF CARBON STEEL WATER BOXES AND TUBE SHEETS OF COOLERS / CONDENSERS

Water boxes, channels, partition plates, end covers and tube sheets etc.

Sl. No.	Design Temperature in °C	Surface Preparation	Paint system		Total DFT in Microns (min.)	Remarks
			Primer	Finish paint		
1	Upto 65	SSPC-SP-10	1 coat of P-6 @ 40μ DFT/coat	2 coats of F-7 @125μ DFT/coat 2x125=250	290	For C.S.
2	Upto 65 Non ferrous and brass tube sheets	SSPC-SP-3	1 coat of P-4 @ 8-10μ DFT/coat. 1 coat of P-6 @ 40μ DFT/coat.	2 coats of F-7 @125μ DFT/coat 2x125=250	300	For non ferrous surfaces

TABLE 11.0 : FIELD PAINTING SYSTEM FOR GI TOWERS/NON-FERROUS TUBE SHEET

Sl. No.	Design Temperature in °C	Surface Preparation	Paint System		Total DFT in Microns (min.)	Remarks
			Primer	Finish Paint		
1	Upto 65	SSPS-SP-3	1 coat of P-4 @ 8-10μ DFT/coat + 1 coat of P-6 @ 40μ DFT/coat	2 coats of F-2 @40μ DFT/coat 2x40=80	130	Shade as per defence Requirements.
2	Upto 65 Non ferrous and brass tube sheets	SSPS-SP-3	1 coat of P-4 @ 8μ DFT/coat. 1 coat of P-6 @ 40μ DFT/coat.	2 coats of F-7 @125μ DFT/coat 2x125=250	300	

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OUTDOOR SWITCHYARD COMPONENTS

This specification covers design, manufacture, assembly, testing before dispatch, inspection (TPI), supply & delivery (including loading, transportation & unloading on platform at site), erection, installation, all civil work including foundation, site testing & commissioning of all kinds of outdoor switchyard components like Isolators, Lightning Arrestors, CVTs, Wave-traps, PLCC equipments, ACSR Moose conductors, Gas Insulated Bus-duct, Protection Couplers, Gantry Towers and structures with all other required accessories for safe, efficient, satisfactory and trouble free operation of the equipment and in compliance with IS/ IEC/ HVPNL & CEA guidelines and in compliance with total project requirements.

1.0 Detailed Scope:

- 1.1 This section of the specification covers design, fabrication, supply, installation, testing and commissioning of Gantry structures and Gantry Towers relevant ISO/IEC standard design for termination of the incoming ACSR Moose conductors and construction of bay for mounting of various outdoor switchyard components viz ACSR Moose terminations, Outdoor Lightning Arrestors, Gas Insulated Busduct, GIS to AIS bushings, CVT, PLCC components, Protection Couplers, Line Traps, Outgoing Bus-duct mounting structures, Isolators and earthing switches and any other components required for full commissioning of the system and in line with GELO approved by HVPNL.
- 1.2 The scope shall include supply, installation, testing and commissioning of bolts, nuts and washers, hanger, D-shackle and all type of accessories like phase plate, circuit plate, number plate, danger plate, ACSR Moose conductor etc. selecting type of foundation, casting of foundation for gantry footing in line with relevant standards.
- 1.3 The scope shall include design, erection of gantries, tack welding of bolts and nuts including supply and application of zinc rich paint, gantry earthing, fixing of insulator string, stringing of conductors and earthwire along with all necessary line accessories. All the clauses in the specification will be relevant for the gantry structures also unless stated otherwise.
- 1.4 The scope of specification covers fabrication, proto-assembly supply and erection of galvanised steel structure for latticed girders and all types of outdoor switchyard equipments support structure. Towers, girder & equipment support structures shall be conforming to IS 2062 (latest edition).
- 1.5 All the raw materials such as steel, zinc for galvanizing, aggregates, reinforcement steel and cement for tower foundation, coke and salt for tower earthing etc. bolts, nuts, washers, D-shackles, hangers, links, danger plates, phase plate, number plate, circuit plate, anti climbing devices etc, required for tower manufacture and erection shall be included in the LSTK contractor's scope of supply. The quality of the material construction shall be verified during the inspection of the materials by authorized Third Party Agency based on the approved QAP clearly indicating the tests for quality checked of the material construction in line with relevant IS/IEC standards.
- 1.6 The scope shall include all types of bolts, nuts, step bolts, inserts in concrete, gusset plates, equipment mounting bolts, structure Earthing bolts, foundation bolts,

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spring washers, fixing plates, angles and bolts for structure mounted or ground mounted marshalling boxes (AC/DC Marshalling box & equipment control cabinet) and any other items as required to complete the job.

- 1.7 The connection of all structures to their foundations shall be by base plates and embedded anchor/ foundation bolts. All steel structures and anchor/ foundation bolts shall be fully galvanized. The weight of the zinc coating shall be at least 0.610 kg/m². One additional nut shall be provided below the base plate which may be used for the purpose of leveling.
- 1.8 The alignment and co-ordinate matching with OSBL point of supply for ISBL system shall be ensured by LSTK contractor prior to start of the job.

2.0 FABRICATION OF STEEL

- 2.1 The fabrication and erection works shall be carried out generally in accordance with IS: 802. A reference however may be made to IS:800 in case of non-stipulation of some particular provision in IS: 802. All materials shall be completely shop fabricated with proper connection material and erection marks for ready assembly in field.
- 2.2 The LSTK contractor shall bear all the expenditure at all stages on account of loading/unloading, transportation and other miscellaneous expenses and losses and damages for all materials upto the fabrication yard/ shop and thereafter to the erection site including all other expenses till the erection of work has been completed and accepted. The unit rates shall be deemed to be inclusive of all such incidental expenses and nothing extra shall be payable on any account in this regard.

3.0 ASSEMBLY

- 3.1 The component parts shall be assembled in such a manner that they are neither twisted nor otherwise damaged and shall be so prepared that the specified chamber, if any, is provided. In order to minimise distortion in member the component parts shall be positioned by using the clamps, clips, dogs, jigs and other suitable means and fasteners (bolts and welds) shall be placed in a balanced pattern. If the individual components are to be bolted, paralleled and tapered drifts shall be used to align the part so that the bolts can be accurately positioned.
- 3.2 Sample towers, beams and equipment support structure shall be trial assembled keeping in view the actual site conditions, before erection in the fabrication shop and shall be inspected and approved by Owner with/without Owner's representative before mass fabrication. Necessary match marks shall be made on these components in the shop before disassembly and dispatching.

4.0 BOLTING

- 4.1 Every bolt shall be provided with a spring washer under the nut so that no part of the threaded portion of the bolt is within the thickness of the parts bolted together.
 - 4.2 All steel items, bolts, nuts and washers shall be galvanised.
 - 4.3 2.0% extra nuts and bolts shall be supplied for erection.
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5.0 **WELDING**

The work shall be done as per approved fabrication drawing which clearly indicate various details of joints to be welded, type of weld, length and size of weld, whether shop or site weld. Symbols for welding on erection and shop drawings shall be according to IS:813.

Efforts shall be made to reduce site welding so as to avoid improper welding due to constructional difficulties.

6.0 **FOUNDATION BOLTS**

- 6.1 Foundation bolts for the towers and equipment supporting structures and elsewhere shall be embedded in first stage concrete while the foundation is cast. The LSTK contractor shall ensure the proper alignment of these bolts to match the holes in the base plate.
- 6.2 The LSTK contractor shall be responsible for the correct alignment and levelling of all steel work on site to ensure that the towers/ structures are plumb.
- 6.3 All foundation bolts for lattice structures are to be supplied by the LSTK contractor.
- 6.4 All foundation bolts shall be fully galvanised so as to achieve 0.61 kg per Sq.m of Zinc Coating as per specification.

7.0 **STABILITY OF STRUCTURE**

The LSTK contractor shall be responsible for the stability of the structure at all stages of its erection at site and shall take all necessary measures by the additions of temporary bracing and guying to ensure adequate resistance to wind and also to loads due to erection equipment and their operations.

8.0 **GROUTING**

The method of grouting the column bases shall be subject to approval of Purchaser and shall be such as to ensure a complete uniformity of contact over the whole area of the steel base. The LSTK contractor will be fully responsible for the grouting operations.

9.0 **GALVANISING**

- 9.1 All structure steel works and single pipe supports shall be galvanised after fabrication.
- 9.2 Zinc required for galvanising shall have to be arranged by the LSTK contractor. Purity of zinc to be used shall be 99.5% as per IS: 209 (latest).
- 9.3 The LSTK contractor shall be required to make arrangement for frequent inspection by the Purchaser as well as continuous inspection by a resident representative of the Purchaser, if so desired for fabrication work.

10.0 **INSPECTION BEFORE DISPATCH**

Sample test for each type of the fabricated steel work shall be inspected and certified by the authorised Third Party Agency (TPI) as satisfactory before it is despatched to the erection site. Such certificate shall not relieve the LSTK contractor of his responsibility regarding adequacy and completeness of fabrication. The inspection shall be done as per approved QAP.

11.0 **TEST CERTIFICATE**

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Copies of all test certificate relating to material procured by the LSTK contractor works shall be submitted at the time of factory inspection for approval of TPI with/without Owner. Same shall be submitted to the Owner before starting of the execution.

12.0 ERECTION

The LSTK contractor should arrange his own erection plant and equipment, welding set, tools and tackles, scaffolding, trestles equipment etc. and any other accessories and ancillaries required for the work.

13.0 SAFETY PRECAUTIONS

The LSTK contractor shall strictly follow at all stages of fabrication, transportation and erection of steel structures, raw materials and other tools and tackles, the stipulations contained in Indian Standard Code for erection for structural steel work – IS:7205.

14.0 MAXIMUM TENSION

14.1 Max tension shall be based on either

- a) At 0°C with 36% full wind pressure, or
- b) At 32°C with full wind pressure whichever is more stringent.

14.2 The sag-tension calculations for terminating ACSR Moose for all type of towers shall have to carried out by the LSTK contractor in event of order after extracting details from state electricity board.

14.3 The initial conductor tension at 32°C and without wind shall be 22% of the ultimate tensile strength of the conductor.

14.4 LIMITING TENSION OF CONDUCTOR & EARTHWIRE

The ultimate tension of conductor and ground wire shall not exceed 70 percent of their ultimate tensile strengths.

15.0 MATERIALS

15.1 TOWER STEEL SECTIONS

The towers shall be fully galvanized structure. The towers to be fabricated have a combination of two grades of steel. One is MS steel and other is HT steel.

15.2 FASTENERS: BOLTS NUTS AND WASHERS

15.2.1 All bolts and nuts shall conform to IS:6639-1972. All bolts and nuts shall be galvanized and shall have hexagonal head and nuts, the heads being forged out of the solid steel rods and shall be truly concentric, and square with the shank, which must be perfectly straight.

15.2.2 The bolt shall be of 16 mm dia and of property class 5.6 as specified in IS:1367 (part-III) 1979 and matching nut of property class as specified in IS:1367 (part-VI) 1980.

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- 15.2.3 Bolts up to M 16 and having length upto 10 times the diameter of the bolts should be manufactured by cold forging and thread rolling process to obtain good and reliable mechanical Properties and effective dimensional control. The shear strength of bolts for 5.6 grade should be 310-MPa minimum as per IS: 12427, bolts should be provided with washer in accordance with IS: 1363 part-I to ensure proper bearing.
- 15.2.4 Nuts should be double chamfered as per the requirement of IS:1363 part-III, 1984. The LSTK contractor should ensure that nuts should not be over – tapped beyond 0.4 mm oversize on effective diameter for size upto M16.
- 15.2.5 Fully threaded bolts shall not be used. The length of bolts shall be such that the threaded portion will not extend into the place of contact of the members.
- 15.2.6 All bolts shall be threaded to take the full depth of the nuts and threaded for enough to permit firm gripping of the members, but not further. It shall be ensured that the threaded portion of each bolt protrudes not less than 3 mm and not more than 8 mm when fully tightened. All nuts shall fit and tight to the point where the shank of the bolt connects to the head.
- 15.2.7 Flat and tapered washers shall be provided wherever necessary. Spring washers shall be provided for insertion under all nuts. These washers shall be of steel electro-galvanised steel, positive lock type and 3.5 mm in thickness for 16 mm dia bolt.
- 15.2.8 The LSTK contractor shall furnish bolt schedules giving thickness of members connected, the size of bolts nut and the washer and the length of shank and the threaded portion of bolts and sizes of bolt holes and any other special details of this nature.
- 15.2.9 To obviate bending stress in bolts or to reduce it to minimum, no bolt shall connect aggregate thickness of more than three (3) times its diameter.
- 15.2.10 The bolt position in assembled towers shall be as per IS:5613 (Part-II/section-2-1976).
- 15.2.11 Bolts at the joints shall be so staggered that nuts may be tightened with spanners without fouling.
- 15.2.12 To ensure effective in-process quality control it is essential that the LSTK contractor should have all the testing facilities for test like weight of zinc coating, shear strength, other testing facilities etc. in-house. The manufacture should also have proper Quality Assurance System, which should be in line with the requirement of this specification and IS:14000 series quality system standard.

15.3 GANTRY TOWER ACCESSORIES

15.3.1 STEP BOLTS & LADDERS

Each tower shall be provided with step bolts in one of the main leg confirming to IS:10238 of not less than 16mm diameter and 175 mm long, spaced not more than 450 mm apart and extending from about 3.5M above the ground level to the top of the tower. The step bolt shall be fixed on one leg of single circuit tower from 3.5 m above ground level to top of the towers. Each step bolt shall be provided with two nuts on one end to fasten the bolt securely to the tower and button head at the other end to prevent the feet from slipping away. The step bolts shall be capable of withstanding a vertical load not less than 1.5 KN. For special structures, where the height of the super structure exceeds 50m, ladders along with protection rings as per the IOCL PR approved

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design shall be provided in continuation of the step bolts on one face of the tower from 30 metres above ground level to the top of the special structure. From 3.5 m to 30 m height of super structure step bolts shall be provided. Suitable plat form using 6 mm thick perforated chequered plates along with suitable railing for access from step bolts to the ladder and from the ladder to each cross-arm tip and the groundwire support shall to be provided. The platform shall be fixed on tower by using countersunk bolts.

15.3.2 INSULATOR STRING AND EARTHWIRE CLAMPS ATTACHMENTS

- a) 'I' shaped suspension insulator string assemblies shall be used for suspension tower (if applicable as per design). For the attachment of suspension insulator string, a suitable dimensioned swinging hanger on the tower shall be provided so as to obtain requisite clearance under extreme swinging condition and free from swinging of the string.
- b) The hanger shall be designed to withstand an UTS in line with relevant IS/IEC standards only.
- c) At tension towers, strain plates of suitable dimensions on the underside of each cross-arm tip and at the top earthwire peak should be provided for taking the hooks or D-shackle of the tension insulator strings or earthwire tension clamps, as the case may be. Full details of the attachments shall be submitted by the LSTK contractor for IOCL PR approval before starting the mass fabrication.
- d) Insulator & insulator string ratings shall be selected such that:
 - a. Under ultimate design wind loading conditions, the load on insulator string shall not exceed 70 % of its selected rating.
 - b. Under everyday temperature and no wind conditions, the load on insulator string shall not exceed 25% of its selected rating.
 - c. The specification of overhead conductor to be used in the outdoor gantry shall be a minimum of following and to match the specific project requirements:

Voltage Level	220 KV
Code Name of Conductor	ACSR "MOOSE"
No. of Conductors/Phase	As per site requirements
Stranding / Wire Diameter	54 / 3.53 mm AL + 7 /3.53 mm steel
Total Sectional Area	597 mm²
Overall Diameter	31.77 mm
Calculated D.C. resistance at 20 deg C	0.05552 Ohm/km
Min. UTS	161.2 k N
Modulus of Elasticity	7034 kg / mm²
Co-efficient of Linear Expansion	19.30 x 10-6 / o C

- e) **Earth Wires:** Two continuously run earth wires – one of 7/3.66 mm galvanized steel wire and another of 24-core OPGW earthed at every tower location shall be used.
- f) **Aviation Requirements and Warning Signals:** Day with/without night visual aids and markers for denoting transmission lines or structures as per requirements of Directorate of Flight Safety or relevant IS or ICAO shall be provided (if applicable).
- g) **Tower Accessories, Hardware & Fittings:** Tower accessories and Conductor / earth wire, Hardware & fittings shall be as per IS 5613-(Part-III / Section-I) and any other International Standard applicable.

15.3.3 CONDUCTOR FORMATION AND DESIGN & FABRICATION OF TOWERS:_____

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- a. **Conductor & Earth wire Formation:** Bundled phase conductors of each circuit shall be vertical formation and the two earth wires in horizontal formation.
- b. **Design, Fabrication, Galvanizing, Testing & Dispatch of Towers:** Towers shall be designed generally as per IS: 802 - Code of Practice for Transmission Line Towers, which follows the ultimate load concept except as specified below:
- c. Suspension Towers (if applicable) shall be designed with 75% wind load under security loading condition (Broken wire case)
- d. **ii) Tension Towers**(if applicable) shall be designed with 100% wind load condition under security loading condition (Broken wore case).

15.3.3.1 **Design Criteria:** The following design factors shall apply:

- If steel with minimum guaranteed yield strength is used for fabrication of tower, loads given in IS: 802 (part-1)-section-2 shall be increased by 1.02.
- If steel with less than minimum guaranteed yield strength is used, loads given in IS: 802 (part-1 section-2) shall be increased by a factor 1.05 in addition to that mentioned above.

15.3.3.2 **Classification of Design Loads:** Classification of loads for design of the towers as per IS: 802, part-1 / section-1-1995 shall be as follows:

- **Reliability Requirements** - Reliability level-2 for 220 kV Towers corresponding to 150 years return period wind loads as per relevant IS shall be considered;
- **Security Requirements** - Ability of a transmission system to be protected from any major collapse such as cascading effect shall be considered.
- **Safety Requirements** - Protection and safety of workers so as to avoid accidents / injury during construction and Maintenance shall also be considered.

15.3.3.3 **General Description of Type and Classification of Towers: (As applicable)** : The towers required for the project shall be Double-Circuit, self-supporting, lattice steel structures with bolted joints, designed to carry line conductors with necessary insulators, earth wire, fittings and fixtures under all loading conditions and classified as per Types indicated in table below:

Type Tower	of	Deviation Limit	Typical Use As
DA		0-2 deg.	Suspension Tower
DB		0-15 deg.	1. Angle tower with tension insulator strings
			2. With uplift forces under broken wire conditions
			3. Under Anti Cascading Conditions
		0 deg.	Section Tower
DC		15-30 deg.	1. Angle tower with tension insulator strings
			2. With uplift forces under broken wire conditions
			3. Under Anti Cascading Conditions
		0 deg.	Transposition Tower with modifications
DD		30-60 deg.	1. Angle tower with tension insulator strings
			2. With uplift forces under broken wire conditions
			3. Dead end with 0–15 deg. deviation on S /Station side
		0 deg.	Complete Dead end

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Special Location		As required as per site conditions
Extensions		3M, 6M, 9M, 12M, 15M, 18M & 25M extensions as required

15.3.3.4 **Thickness of Members:** The minimum thickness of angle sections used in the design of towers, unless otherwise specified elsewhere in this specification, shall not be less than the following:

- Main corner leg members including the ground wire peak: 5 mm
- For all other members : 4 mm

15.3.3.5 **Slenderness Ratio:** Maximum limit of the slenderness ratio (Kl / r) for members computed in accordance with clause-6 of IS: 802 (Part-1/Sec-2) 1992 shall not exceed value specified here under:

a) For main corner leg members including the corner members of earth wire peak and the lower horizontal members of the cross-arms in compression	120
b) For other members carrying computed stresses	200
c) For redundant members and those members carrying nominal stresses	250
d) For members having tensile stress only	400

15.3.3.6 **Erection Stresses:** Where erection stresses combined with other permissible co-existent stresses could produce a working stress in any member appreciably above the specified permissible working stress, such other provisions are to be made as may be necessary to bring the working stress within the specified permissible limit.

15.3.3.7 **Fabrication, Galvanization, Testing, and Dispatch of Towers:** Fabrication of all type of towers and tower materials shall be done in conformity with IS: 802 (Part-II) 1992 & CBIP publication No.-268 or relevant international standards.

15.3.3.7.1 **Fabrication:** All similar parts shall be made strictly inter-changeable.

- **Tower Members:** Standard Structural Steel Angle Sections & Plates of tested quality as per IS: 2062 or any other equivalent international standards shall be used in fabrication of stubs, towers, extensions, stub setting templates etc.
- **Grades of Steel:** Not more than two (2) grades of steel shall be used.
- **Max. Length of Members:** No individual member shall be longer than 6000 mm.
- **Fasteners:** Full threaded hexagonal, chamfered, galvanized MS bolts & nuts of 16mm / 20 mm dia. conforming to IS: 6639-1972, IS: 1363-1967 / 1984 & IS: 12427-1988 of property class 5.6 as specified in IS: 1367 (part-III) 1979 and matching nuts of property class as specified in IS: 1367 (part-VI) 1980 shall be used. The high tensile steel bolts and nuts conforming to IS: 8500-1992 of property class 8.8 of IS: 3757:1985 and IS: 6623:1985 respectively could also be used; but all bolts & nuts of material similar to the material of the concerned tower member shall only be used.
- **Bolt Spacing:** Minimum bolt spacing and rolled edge distance and sheared edge distance from the centers of the bolt holes shall be maintained as per IS: 802. Shearing stress and bearing stress for bolts shall be calculated as per clause 5.4 of IS: 802 Part-1/Sec-2 1992.

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- **Step Bolts & Ladders:** Each tower shall be provided with step bolts capable of withstanding a vertical load not less than 1.5 KN and secured with two (2) nuts conforming to IS: 10238 of not less than 16 mm diameter and 175 mm long, spaced not more than 450 mm apart and extending

from about 3.5 meters above the ground level to top of tower. The step bolts may be provided in only one of the main legs on in line towers and on two diagonally opposite legs in Section / Angle towers.

- **Identification Mark:** Each individual member shall have an erection mark conforming to the component number given to it in the fabrication drawings. The identification mark shall be made with marking dies of 16 mm size before galvanizing and shall be legible after galvanizing. The coding of identification mark shall be as follows:

A-BB-CC-DDD-H; where:

A = Authority's code assigned to the Concessionaire-Alphabet

BB = Concessionaire's Mark-Numerical

CC = Tower type-Alphabet

DDD = Number mark to be assigned by Concessionaire - Numerical.

H = Mark for HT steel members

15.3.4 EARTHWIRE CLAMPS:

a) **SUSPENSION CLAMP**

Earthwire suspension clamps will be supplied by the LSTK contractor, the reference drawing for the same is enclosed with the specification. Earthwire peaks/cross-arms are to be suitably designed to accommodate the shackle of the suspension clamp.

b) **TENSION CLAMPS**

The LSTK contractor shall supply earthwire tension clamps for incorporation on the tension towers. The reference drawing for the same is enclosed with this specification.

c) **ANTICLIMBING DEVICE**

Barbed wire type anti-climbing device/ fencing as per enclosed drawing shall be provided and installed by the LSTK contractor for all towers/gantries. The height of the anti-climbing device shall be provided approximately 3m above ground level. The barbed wire shall conform to IS:278-1978. the barbed wires shall be given chromating dip as per procedure laid down in IS:1340-1959.

d) **DANGER, NUMBER, AND PHASE PLATE**

Danger, Number, Circuit and phase plates shall be provided and installed by the LSTK contractor.

Each tower shall be fitted with a number plate, circuit plate (in case of double circuit) and danger plate. Each tension tower shall be provided with a set of phase plates also. All the double circuit towers are to be provided with circuit plate fixed near the legs. The height for fixing these accessories shall not be more than 4.5m above the ground level.

The letters figures and the conventional skull and bones of danger plates shall conform to IS:2551-1963 and shall be in a signal red on the front of the plate. The corners of the number, danger & circuit plate shall be rounded off to remove sharp edges.

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e) **BIRD GUARDS**

To prevent birds perching immediately above the suspension insulator string and fouling the same with dropping, suitable bird guards shall be provided at cross arm tips of all suspension towers. The bird guard arrangement shall be such that it shall either prevent bird from perching in position where they are liable to cause the damages or ensure that if birds do perch, dropping will fall clear of the insulator string.

15.3.5 TOWER FABRICATION

The fabrication of towers shall be in conformity with the following:

- a) Except where hereinafter modified, details of fabrication shall conform to IS:802 (Part-II) 1978 or the relevant international standards.
- b) The tower structure shall be accurately fabricated to connect together easily at site without any undue strain on the bolts.
- c) The diameter of the hole shall be equal to the diameter of bolt plus 1.5 mm.
- d) All similar parts shall be made strictly inter-changeable. All steel sections before any work is done on them, shall be carefully leveled, straightened and made true to detailed drawings by methods which will not damage the materials so that when assembled, the adjacent matching surfaces are in close contact throughout. No rough edges shall be permitted in the entire structure.

15.3.6 DRILLING AND PUNCHING

- a) Before any cutting work is started, all steel sections shall be carefully straightened and trued by pressure and not by hammering. They shall again be trued after being punched and drilled.
- b) Holes for bolts shall be drilled or punched with a jig but drilled holes shall be preferred. Punching may be adopted for thickness upto 16mm. tolerances regarding punched holes are as follows:
 - a. Holes must be perfectly circular and no tolerance in this respect is permissible.
 - b. The max. allowable difference in diameter of the holes on the two sides of plates or angle is 0.8 mm i.e. the allowable taper in a punched hole should not exceed 0.8 mm in diameter.
 - c. Holes must be square with the plates or angles and have their walls parallel.
 - d. All burrs left by drills or punch shall be removed completely. When the tower members are in position the holes shall be truly opposite to each other. Drilling or reaming to enlarge holes shall not be permitted.

15.3.6 ERECTION MARK

Each individual member shall have an erection mark conforming to the component number given to it in the fabrication drawings. This mark shall be made with marking dies of 16 mm size before galvanizing and shall be legible after galvanizing.

15.3.7 GALVANISING

Fully galvanized towers and stub shall be used for the lines. Galvanizing of the member of the towers shall conform to IS:2629-1985 and IS:4759-1968. All galvanizing members shall withstand tests as per IS:2633-1986. For fasteners the galvanizing shall conform to IS:1367 (Part-13). The galvanizing shall be done after all fabrication work is completed, except that the nuts may be tapped or re-run after galvanizing. Threads of bolts and nuts shall have a neat fit and shall be such that they can be turned with finger throughout the

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length of the threads of bolts and they shall be capable of developing full strength of the bolts. Spring washers shall be electro-galvanised as per grade 4 of IS: 1573-1970.

16.0 INSULATOR HOISTING

Damaged insulators and fittings, if any, shall not be employed in the assemblies. Before hoisting all insulators shall be cleaned in a manner that will not spoil, injure or scratch the surface of the insulator, but in no case shall any oil be used for the purpose. Corona control rings/arching horn shall be fitted in an approved manner. Torque wrench shall be used for fixing different line materials and their components, like suspension clamp for conductor and earth-wire etc. Whenever recommended by the LSTK contractor of the same for river crossing towers.

17.0 STRINGING OF CONDUCTOR AND EARTHWIRE

- a) The stringing of the conductor shall be done by standard stringing method.
- b) After being pulled the conductor/earth-wire shall not be allowed to hang in the stringing blocks for more than 96 hours being pulled to the specified sag.
- c) The stringing of conductor shall be done as per initial stringing chart duly approved by the IOCL PR. The LSTK contractor shall prepare the initial stringing chart taking account of conductor creep in respect of ACSR 'Moose' which shall be compensated by over-tensioning the conductor at a temperature of 26°C lower than the ambient temperature during stringing. Conductor creep in respect of ACSR 'Moose' shall be compensated by over-tensioning the conductor at a temperature of 21°C lower than the ambient temperature during stringing.
- d) The LSTK contractor shall give complete details of the stringing methods, which he proposes to follow. Before the commencement of stringing the LSTK contractor shall submit the stringing charts for the conductor and earth-wire for various temperatures and span, along with equivalent spans for the approval of the IOCL PR.

18.0 JOINTING

- a) All the joints on the conductor and earth-wire shall be of compression type, in accordance with the recommendations of the LSTK contractor for which all necessary tools, equipment like compressors, dies, processes etc. shall have to be arranged by the LSTK contractor. Each part of the joint shall be cleaned by wire brush to make it free of rust or dirt etc. and properly greased with anticorrosive compound if required, and as recommended by the LSTK contractor before the final compression is done with the compressors.

19.0 FINAL CHECKING, TESTING AND COMMISSIONING

After completion of the works, final checking of the line shall be done by the LSTK contractor to ensure that all the foundation works, tower erection, and stringing have been done strictly according to the specifications in line with P.O specification. LSTK contractor to note that Design of foundations shall

be done by limit state method with minimum overload factor as 1.1. Minimum factor of safety for design of pile or well type foundations shall be 2.5. The LSTK contractor shall, for safety assurance, get the designs counter checked and certified from list agencies under clause 10.6

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of Section-1 Chapter-1. LSTK contractor shall only submit the vetted drawings for all types of civil/structural drawings to IOCL PR for verification and documentation purpose only.

All the works shall be thoroughly inspected keeping in view of the following main points:

- a. Sufficient back filled earth is lying over each foundation pit and it is equitably compacted.
- b. Concrete chimneys and their copings are in good finely shaped conditions.
- c. All the tower members are correctly used, strictly according to final approved drawing and are free of any defect or damage whatsoever.
- d. All bolts are properly tightened and punched/tack welded and painted Zinc rich primer and enamel paint.
- e. The stringing of the conductors and earth-wire has been done as per the approved sag and tension charts and desired clearances are clearly available.
- f. All conductor and earth-wire accessories are properly installed.
- g. All other requirements to complete the work like fixing of danger plate, phase plate, number plate, anti climbing device, aviation signal (wherever required) etc. are properly installed.
- h. Wherever required it should be ensured that revetment is provided.
- i. The original tracings of profile route alignment and tower, design, structural drawings, bill of material, shop drawings of all towers other than the towers designed by the IOCL PR are submitted to the IOCL PR for reference and record.
- j. The insulation of line as a whole is tested by the contractor by providing his own equipment, labour etc. to the satisfaction of the IOCL PR.
- k. All towers are to be properly grounded.
- l. The line is tested satisfactorily for commissioning purpose.

20.0 DOCUMENTATION: The document schedule for this section shall follow the following vendor Data requirement schedule.

LSTK contractor's scope of work for all types of civil and structural part for both outdoor switchyard as well as sub-station building shall also include vetting of following by list agencies under clause 10.6 of Section-1 Chapter-1 which are to be submitted to Owner/Engineer-in-Charge for approval. IOCL's scope shall be limited to receiving and acknowledge the verified/vetted drawings along with its base calculation for future references during and post construction period.

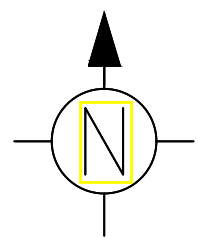
- All structural calculations, design, drawings and design basis
- Slope stability analysis of earth mound in proposed area of work, methodology of earth cutting and execution scheme

Cost for vetting of above design, calculations, schemes, drawing etc. to be borne by the LSTK contractor. Drawings/documents vetted by mentioned authorities shall bear signature with seal & full name with designation. LSTK contractor to confirm the same in their bid document

Sr No	Description with bids	With Bids	Post order		Final documents with equipments	
			For review	For records	soft copy	Prints
1	Tower accessories drawings like design plate, name			x		

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	plate etc					
2	Sag-tension calculation and sag-template curve drawings		x		x	x
3	Dimensional / Assembly Drawings		x	x	x	x
3a	Detail to indicate the type, size, arrangement, dimensions, material description		x	x	x	x
3b	Bill of materials		x	x	x	x
3c	Cross Sectional View		x	x		
3d	Outline general arrangement		x		x	x
3e	Weight of each component, break-up for packing and shipment.		x			x
3f	Fixing arrangement required, the dimensions required for installation		x	x		x
4	Tower footing earthing drawing		x	x	x	x
5	Bill Of Material			x		x
8	Quality plan for fabrication and site activities including quality system		x			x
9	Test Certificates (of materials used)			x		x
10	List Of special Tools & Tackles		x	x	x	x
11	Equipment storage procedure at site					x



Annexure - S2 / C1 / 4

PLANT BLDG.

SHED FOR VAM

SUBSTATION-28

SWITCH YARD

ROAD 7.5 M WIDE

WT-3

DG SHED

NOTES:-

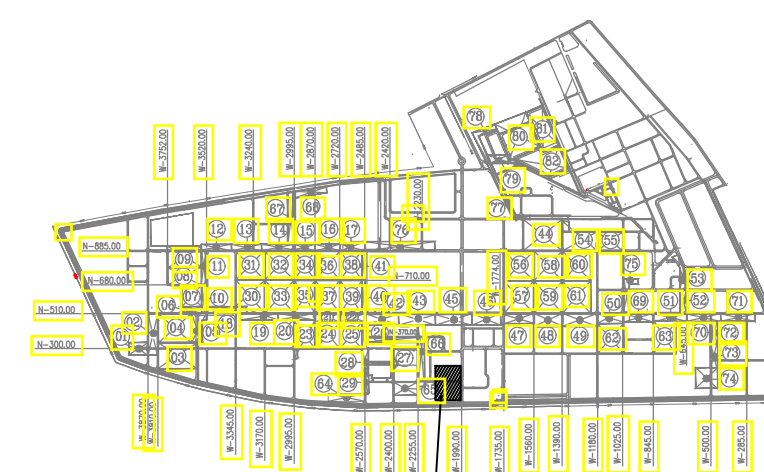
1. THIS GELO IS INDICATIVE ONLY.
2. VENDOR TO PREPARE GELO AS PER SITE CONDITION MEETING ALL HVPNL GUIDELINES AND OBTAIN IT'S APPROVAL PRIOR TO START OF JOB. IT IS THE RESPONSIBILITY OF LSTK VENDOR TO ENSURE THAT BID IS IN LINE WITH HVPNL GUIDELINES.

LEGEND:-

EXISTING LINE

PROPOSED LINE

FENCING LINE



KEY PLAN

EL.100000
F.F.L

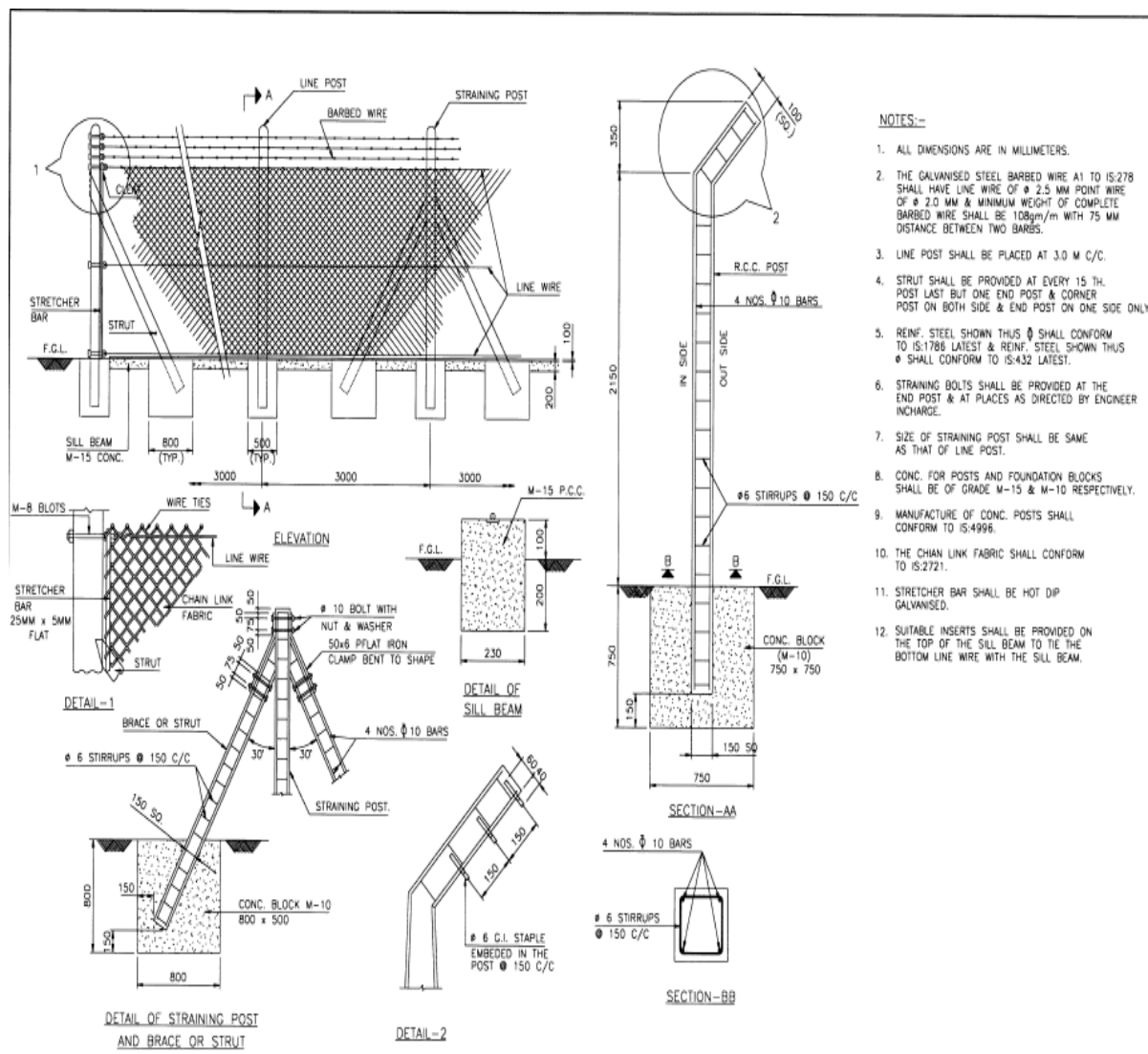
REFERENCE DRAWING:- IDCL/PR/0001/REV-19/OVERALL PLOT PLAN



PANIPAT
REFINERY
ENGINEERING SERVICES

INDICATIVE GELO OF
220KV SWITCH YARD

SCALE	UNIT	JOB NO	DISCIPLINE	DRG. NO.	SHT.NO.	REV.
1:364	TPS		ELE	4165	01	1

INDICATIVE DRAWING OF CHAIN LINK FENCING

S.N	ITEM	SPECIFICATIONS	SUGGESTED VENDORS
1	Safety Shoe	<p>Industrial safety shoe shall be suitable for oil refinery & having resistance to oil, acids/alkali, antistatic & electrical resistant. The shoe should meet the requirements of relevant <u>IS 15298 (Part 2) : 2011 / ISO 20345 : 2004</u>/ DIN EN 344-1,345 #1 (1997) and DIN 4843 part 100 having the following broad specification: -</p> <ol style="list-style-type: none"> Upper Leather- The Shoe upper should be made of water penetration & absorption resistant leather having properties as follow: <ol style="list-style-type: none"> Thickness-2.0 to 2.5 mm Tensile Strength-1.55 kg.mm² (min.) Elongation-45-75% Tongue Tear Strength- 45 kg.cm²(min.) Colour Fastness -Fast Flexibility Test -No damage / crack till 100000 cycles (min.) <p>The upper should have padded collar for ankle protection, bellow tongue to prevent water slippage & suitable D-rings for lace</p> <p>Bottom Sole -Bottom sole should be made with Poly Urethane Rubber (<u>PU/PUR/ TPR/TPU</u>) as per relevant DIN/<u>IS/ISO</u> Specification of flexing/ Abrasion/oil Swelling/electrical resistance & hardness. Cushion in the sole to be provided. The sole should have Anti Skid & Anti Static Design. There should not be any nails in the shoe.</p> The material should be resistant to Oils, alkalis & Acids. Toes Cap- Steel / Alloy Toe cap. Threads- Nylon twisted threads resistant to Oil, Acids & Alkali should be used. Laces -Brown colour round shape Nylon laces of 100 cm length should be used which shall meet following requirement: <ol style="list-style-type: none"> Breaking Strength-500 N (Min.) Elongation-25-30% Slip Resistance-12 N (Min.) Bodkin Strength-150 N (Min.) Color: Dark Brown/ Black Test Required -Vendor shall carry out the tests as per DIN/<u>IS/ISO</u> standard or produce the test Certificate from Govt. approved Test Lab Guarantee- Vendor should give a guarantee of maximum period in months against any manufacturing defects from the date of supply of the material General: Year of Manufacturing shall be embossed at suitable location on the sole. 	<p>M/s Liberty, M/s BATA, M/s Karam, M/s Rahman, M/s Allen Cooper, M/s Red Chief, M/s Myco.</p>

2	Industrial Safety Helmet	<p>Industrial safety helmet of tough light weight made of superior quality HDPE.</p> <p>It should have minimum 6 points STAZ on suspension with LDPE cross member on head.</p> <p>It should have adjustable headband and black nylon double , V- shape chinstrap to reduce the risk of the helmet coming off as a result of impact during a fall (head band range 530 - 600 mm).</p> <p>Helmet should be provided with appropriate sweatband to absorb and dry sweat from the forehead and must have the facility/ slot to fix earmuff.</p> <p>Helmet should have arrangement for side attachments.</p> <p>The safety helmet shall be provided with of adjustable knob mechanism such as ratchet facility.</p> <p>Helmet shall be approved by Directorate-General of Mines Safety (DGMS) and having ISI mark (IS: 2925) and EN 397 certified.</p>	<p>M/s Joseph Leslie & Co., M/s Sure Safety, M/s Karam, M/s 3M, M/s MSA</p>
3	Dust Mask	<p>NIOSH N-95 DUST/ MIST RESPIRATOR SPECIFICATIONS</p> <p>Description : Should be NIOSH N95 filtering face piece particulate respirator for Dust/Mist applications.</p> <p>Construction : It should have a Superior molded cup shaped design with special stiffened inner shell to allow retention of shape after repeated use. Triple layer non-woven micro-fiber filter material. The construction should incorporate metal free welded headbands (Staple/Stitching free), a aluminum nose clip and foam around the nose section.</p> <p>Filter Media : Melt blown polypropylene micro fibres charges with a stable charge during drawing the fiber. This should give high filtration efficiency with lowest possible breathing resistance. The filter media should be the whole respirator surface & additionally should also have Electro-statically charged filter media capable of filtering 0.3 micron, which is the most penetrating particle size.</p> <p>Head Bands : Should have, Staple/Stitching Free; Twin welded head bands made of poly-isoprene (devoid of skin irritation caused by LATEX), having very good elastic retention properties. The Band should also provide constant tension to the wearer through out the usage life for good face seal Fit and should also not cause irritation to the wearer.</p> <p>Nose Clip : The nose clip should be made of strengthened aluminium with high quality adhesive to ensure uniform adhesion to the respirator surface and long rust free life. The aluminium nose should be soft and pliable and confirm to the nasal contours of</p>	<p>M/s Joseph Leslie & Co., M/s 3M, M/s Sure Safety, M/s Karam, M/s Voltech, M/s ABN Equipments, M/s Kewalson.</p>

		<p>the wearer to provide comfort, secure face seal and reduce the potential for eyewear fogging. The clips should adjust easily for fewer pressure points and helps secure fit over variety of face sizes.</p> <p>Nose Foam : The nose clip should be supported underneath with a hypoallergenic nose foam pad, which helps to give a good fit and does not cause skin allergies at the point of contact.</p> <p>Weight : The weight of the respirator should not be more than 9 grams.</p> <p>Filtering efficiency : It should provide at least 95% filtration efficiency against solid and liquid aerosols that do not contain oil.</p> <p>Breathing Resistance Must not exceed 10 mm of water column. Test certificate must be submitted along with offer, duly attested by manufacturer. Photocopy without manufacturer.s attestation shall not be considered.</p> <p>Fit Test : The manufacturer shall provide fit testing facility and relevant training to ensure proper fitting and compliance of the respirator. Details of fit testing procedure must be submitted along with offer. Fit testing of the respirator on users must be carried out as per OSHA Fit Testing protocol for the samples, before the order placement.</p> <p>Training : The manufacturer / supplier should provide extensive training on usage, maintenance and limitations of the product to the users.</p> <p>Approvals : Should meet NIOSH. N95 /IS 9473:2002 / EN149 specification requirements. Batch Test certificate (of past production lot) on manufacturer's original letter head must be submitted detailing the tests conducted at the time of offer.</p>	
4	Ear Plug	<p>Ear plug for protection against noise(NRR to be minimum 29db) made of soft sponge(e.g. 3M make)material, non-allergic, smooth, comfortable, tapered shape to fit into the ear canal closely, longer length to facilitate fitting & removing, attached with nylon thread packed in good quality self sealing plastic pouch.</p>	<p>M/s Joseph Leslie & Co., M/s 3M, M/s Sure Safety, M/s Karam, M/s Voltech, M/s ABN Equipments, M/s Kewalson.</p>
5	Safety Goggles for Acid/Splash protection	<p>PANORAMA type Safety Goggles with clear vision for use while handling Acid/Alkali & other chemicals. Safety goggles shall be made of polycarbonate with proper sealing arrangement to prevent entry of chemicals from sides. Material used for frame shall be resistant to chemicals. It should have ventilating ports on sides.It should be able to be worn over prescription spectacles</p> <p>Frame: Soft vinyl Goggle body</p>	<p>M/s Joseph Leslie & Co., M/s 3M, M/s Sure Safety, M/s Karam, M/s Unicare, M/s ABN Equipments, M/s Kewalson.</p>

		<p>Lens: Hard coated scratch resistant High impact polycarbonate anti fog lens</p> <p>Compliance: CE Marked to EN 166 / ANSI Z87.1-2003</p>	
6	Safety Goggles for flying particle protection	<ol style="list-style-type: none"> 1. The spectacles shall confirm to requirements of EN-166 standard or relevant ANSI standards. 2. The lens of spectacles shall be either CE marked or Z-87+ marked as applicable. 3. The safety spectacles shall be made of poly carbonate lens of optical class-1 or equivalent. 4. Safety spectacles shall have the protection against the 99% of harmful UV radiation. 5. The spectacles will have Plain clear lens without any shade for ease to wear & work during dark/ night hours. 6. The spectacles will have good impact resistance to external forces. 7. Spectacles should be able to provide complete eye protection including sides of the eyes as well & should fit comfortably on the face of the wearer. 8. The spectacles shall have frame with length adjustable temple/arms. 9. The spectacles shall have a good quality cord attached with the frame for hanging around neck of the user. 10. Safety spectacles to be supplied in a cover / pouch. 	<p>M/s Joseph Leslie & Co.,</p> <p>M/s 3M,</p> <p>M/s Sure Safety,</p> <p>M/s Karam,</p> <p>M/s Unicare,</p> <p>M/s ABN Equipments,</p> <p>M/s Kewalson.</p>
7	Full body Safety Harness	<ol style="list-style-type: none"> 1. CE marked Full Body Harness with Double Lanyard Integrated with Energy Absorber shall conform to EN 361 latest edition (EN Standard for Personal Protective Equipment against fall from heights- Full body harness), Lanyards shall conform to EN 354 latest edition (EN Standard for Personal Protective Equipment against fall from heights- Lanyards) and Energy Absorber shall conform to EN 355 latest edition (EN Standard for Personal Protective Equipment against fall from heights- Energy Absorber). <p>"Full body harness shall have front attachment at chest level (two textile loops) for fall arrester and back attachment (Dorsal steel alloy D ring), conforming to EN 362 (EN Standard for Personal Protective Equipment against fall from heights- Connectors) latest edition, fall arrest lanyard.</p> <p>"It should be with two adjustable shoulder and thigh straps with roller buckles for easy adjustment.</p> <p>"It should have sit strap ideally positioned for extended comfort.</p> <ol style="list-style-type: none"> 2. Double Synthetic fiber rope Lanyard with hooks Integral with Energy Absorber shall carry CE marking. 	<p>M/s Udyogi Plastics,</p> <p>M/s Joseph Leslie & Co.,</p> <p>M/s 3M,</p> <p>M/s Sure Safety,</p> <p>M/s Karam,</p> <p>M/s Unicare,</p> <p>M/s ABN Equipments,</p> <p>M/s Kewalson.</p>

		<p>"Both Lanyards shall be permanently attached with Full Body Harness at one end and with ready to use scaffold hook connectors separately one for each lanyard conforming to EN 362 having CE marked at other end, with minimum opening of 50mm and closure mechanism with protection against inadvertent opening.</p> <p>"Length of lanyards including Energy / Absorber, terminations and connectors shall be of 2 meters.</p> <p>3. Along with supply, following documents shall be submitted:</p> <p>a) Copies of valid documents from the certified / notified body that allow a product to carry CE mark /EN certification for full body harness (EN361,) Lanyard integral with energy absorber (EN 354/EN 355) and connector (EN 362).</p> <p>b) Copy of valid EN Certificates.</p> <p>c) Instruction manual(s) Document(s) for applications / limitations, safe use, pre use checks, periodic examinations and maintenance / repairs of supplied materials/items.</p>	
8	Hand Gloves (Cotton Polka Dotted for Mechanical Grip)	<p>1) Made out closely and thickly woven cotton knitted hand gloves having have four fingers and the thumb with coating of co-polymer of butadiene - acrylonitrile called polka dots at palm side for very good dry grip and uncoated back to allow the air circulation for keeping the hands cool.</p> <p>2) The Polka dot cotton knitted hand gloves will be little elastic in nature for better grip and will have very good mechanical resistance for abrasion, cut, wear & tear.</p> <p>3) The Polka dot cotton knitted hand gloves will confirm to EN-388 or relevant ANSI standard.</p> <p>4) The overall length of the hand gloves will be from : 210 mm to 280 mm.</p> <p>5) The Polka dot cotton knitted hand gloves should be suitable for Better Grip during Material Handling , packaging & General Maintenance work.</p>	<p>M/s Midas Safety, M/s H K Safety, M/s Ganeshi Lal Sumerchand, M/s Joseph Leslie & Co., M/s Sure Safety, M/s Karam, M/s Voltech, M/s Kewalson, M/s Swastik Industrial Services.</p>
9	Hand Gloves (Cotton-Canvas Type for Material Handling)	<p>The gloves will be made of unbleached cotton drill cloth. Gloves will be of the four fingers and thumb design having a one-piece palm including the front of all four fingers and back of the index finger also. The seam on the back of the hand shall be an in-seam. The design shall be generally clute pattern as per is:6994(part-i)-1973 with inside blanket lining on the front side of fingers,thumb and palm. overall finished length shall be 14 inch. The stitching of fingers, thumb and cuff shall provide a comfortable wear to the user.</p>	<p>M/s Midas Safety, M/s H K Safety, M/s Ganeshi Lal Sumerchand, M/s Joseph Leslie & Co., M/s Sure Safety, M/s Karam, M/s Voltech, M/s Kewalson, M/s Swastik Industrial</p>

		the cuff shall also be of cotton drill, the edges of which shall be hemmed. all stitching shall be lock-stitch type with cotton sewing thread confirming to variety no-23 of is:1720-1969. there shall be 6-8 stitches per 25 mm. the ends shall be securely back stitched.	Services.
10	Hand Gloves (Nitrile- for handling chemicals)	CE Marked fully Nitrile rubber hand gloves (In pair) shall have inside soft cotton flocked lining. It shall be able to resist Acid, alkali & solvent while providing solid protection against snags, abrasion, puncture & cuts. Nitrile Rubber hand glove should meet requirement of EN-388 & EN-374. The overall length of the Gloves shall not be less than 12 Inches (from middle finger to end of the sleeve).	M/s Midas Safety, M/s H K Safety, M/s Ganeshi Lal Sumerchand, M/s Joseph Leslie & Co., M/s Sure Safety, M/s Karam, M/s Voltech, M/s Kewalson, M/s Swastik Industrial Services.
11	Hand Gloves (Heat Resistant- for welding etc.)	CE/ ANSI approved five fingers Hand Glove with heat resistant upto 250 deg C, as per EN-407. Overall length of the Glove (from middle finger to other end) shall not be less than 10 inch. Heat resistance hand glove to be soft & comfortable for use in petrochemical operations.	M/s Midas Safety, M/s H K Safety, M/s Ganeshi Lal Sumerchand, M/s Joseph Leslie & Co., M/s Sure Safety, M/s Karam, M/s Voltech, M/s Kewalson, M/s Swastik Industrial Services.

Guidelines on Personal Protective Equipment (PPE)

<u>INDEX</u>			
SN	DESCRIPTION	PPE TO BE USED	Page No
1	Work at Height (height > 2 M)	<ul style="list-style-type: none"> • Safety Shoe (A) • Full Body Safety Harness With shock absorbers (Two alternatives), • Shock absorbing lanyard double 'Y' type • Restrain Lanyard, • Rope Grab (In case of vertical life line being used) • Helmet (A) 	4-11
2	a) Excavation. b) Fire pump Operation. c) Testing of Pressure Gauge	<ul style="list-style-type: none"> • Helmet (B) • Safety Shoe (A) 	12-13
3	Excavation involving dewatering works	<ul style="list-style-type: none"> • Helmet (B) • Gumboot • Gloves (Two alternatives) • Goggles 	14-18
4	Blast Cleaning	<ul style="list-style-type: none"> • Helmet (B) • Safety Shoe(A) • Goggles • Ear Muff • Gloves (Two Alternatives) • Apron (Three Alternatives) • Half face mask 	19-26
5	Painting (Confined space / external)	<ul style="list-style-type: none"> • Helmet (A) • Safety Shoe • Gloves (Two alternative) • Half face mask • Apron (Two Alternatives) 	27-30

Guidelines on Personal Protective Equipment (PPE)

<u>INDEX</u>			
SN	DESCRIPTION	PPE TO BE USED	Page No
6	a) Working in Confined space b) Testing of Gas sensor c) Tank Gauging d) De Gassing of LPG Cylinder e) Shuttering works f) Brick masonry g) Handling of Battery	<ul style="list-style-type: none"> • Helmet (B) • Safety Shoe (A) • Gloves (Two Alternatives) 	31-32
7	a) Road work. b) Reinforcement c) Concreting	<ul style="list-style-type: none"> • Helmet (B) • Gum Boot • Goggles • Gloves (Two Alternatives) 	33-34
8	a) Grass Cutting b) Blinding & de-blinding work	<ul style="list-style-type: none"> • Helmet (B) • Gum Boot 	35
9	Electrical Work	<ul style="list-style-type: none"> • Safety Shoe (B) • Helmet (B) • Gloves (Electrical) 	36-38
10	Working with possibility of	<ul style="list-style-type: none"> • Helmet (B) • Safety Shoe (A) • Goggles • Apron (Two Alternatives) 	39-41

Guidelines on Personal Protective Equipment (PPE)

<u>INDEX</u>			
SN	DESCRIPTION	PPE TO BE USED	Page No
11	Welding and Cutting works	<ul style="list-style-type: none"> • Welding shield • Safety Shoe (A) • Apron Welding • Gloves (Welding) • Helmet (B) 	42-44
12	Tank Cleaning	<ul style="list-style-type: none"> • Helmet (B) • Gum Boot • Apron (Two Alternatives) • Gloves (Two Alternatives) 	45-47
13	Product pump house operation	<ul style="list-style-type: none"> • Helmet (B) • Safety Shoe (A) • Goggles • Gloves (Two Alternatives) 	48-19
14	DG Operation	<ul style="list-style-type: none"> • Helmet (B) • Safety shoe (B) • Ear muff • Electrical glove 	50

- 1) **Additional PPE to be provided for various activities as per requirement of Job Safety Analysis (JSA), OISD and Statutory stipulations.**
- 2) Training inputs as required to be given for proper usage, maintenance of PPE.
- 3) Various EN Standards / BIS codes mentioned are available on line on IOCL CO, HSE website.

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Issued in May 2017

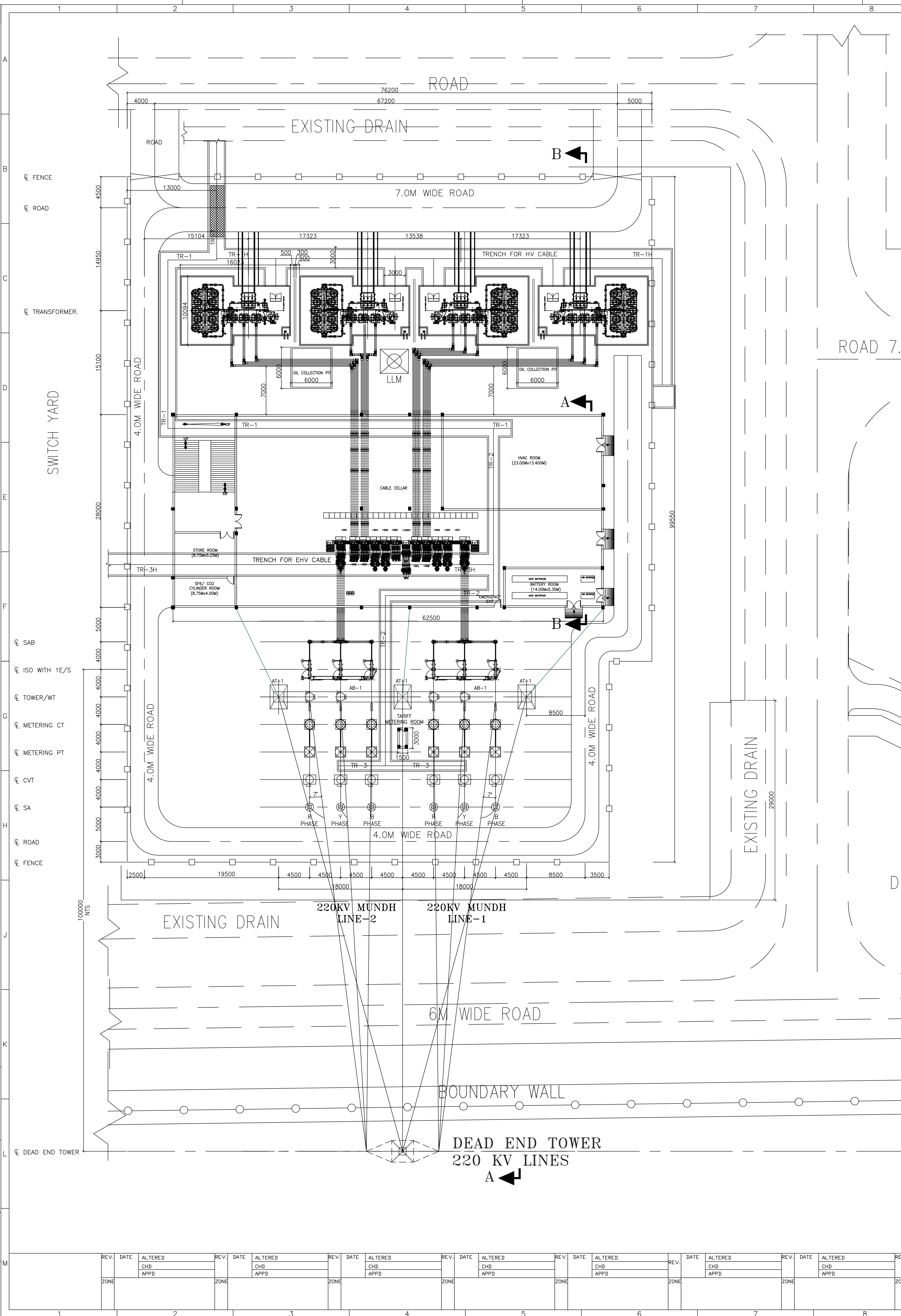
SECTION - 3

ENCLOSURES TO THE SPECIFICATION

(b) TENDER DRAWINGS

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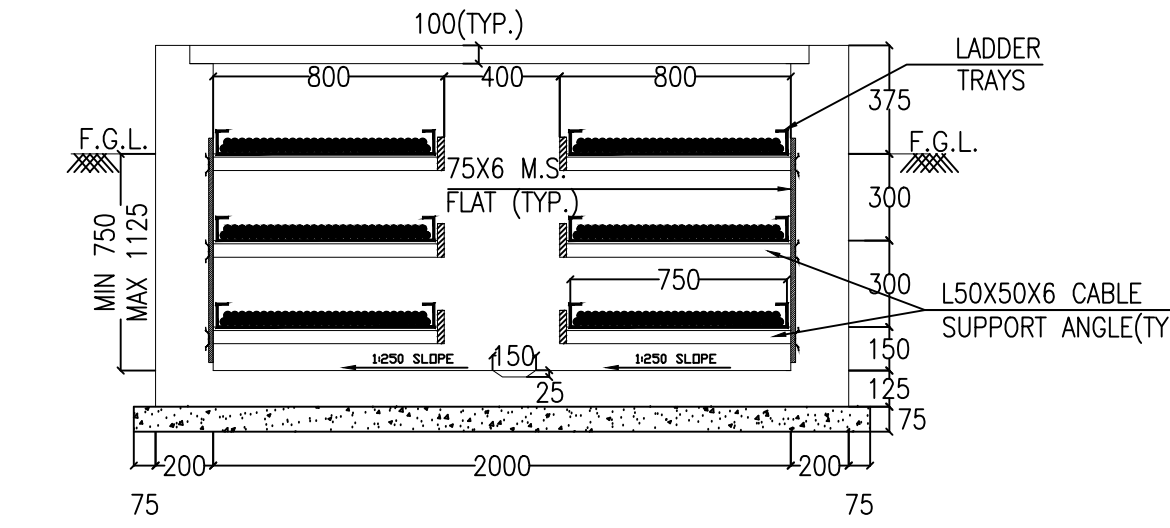
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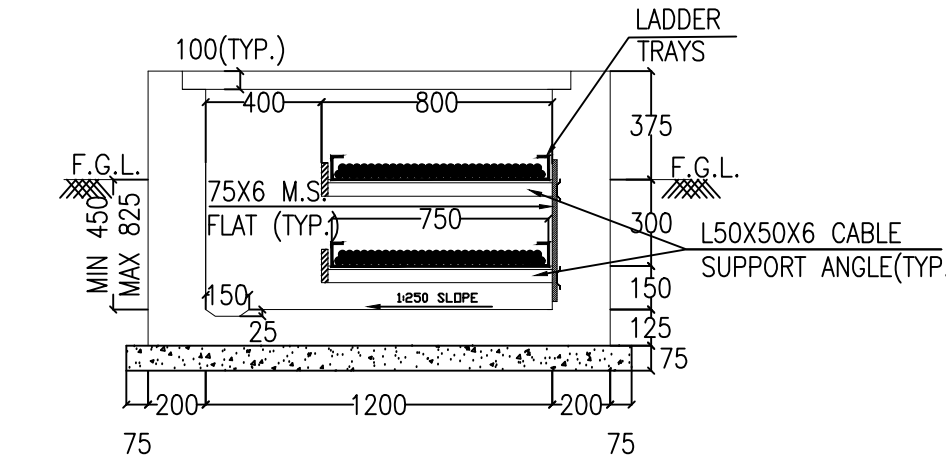
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WT-3

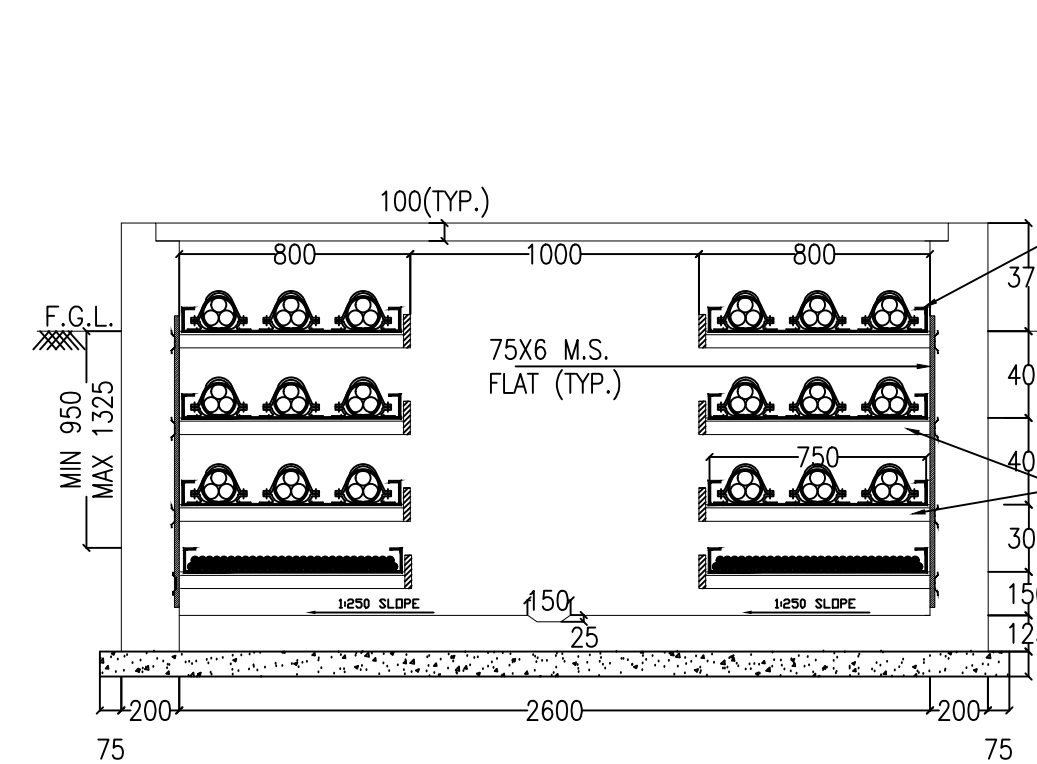
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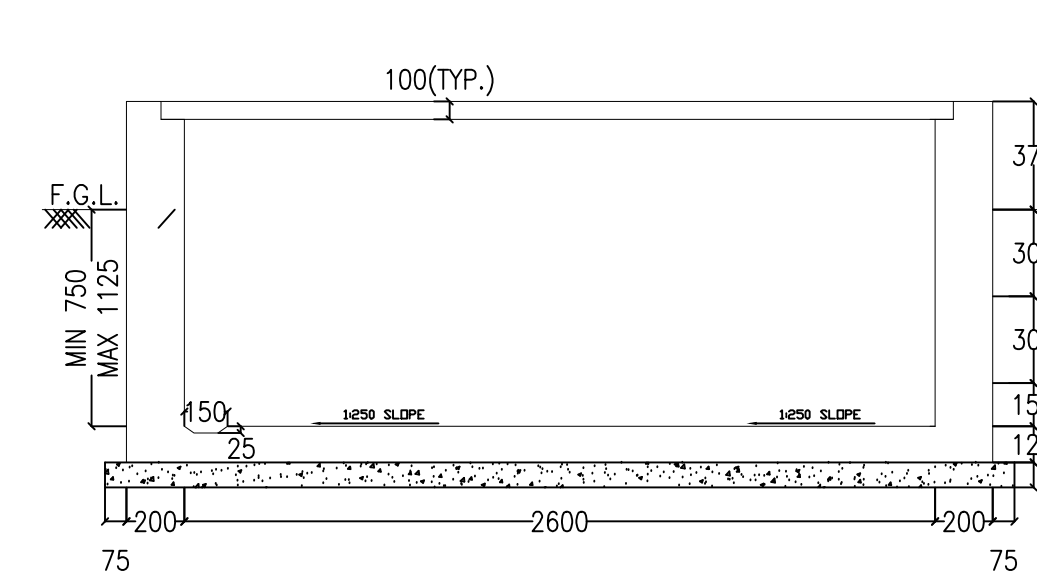
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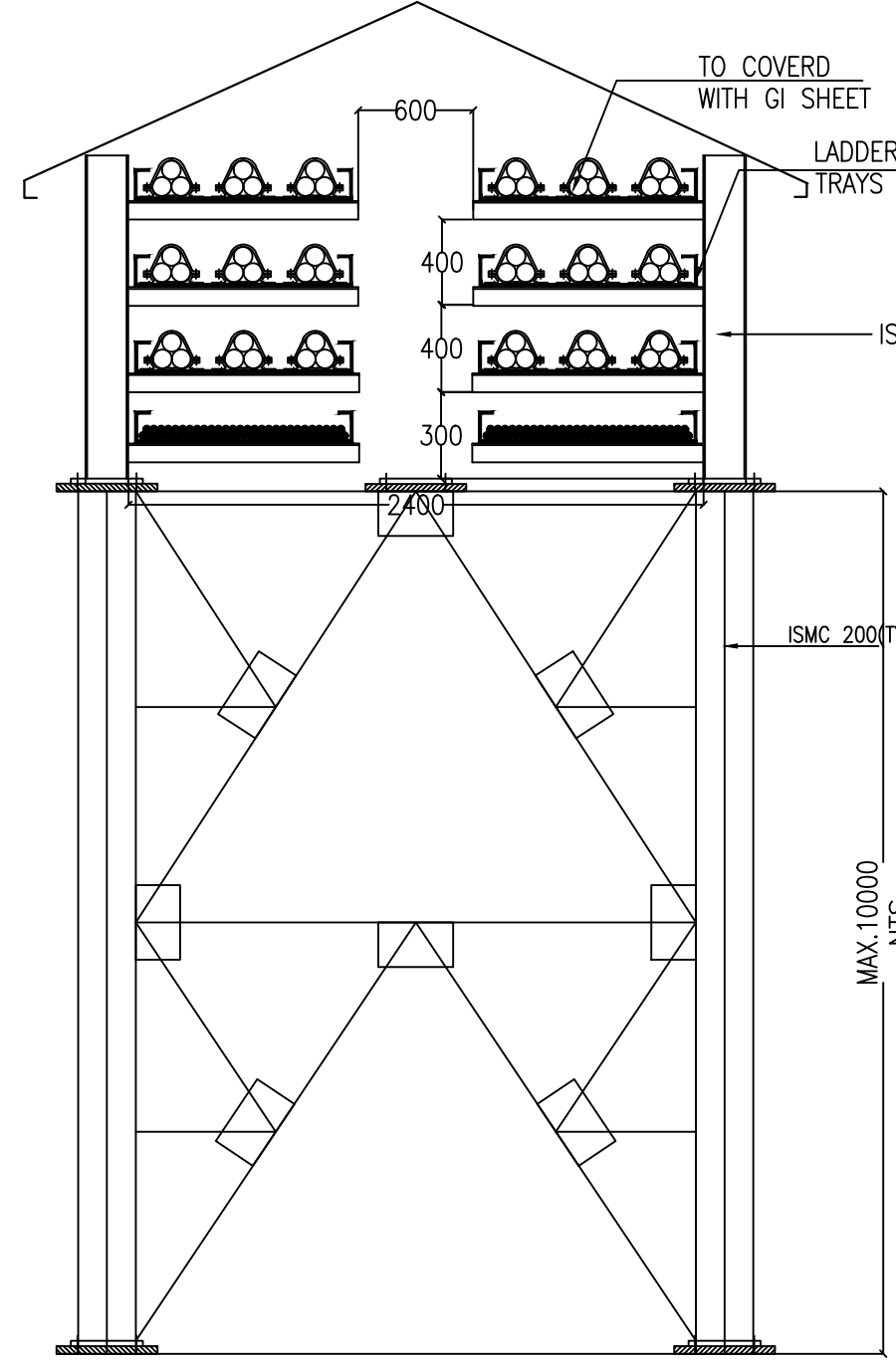
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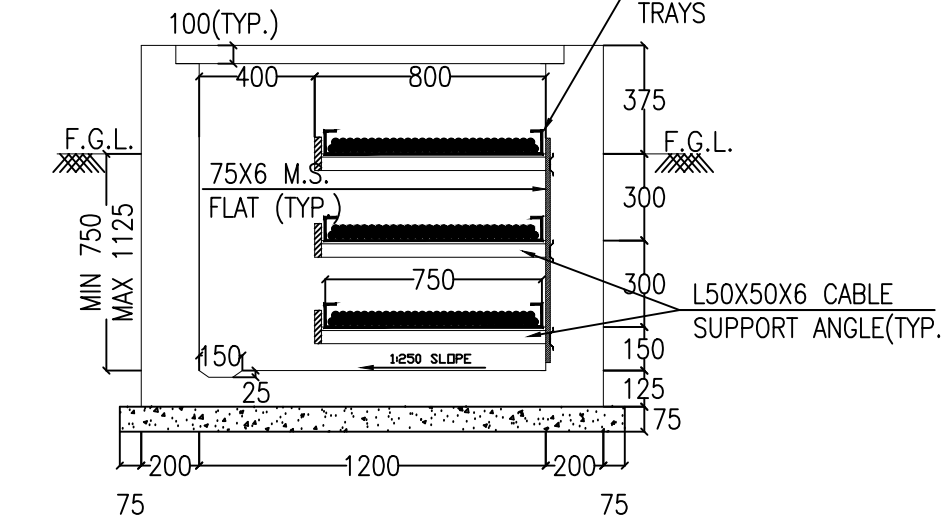
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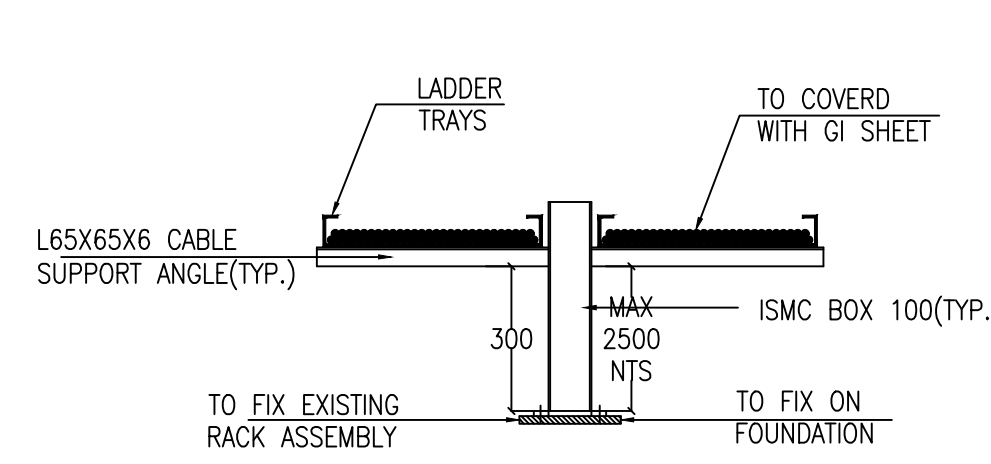
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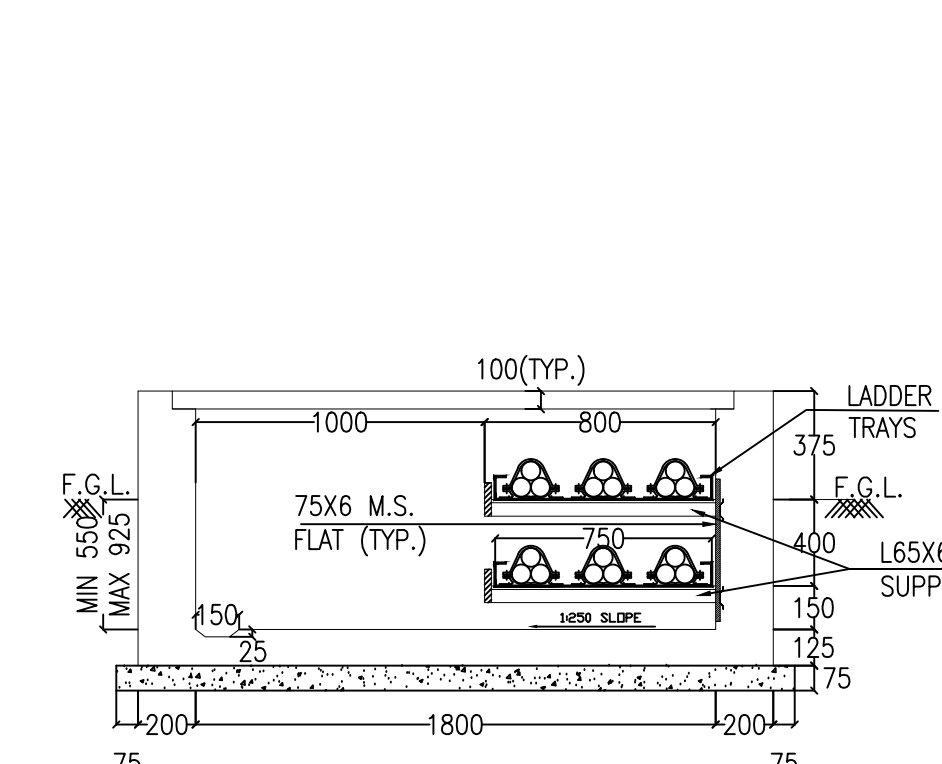
RA-2H WITH TRESSLE
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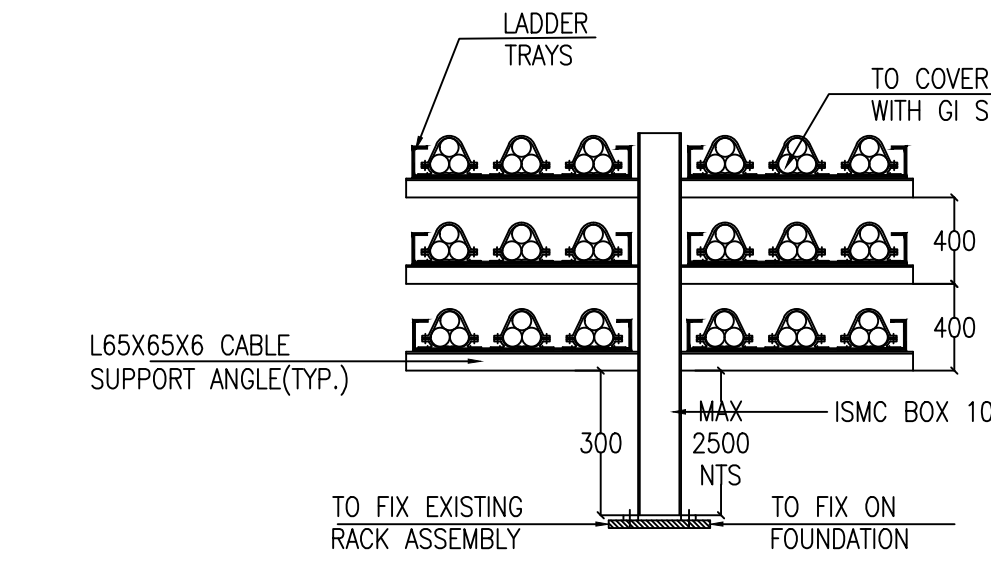
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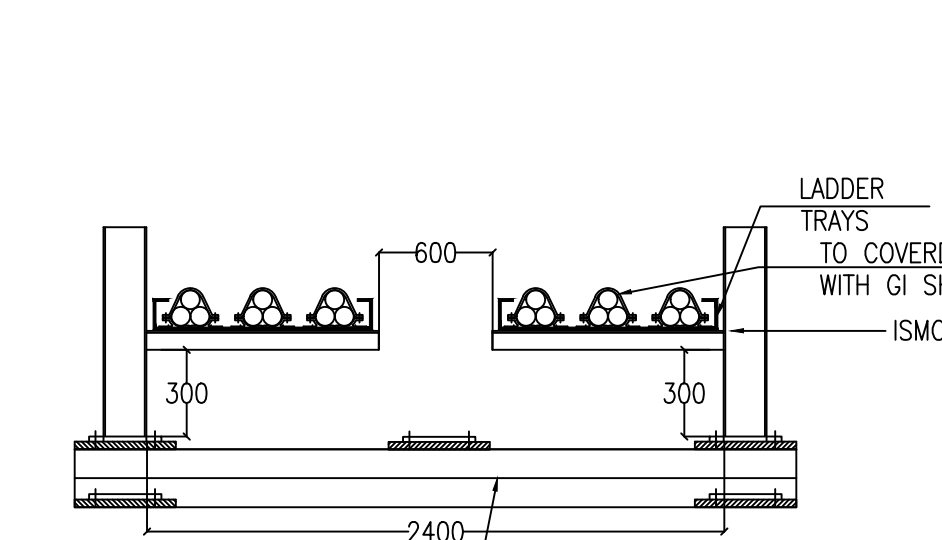
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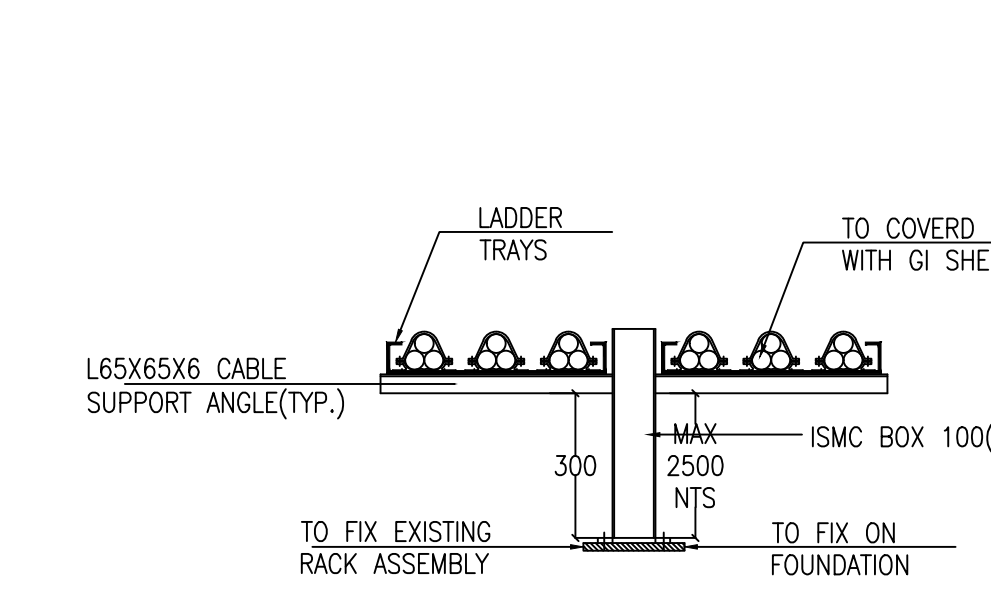
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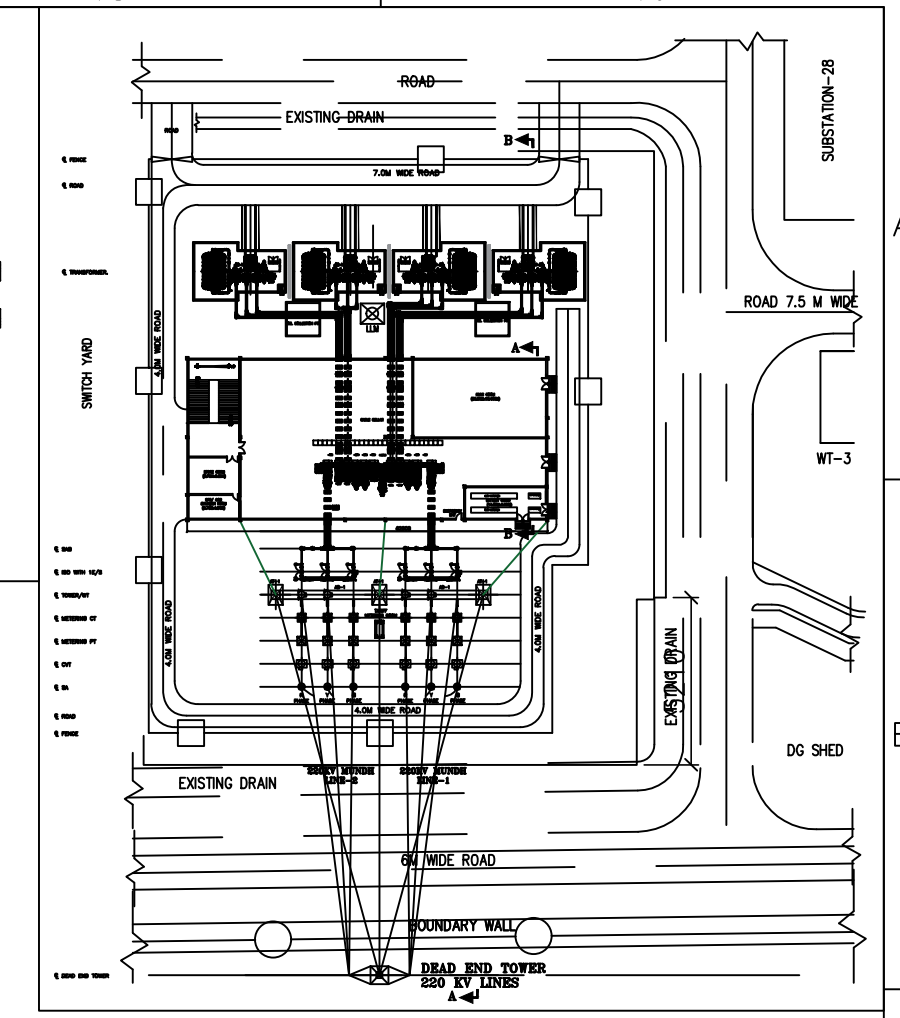
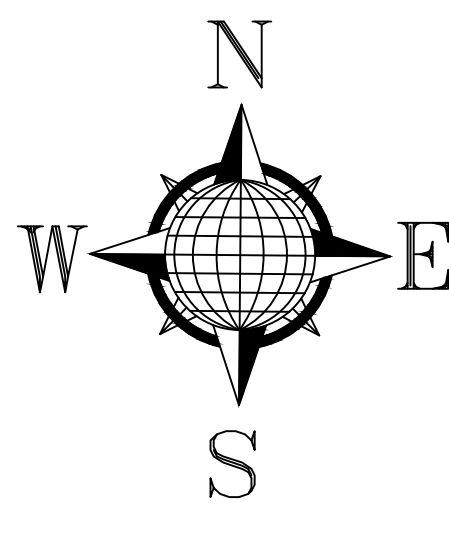
RA-1H
(TYPICAL DETAILS)



RA-2H WITH BRIDGE
(TYPICAL DETAILS)



RA-3H
(TYPICAL DETAILS)



KEY PLAN

- NOTES:-
1. ALL DIMENSIONS ARE IN mm.
 2. THE LOCATION OF TRENCHES/ TRESSLE/ RACK ASSEMBLY MARKED IN THIS DRAWING MAY BE MODIFIED TO SUIT SITE CONDITIONS.
 3. OPENINGS FOR TAKING OUT PIPES TO EQUIPMENT/ PANEL SHALL BE PROVIDED IN CABLE TRENCHES OPENING OF SIZE SUITABLE TO DIA. 50/110 PIPE SHALL BE PROVIDED BELOW TOP CABLE SUPPORT.
 4. INSERTS MUST BE EMBEDDED FOR FIXING CABLE SUPPORT RACK ASSEMBLY.
 5. POWER CABLES SHALL BE LAID IN TOP TIERS AND CONTROL CABLES IN BOTTOM TIERS, AS PER TECHNICAL SPECIFICATION.
 6. EARTH CONDUCTOR 50x3 IS FLAT SHALL BE RUN ALONG THE TOP TIER AND TO BE WELDED ON THE CABLE SUPPORT BEFORE INSTALLATION OF CABLES.
 7. CROSSING AT ROAD SHALL BE IN BOX CULVERT.
 8. FOR POWER & CONTROL, SEPARATE PIPES SHALL BE USED CONSIDERING 60% VOID FOR EACH PIPE I.E. 40% FILLING CRITERIA ACCORDINGLY, ADDITIONAL PIPES (IF REQUIRED) WILL BE PROVIDED AS PER SITE CONDITION.
 9. ALL OTHER DETAILS PERTAINING TO CIVIL WORKS SHALL REFLECT IN RESPECTIVE CIVIL DRAWINGS.
 10. CONTROL CABLES & POWER CABLES MUST BE LAID IN SEPARATE PVC PIPES.
 - TO BE USED AS CIVIL INPUT
 - FOR INSTALLATION OF CABLE RACK ASSEMBLY AT SITE.
 11. FOR CABLE LAYING AND ROUTING AT SITE.
 12. CABLE RACK AND SUPPORTS SHALL BE PAINTED AFTER INSTALLATION WITH 2 COATS OF METAL PRIMER (COMPRISING OF RED OXIDE & ZINC CHROMATE IN A SYNTHETIC MEDIUM) FOLLOWED BY TWO FINISHING COAT OF ALUMINUM PAINT. SUITABLE PULL OUT BOX SHALL BE PROVIDED IF REQUIRED.
 - 13.

LENGTH OF CABLE TRENCH/
CABLE TRESSLE/ RACK ASSEMBLY

S.NO.	SECTION	APPROX. LENGTH (IN METERS)
1.	TR-1	110
2.	TR-2	70
3.	TR-3	30
4.	RA-1	180
5.	TR-1H	100
6.	TR-2H	250
7.	TR-3H	60
8.	RA-1H	40
9.	RA-2H WITH TRESSLE	60
10.	TR-2H WITH BRIDGE	30
11.	TR-3H	4500

REFERENCE DRAWING (S)/ DOCUMENT(S) -

SL. NO.	DRAWING/ DOCUMENT NO.	DRAWING TITLE
2.	TB-411-316-011	220/33kV SWITCHYARD- LAYOUT PLAN & SECTION
1.	TB-411-510-001	220/33kV SWITCHYARD- SINGLE LINE DIAGRAM

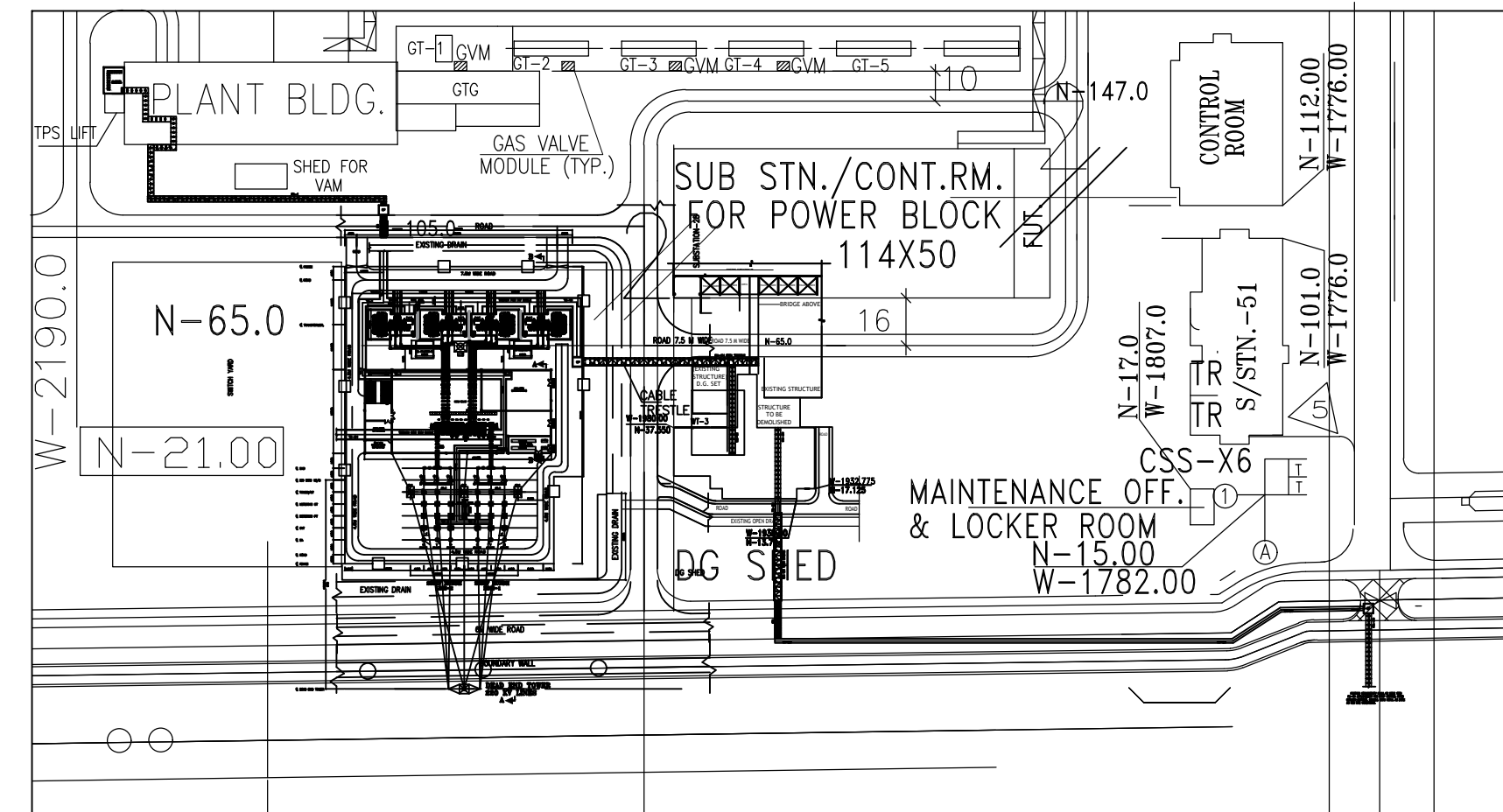
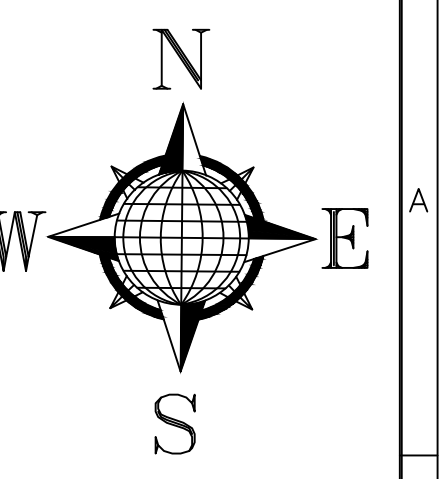
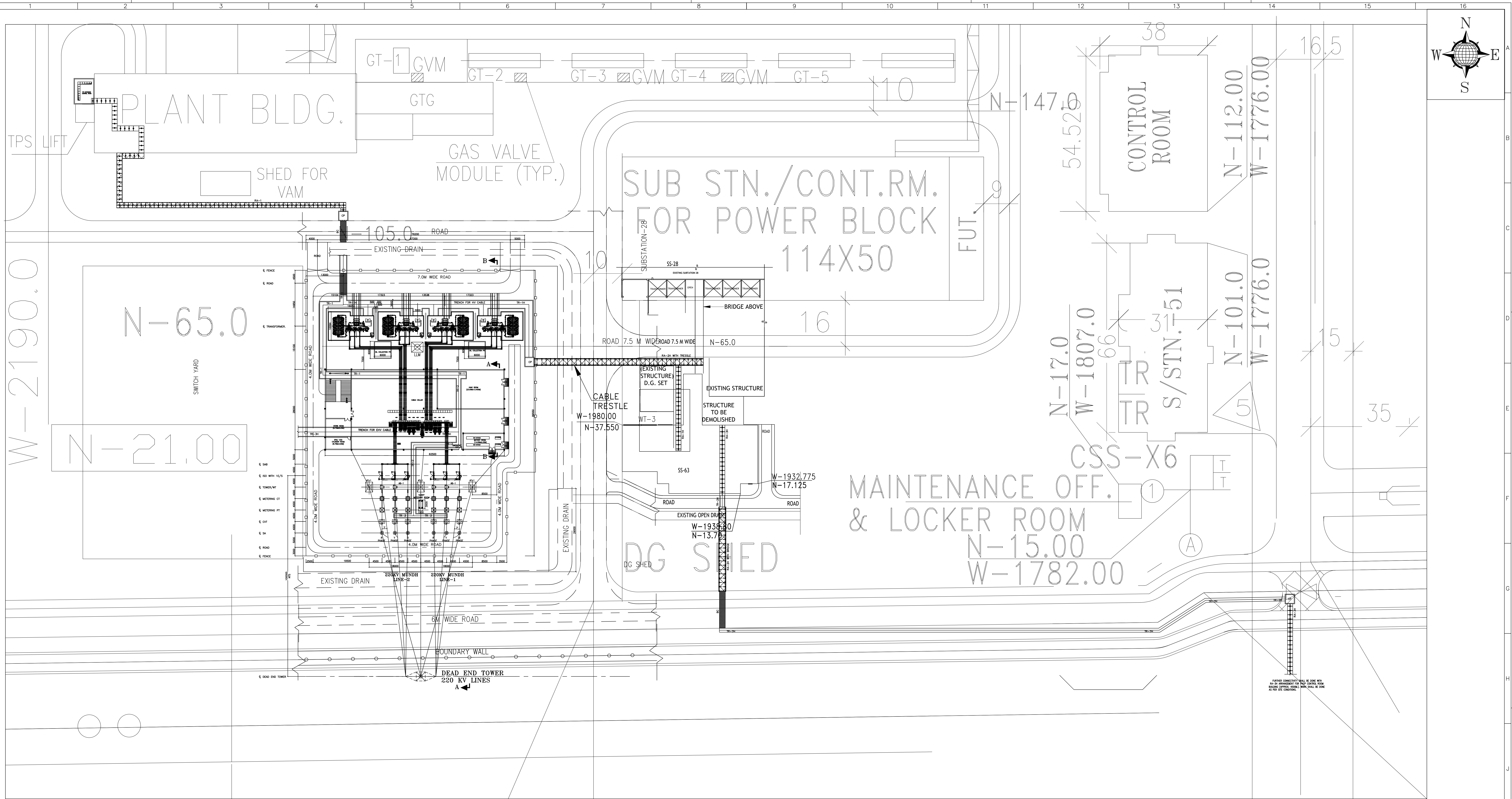
PROJECT: LSTK JOB FOR ISBL WORK OF 220kV GRID POWER IMPORT AT PANIPAT REFINERY
LOA NO. RPRC182491/26286965 DTD.24.01.2020

OWNER 		INDIAN OIL CORPORATION LIMITED	
DESIGNER 		TATA CONSULTING ENGINEERS LIMITED	
DEPT. 180M	UNTL. C/M	DMS. OR	SCALE N.T.S.
CODE 411	DATE 28.04.20	APPROVED CHD	DATE 16.03.2020
PK DKS	DATE 12.04.20	APPROVED CHD	DATE 16.03.2020
PK VK	DATE 30.03.2020	APPROVED CHD	DATE 16.03.2020
TITLE 220/33kV SWITCHYARD- OUTDOOR CABLE TRENCH/ TRESSLE/ RACK ASSEMBLY LAYOUT		DRAWING/ DOCUMENT NO. TB-411-316-018	
		SHT. No 01 NO. OF SHT. 02	




SIZE-A0

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INVENTORY NO.	DATE	REV.	DATE	REF. DRS. NO.	COMPUTER FILE NAME



KEY PLAN

REFERENCE DRAWING (S)/ DOCUMENT(S) -				DRAWING TITLE			
SL. NO.	DRAWING/ DOCUMENT NO.			DRAWING TITLE			
2.	TB-411-316-011			220/33kV SWITCHYARD- LAYOUT PLAN & SECTION			
1.	TB-411-510-001			220/33kV SWITCHYARD- SINGLE LINE DIAGRAM			
PROJECT: LSTK JOB FOR ISBL WORK OF 220kV GRID POWER IMPORT AT PANIPAT REFINERY LOA NO. RPRC182491/26286965 DTD.24.01.2020							
DRAWN BY: 				INDIAN OIL CORPORATION LIMITED			
CONSULTANT: 				TATA CONSULTING ENGINEERS LIMITED			
APPROVED BY: 				भारत हेवी इलेक्ट्रिकल्स लिमिटेड भारतीय भारी विद्युत कालिका लिमिटेड BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION PROJECTS DIVISION			
DEPT. TBM	UNTL. DMS	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO. OF ITEMS	
CODE 411	OR C/M/Y	N.T.S.	N.A.	N.A.	N.A.	N.A.	
TITLE: 220/33kV SWITCHYARD- OUTDOOR CABLE TRENCH/ TRESSLE/ RACK ASSEMBLY LAYOUT				DRAWING/ DOCUMENT NO. TB-411-316-018			
				SHT. No 02		NO. OF SHT. 02	