



**रेल विकास निगम लिमिटेड**  
***Rail Vikas Nigam Limited***

## **Volume-II**

### **Bidding Document**

**for**

**“Civil work of Transformer foundation, Equipment foundation,  
Internal road construction , Boundary Wall , Fire wall, Cabel  
trenching and allied works at BKC RSS (approx 1.35KM)  
in connection with Mumbai Metro Line 2B Project MMRDA”**

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# **Section 1**

## **BILL OF QUANTITY**

<b>BOQ Item NO.</b>	<b>Item Description</b>	<b>Unit</b>	<b>Total Qty</b>	<b>Rate Per Unit(Excl GST)</b>	<b>Total Amount (Excl GST)</b>
1	Excavation in all types of soils (for sewerage works),such as Earth, Marine clay, Marshy land, Running sand, Garbage, Slush, Murum, Rock boulders etc as directed by the engineer. The rate includes dewatering, backfilling, removing the rank vegetation and removing the excavated materials within a lead of 150M as directed including levelling, ramming,etc complete, and measured from the edge of cutting including all lifts and stacking in layers and removing the surplus excavated materials as directed for lift upto 2M{Records to be maintained properly}.The rate also includes supporting public utilities such as cables,drains,pipe water mains, but shall not include the cost of shoring etc as specified and directed. 1) The rate includes the handling/supporting the existing utilities such as cables, drains, pipes, water mains etc. 2) It also includes the royalty and other taxes if any.	Cum	5,958.62		
a	-do-do- as per item R2-SE-1-1 for lift from 2m to 4.0m	Cum	2,283.36		
b	-do-do- as per item R2-SE-1-1 for lift from 4m to 6.0m	Cum	336.53		

2	<p>Add for lead upto 3 km including levelling.</p> <p>Note :</p> <p>1.This lead will be admissible only within MCGM limits. The distance between centerlines shall be taken as the lead which shall be measured by the shortest route on the plan and not the actual route taken by the Contractor. Here Centerlines represents the center point (for area/mass excavation) and the center chainage for linear excavation.</p> <p>2. The Engineer In Charge shall exclusively include these directions in the Tender/Bid document and the Tenders/Bidders shall be insisted to make the declaration of the dumping plot at the time of submission of Bid.</p> <p>3. The Engineer In Charge shall take the quantity in account for the disposal only upto Municipal Limits for the Shortest Route and payment will be made as per the actual distance within municipal limit. The payment will be restricted to the shortest distance upto the Municipal limit for the plot identified outside the Municipal limit.</p> <p>4. Prior Specific sanction of Head of Dept. should be taken if transportation is to be done at night for above items, (i.e. between 8.00 pm. to 6 am.) and the rate shall be reduced by 10%. This item will be operated/executed with the</p>	Cum	7,509.26		
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3	<p>Add for each additional lead of 1km beyond initial lead of 3km including levelling.</p> <p>Note :</p> <p>.This lead will be admissible only within MCGM limits. The distance between centerlines shall be taken as the lead which shall be measured by the shortest route on the plan and not the actual route taken by the Contractor. Here Centerlines represents the center point (for area/mass excavation) and the center chainage for linear excavation.</p> <p>2. The Engineer In Charge shall exclusively include these directions in the Tender/Bid document and the Tenders/Bidders shall be insisted to make the declaration of the dumping plot at the time of submission of Bid.</p> <p>3. The Engineer In Charge shall take the quantity in account for the disposal only upto Municipal Limits for the Shortest Route and payment will be made as per the actual distance within municipal limit. The payment will be restricted to the shortest distance upto the Municipal limit for the plot identified outside the Municipal limit.</p> <p>4. Prior Specific sanction of Head of Dept. should be taken if transportation is to be done at night for above items, (i.e. between 8.00 pm. to 6 am.) and the</p>	Cum	-		
a	Upto 27km	Cum	2,02,750.11		
4	Removing body water from water mains etc. by means of pumps and discharging the same in nearest drain lines etc. complete as directed & as specified by Engineer In Charge.(Each shift shall been of 8 hours prorata payment will be made for part-shift. Minimum payment shall be made for one shift.)		-		
a	30 HP	Shift	395.00		
b	10Hp	Shift	400.00		
c	05Hp	Shift	810.00		
5	Providing and laying in position M-10 plain cement concrete to fill up loose pockets of foundations bed for making required levels, curing, annular fillingaround abutments, piers, columns for foundation.	Cum	252.90		

6	Providing & placing in position controlled Ready Mix Concrete of grade M- 40 in walls and deck slab above or below ground level at any height / depth by using Ordinary Portland Cement including Transportation anywhere in Mumbai including curing by any means etc complete as directed by Engineer-in-Charge. (Reinforcement & Formwork shall be paid separately).	Cum	687.66		
7	Providing and fixing in position steel bars reinforcement of various diameters for R.C.C. pile, pile caps, footings,raft,retaining wall,shear wall, lift wall, foundations, slabs, beams, columns, canopies, staircases, newels, chajjas, lintels, pardies, coping, fins, arches, etc. as per detailed designs, drawings and bar bending schedules,including straightening, cutting, bending, hooking the bars, binding with wires or tack welding, supporting as required etc. all complete at all levels.Thermo-Mechanically Treated steel bars. (Fe 500 D)	MT	99.01		
a	Providing Fusion Bonded Epoxy Coating (FBEC) to reinforced bars of 8mm diameter as per IS: 13620-1993 specifications for a thickness of 175micron Permissible variation of 50 micron including testing of coating at plant, including cost for careful handling using PVC coating, binding wires instead of G. I. wires to and from Plant) touching up the material supplied repair work etc complete as per detailed specifications.	MT	64.16		
b	Providing Fusion Bonded Epoxy Coating (FBEC) to reinforced bars of 12mm diameter as per IS: 13620-1993 specifications for a thickness of 175micron Permissible variation of 50 micron including testing of coating at plant, including cost for careful handling using PVC coating, binding wires instead of G. I. wires to and from Plant) touching up the material supplied repair work etc complete as per detailed specifications.	MT	4.16		

c	Providing Fusion Bonded Epoxy Coating (FBEC) to reinforced bars of 16mm diameter as per IS: 13620-1993 specifications for a thickness of 175micron Permissible variation of 50 micron including testing of coating at plant, including cost for careful handling using PVC coating, binding wires instead of G. I. wires to and from Plant) touching up the material supplied repair work etc complete as per detailed specifications.	MT	3.07		
d	Providing Fusion Bonded Epoxy Coating (FBEC) to reinforced bars of 20mm diameter as per IS: 13620-1993 specifications for a thickness of 175micron Permissible variation of 50 micron including testing of coating at plant, including cost for careful handling using PVC coating, binding wires instead of G. I. wires to and from Plant) touching up the material supplied repair work etc complete as per detailed specifications.	MT	2.24		
8	Providing, detailing, fabricating and fixing at desired location using hot rolled sections and MS Plates of grade Fe 250 as per specifications and approved fabrication drawings (which are to be prepared by Contractor and got approved from Engineer), transporting to site and erecting structural steel members for all heights & at all levels including provision of necessary erection bolts, fixing bolts, nuts, washers, cleats, stiffeners, gussets, base plate, and all necessary fixtures and operations like preheating as per specifications, straightening, bending, cutting,drilling, grinding, machining if specified, welding, grinding and removing the welding burr and preparing surface for painting with wire brush cleaning and applying two coats of epoxy red oxide zinc phosphate primer of 30 microns each and two coats of Epoxy Corrosion Resistant Enamel paint of 30 microns after fabrication including touching up with spray painting after erection etc complete as directed by Engineer In Charge. (The qty. for this item shall be measured for gusset plates, baseplates, bolts in M.T.)	MT	51.87		



9	Providing & Laying dry stone Rubble Soling with average 230 mm size hard stone set in regular lines, handpacked and interstices thoroughly filled with small chips including filling in with good quality murum brought from outside, compacting with iron rammers, watering, sand spreading 12mm thk. layer of grit on top etc complete as directed by Engineer In Charge. (Note: The rate includes the royalty and other taxes if any)	Cum	972.23		
10	Filling in plinth, floors, trenches, pits with approved contractor's murum in layers not exceeding 200mm including breaking of clods, watering, consolidating each layer in filled up area by rolling and compacting with roller/ plate compactor as required to achieve not less than 97% modified proctor density conforming to relevant IS etc. complete as directed by Engineer In charge. The rate includes necessary soil testing charges at laboratory & field as per relevant I.S. codes, royalty, octroi and other taxes if any. (Note: Borrow areas selected by CONTRACTOR shall be got approved from Engineer In Charge, before executing the work)	Cum	2,678.35		
11	Providing and fixing superior quality single leaf B.W.P. grade solid core flush door shutters of standard make conforming to IS:2202- 1991 (Part I & II) including one coat of primer, putty and 2 coats of synthetic enamel paint on both faces etc. with 12 mm thk teak wood lipping all around all around etc. complete (Hinges, aldop & standard door hardware to be paid separately)		-		
a	35mm thick shutter	Sq meters	4,554.00		
12	Providing and fixing in position (as per 1868 / 1982) Aluminium sliding window of three tracks with rectangular pipe 95 x 38.10 x 0.90 mm at weight 0.637 kg/Rmt. with window frame bottom track section 92 x 31.75 x 1.30 mm at weight 1.070 kg/Rmt.. Top and side track section 92 x 31.75 x 1.30 mm at weight 0.933 kg/Rmt. The shutter should be of bearing bottom 40 x 18 x 1.25 mm at weight 0.417 kg/Rmt. Inter locking section 40 x 18 x 1.10 mm at weight 0.469 kg/Rmt. and handle and top section 40 x 18 x 1.25 mm at weight 0.417 kg/Rmt. As per detailed drawings and as directed by Engineerincharge with all necessary Aluminium sections fixtures and fastenings such as roller bearing in nylon casting and self locking catch fitted in vertical section of shutter including 5 mm thick plain glass and aluminium mosquito net shutter with stainless steel jail with all required screws and nuts etc, complete. With powder coating without box	Sq meters	10,850.00		

13	Providing and laying 10 to 13mm thk. heavy duty, scratch resistant, high abrasion resistant vitrified tiles (Durastone or equivalent) conforming to I.S.15622 with special hard wearing layer and water absorption less than 0.08% for flooring of an approved, quality, make, pattern and size for flooring including cement mortar bedding of 25 mm thick in 1:4 proportion, cutting, leveling, jointing, filling the joints by neat cement slurry or approved colour grout, curing, finishing etc complete as directed by Engineer In Charge.	Sq meters	3,408.00		
14	Providing and laying polished natural stone strips upto 100mm wide as specified below (Machine cut) 25-30 mm. thick of an approved quality and size for paving /flooring including cement mortar bedding of 25 mm thick in 1:4 proportion, cement float, machine cutting, dressing, leveling, jointing, filling the joints with neat cement slurry or with required pigment, machine polishing at site, curing, finishing, etc complete as directed by Engineer In Charge.		-		
a	18 mm thk. Steel Gray Granite tiles/slab	Running Meters	1,880.00		
15	Providing and applying 6 mm thick internal ceiling plaster in cement mortar 1:3 with neeru finish at all heights and locations in single coat for concrete surfaces including scaffolding, hacking of concrete surface, watering, finishing, curing etc. complete.	Sq meters	1146.00		
16	Providing and applying 12 mm thick internal plaster in cement mortar 1:3 with neeru finish at all heights and locations in one coat for masonry (except stone masonry) and concrete surfaces including racking out joints, hacking of concrete surface, watering, finishing, curing, scaffolding etc. complete.	Sq meters	1,281.00		

17	Providing and applying first coat of approved Waterproof primer, and two coats of waterproof acrylic based textured exterior paint of an approved make and colour as per manufacturers specifications to textured sand faced or other surfaces, upto 10m height from ground level and at all locations as directed including preparing surfaces for painting by any approved means, scaffolding, cleaning and curing etc. complete as directed by Engineer-in-charge.	Sq meters	572.80		
18	Motor	LS	3.00		
19	electrical wire & fitting	LS	3.00		
20	Plumbing Work	LS	3.00		
21	<p>Providing and laying integral cement based treatment for water proofing on horizontal surface at all depth below ground level for under ground structures as directed by Engineer-in-Charge and consisting of : i) Ist layer of 22 mm to 25 mm thick approved and specified rough stone slab over a 25 mm thick base of cement mortar 1:3 (1 cement : 3 coarse sand) mixed with water proofing compound conforming to IS:2645 in the recommended proportion over the leveling course (leveling course to be paid separately). Joints sealed and grouted with cement slurry mixed with water proofing compound.</p> <p>ii) 2nd layer of 25 mm thick cement mortar 1:3 (1 cement: 3 coarse sand) mixed with water proofing compound in recommended proportions. iii) Finishing top with stone aggregate of 10 mm to 12 mm nominal size spreading @ 8 cudm/sqm thoroughly embedded in the 2nd layer. -Using rough kota stone of size 550 mm x 850 mm</p>	Sqmeters	1,716.00		

22	Providing and laying integral cement based treatment for water proofing on the vertical surface by fixing specified stone slab 22 mm to 25 mm thick with cement slurry mixed with water proofing compound conforming to IS:2645 in recommended proportions with a gap of 20 mm (minimum) between stone slabs and the receiving surfaces and filling the gaps with neat cement slurry mixed with water proofing compound and finishing the exterior of stone slab with cement mortar 1:3 (1 cement : 3 coarse sand) 20 mm thick with neat cement punning mixed with water proofing compound in recommended proportion complete at all levels and as directed by Engineer-in-charge :-Using rough Kota stone of size 550 mm x 850 mm	Sq.meters	1,893.00		
23	Providing and Fixing of Foundation Bolts and nuts in RCC column / pedestal / beam at any level including maintaining the accuracy towards line, level & position including making and using the template etc. complete as directed by Engineer In Charge. (Contractor will take due care for its threads and rusting by applying grease and cotton waste.	MT	3.12		
24	Providing, fabricating and fixing 1.0m high Cast Iron hand railing including decorative studs at regular interval, painting with one coat of red oxide zinc chromate primer and two coats of synthetic enamel paint etc complete as directed by Engineer In Charge.	Running Meters	31.60		
25	Providing structural steel work in hollow section of various thickness and sizes in square, rectangular and round shape from 25mm to 450 mm section as per IS 4923 YST 310 Grade produced from iron ore and blast furnace route etc. as per detailed designs and drawing or as directed including cutting, fabricating, hoisting, erecting, fixing in position, making riveted/ bolted/ welded connections and painting complete.	MT	3.72		

26	Providing and laying in position ready mixed plain cement concrete, using fly ash and cement content as per approved design mix from Engineer-in-charge and fly ash conforming to grade I of IS 3812 (Part-1) only be used as part replacement of OPC as per IS 456 and uniform blending with cement is to be ensured in accordance with clauses 5.2 and 5.2.1 of IS: 456- 2000 in the items of ready mixed concrete and manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for plain cement concrete work, including pumping of R.M.C. from transit mixer to site of laying and curing, including the cost of centering, shuttering and finishing, including cost of curing, 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 the Engineer - in - charge. M-15 grade plain cement concrete (cement content considered @ 240 kg/cum).	Cum	64.05		
27	Providing and laying in position ready 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 and the cost of centering, shuttering, finishing and excluding 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. The Mix design as per particular specifications shall be got approved by Engineer-in-Charge before execution of the item. The rate shall include cost of all specified materials and operations at all levels and heights, including the cost of centering, shuttering and and excluding reinforcement which shall be paid under relevant item. (Note :- Cement content considered in this item is @ 300 kg/cum as per IS 456 table showing minimum cement content. No extra will be paid nor any amount will recovered on account of variation of cement in mix design as per specifications for controlled concrete). Foundations, footings, bases of columns, rafts, pilecap	Cum	87.81		
28	Providing weep holes in Brick masonry/Plain/Reinforced concrete abutment, wing wall/return wall with 100 mm dia PVC pipe, extending through the full width of the structure with slope of 1V :20H towards drawing face. Complete as per drawing and Technical specifications	Each	260.00		

29	Providing and applying 25 mm thick external sand faced cement plaster with neat cement rendering upto 10m from ground level and at all locations in cement mortar proportion specified below in two coats for masonry (except stone masonry) and concrete surfaces including providing water proofing compound to the first coat of plaster as per manufacturers specification, racking out joints, hacking of concrete surface, finishing, curing, scaffolding etc complete as directed By Engineer In Charge. Min. time lag between two coats shall be 24 hours.(as per IS 2402 of 1963.)In cement mortar 1:2	Sqmeters	3,075.06		
30	Providing and fixing of cement concrete Kerb Stone of various grades of size:500 mm width x325 height x165 mm thick (Half Batter,BullNose/ Full Batter)manufactured inwet press vacuumdewatering technology plant / equivalantwith facepimple finish for high visibility with excellent quality and finishand edges perfect and sharp.Grade–M-25. Including excavationinanysoilexcept rock, layingalevelingcourseofM15grade RMC100mm. thick, torequireslope(inclusiveof formwork) jointing in C.M.1:2proportion flush toconcretesurface, paintingexposedsurface withonecoatofprimerandtwocoatsof1stgraderoadmarkingpaint in theyellow/white/black or any shadeas directed. (Kerbstones shall be procured from MCGM registered agencies). Rmt 1219.00	MTR	1994.53		
31	Providing applying Yellow & Black road marking paint grade–I in3-coats including single coat of approved brand primer after cleaning of old surfaceof kerbstonewithbrushingbywirebrushasper relevant I.S. codes to satisfaction of Engineer in charge --- etc. complete	Running Meters	140.00		
32	Providing and laying of Filter media with granular materials/stone crushed aggregates satisfying the requirements laid down in clause 2504 of MoRTH specifications to a thickness of not less than 600 mm with smaller size towards the soil and bigger size towards the wall and provided over the entire surface behind abutment, wing wall and return wall to the full height compacted to a firm condition complete as per drawing and technical specification.	Cum	390.60		

33	<p>Supplying, fabricating, transportation to site and Fixing Galvanized Chain Link Fencing of 10 gauge G.I. Mesh, sizes 50 x 50 mm diamond pattern, fixed 75 mm below finished ground level / coping, including providing and erecting ISA 50x50x6 angle posts @ 2.5m C/C with cross support at every 8th pole &amp; at corners and 2 nos 6mm dia MS bars at top and bottom with necessary U hooks, nuts and bolts, washers, total height of fencing @ 2.0m above ground including embedding the angle post in concrete block of 0.45m x 0.45m x 0.6m of cement concrete M15 grade including necessary excavation, and cleaning, preparing the surface, applying one coat of red oxide zinc chromate primer and two coats of Synthetic Enamel paint of approved manufacture, brand, colour, shade etc. complete as directed by Engineer In Charge. (first coat of synthetic enamel paint after fabrication and second coat after erection including touching up the primer coat)</p>	Sq meters	106.00		
34	<p>Providing, detailing, and fabricating as per specifications, transporting to site and erecting Openable Entrance Gates fabricated using B Class GI Hollow pipes including track and wheel, locking arrangement, fixing bolts, nuts, washers, cleats, stiffeners, gussets and all necessary operations like straightening, bending, cutting, drilling, grinding, machining if specified, welding etc. complete weighing 18 to 20kg/Sqm, including cleaning, Grinding and removing the welding burr and preparing surface and applying one coat of red oxide zinc chromate primer and one coat of Synthetic Enamel paint after fabrication and second coat of Synthetic Enamel paint after erection, with approved colour, shade and brand etc. including touching up with primer etc. complete as directed by Engineer In Charge.</p>	Sq meters	10.80		

35	Drilling with core cutting machine in RCC slabs, walls etc.wherever required in buildings, manholes,ducts, water tanks, pits etc. for laying pipes,sleeves and making good the same to give an even finish . The rate shall include the cost of drilling core, providing EPOXY based water proofing compound for sealing the joints around the pipes, nominal reinforcement wherever required,scaffolding and labour charges for working at all levels ,leads and heights . (Maximum thickness of RCC members shall be 300mm) and as directed by Engineer-In-Charge.		-		
a	g) Above 200 mm to 250mm dia	Each	90.00		
36	Providing and lowering in trenches HDPE Pipe Conforming to ISO 4427 of 1996, manufactured from virgin resin of PE-80 food grade compounded raw material having blue colour only with quality assurance certificate from quality agencies likeCIPET(India) / DVGM / KIWA / SPGN / WRC etc. for usage in drinking water system. The cost shall include testing of all materials, labour, excluding all taxes (Central, State and Municipal), inspection charges, transportation up to site, transitinsurance, loading, unloading, stacking, providing and fixing etc complete in all respect and as directed by Engineer In-Charge.Note : :Only MCGM approved brands shall be used. Note : (2) Rebate for salvation cost of old pipe has been considered and old pipes may be removed by the contractors as directed.		-		
a	110 mm	RUNNING METERS	79.00		
37	Providing Laying and lowering in trenches HDPE Pipe confirming to IS 4984, manufactured from virgin resin of PE- 100 food grade raw material having black colour with blue strips only with quality assurance certificate from quality agencies like CIPET(India) / DVGM / KIWA / SPGN / WRC etc. for usage in drinking , labour, excluding all taxes (Central, State and Municipal), inspection charges, transportation up to site, transit insurance, loading, unloading, stacking, etc. complete as specified &directed. Note : :Only MCGM approved brands shall be used.		-		
a	250 mm dia	RUNNING METERS	687.00		



38	Supplying HDPE Pipe Conforming to ISO 4427 of 1996, manufactured from virgin resin of PE-80 food grade compounded raw material having blue colour only with quality assurance certificate from quality agencies like CIPET(India) / DVGM / KIWA / SPGN / WRC etc. for usage in drinking water system. The cost shall include testing of all materials, labour, excluding all taxes (Central, State and Municipal), inspection charges, transportation to the directed municipal establishment, transit insurance, loading, unloading, stacking etc complete in all respect and as directed by Engineer In-Charge. Note :Only MCGM approved brands shall be used.		-		
a	110 mm dia	RUNNING METERS	422.00		
39	Supply & filling sand metal, GRAVELLY SAND, corresponded to CLASS II/ CLASS III GRADING of TABLE 100.1 of BMC road specifications for roadworks in trenches upto required depth & watering, ramming etc. complete as directed	Cum	189.74		
40	Supplying and fixing Drain cover		-		
a	1800*450 -176 rmt	Nos	393.00		
b	1200*600 - 39 rmt	Nos	88.00		
41	Providing and Casting RCC bored cast in-situ Vertical as per IS 2911 (Part 1, Section 2) by boring through all kinds of soils/ Sand /Rock by rotary hydraulic rigs using temporary casing up to stable strata / bentonite mud circulation as specified, from tip to cut-off elevation of piles. Reinforced Cement Concrete work of filling the bore (after placement of reinforcement cage as per drawing) with M25 grade Ready Mix Concrete using 43 Grade Ordinary Portland Cement confirming to IS : 8112, of approved make and brand with minimum cement content of 400 kg/m3 and with water -cement ratio, including the water contained in aggregates (10mm to max 20mm size), not exceeding 0.45, with approved plasticizer as specified, including placing of concrete from tip to minimum of 600mm above the specified cut-off level, breaking pile head to cutoff level and exposing pile reinforcement for embedment in pile cap, Disposing & levelling of bored/excavated material suitably at locations approved by the local authorities including all lead and lifts, all complete for piles having diameter of (Pile will be measured for payment for length between pile tip to cut-off level along the pile axis.Reinforcement shall be paid separately)		-		
a	600 mm	Running Meters	208.00		

b	Extra over rate for items CS-PLG-1 & 2 for using M40 instead of M 25	Running Meters	208.00		
42	Excavation for trenches and trenches under Road crossing and laying of HDPE Pipes , Shoring and shuttring and hard barrication fixing (if required) as per approved drawings with proper, de-watering arrangement & sufficient clearances from all sites . Excavation in all types of soil - hard murrum, earth rock, debris, backfilled earth, where underground service lines are likely to be present, demolishing PCC/brick work/rubble masionary encountererd while making the trenches, disposal of excavated earth within 24 hours. Laying of PCC bed and HDPE pipes & erecting side tiles approved trench drawing. Backfilling with (sand metal mix) ,Warning tape, Top will be Reinstated with Soling & Compaction , Asphalt,& PCC M 20 or Satutory requirement on Top Crossing drawing complete. (For Double Circuit) Trench Cross sectionDrawings shall be prepared by Bidder as per Specifications and approved by Owner. (Read Explanatory Notes for Work Scope)	meter	1300		
43	Services for un-coiling & laying 110 kV, 630 Sq.mm XLPE insulated cable and 4 core Fo cable for Distributed Temperature Sensing system as per approved drawing, & specification in open trench & through HDPE pipe laid along the route,including Loading from store,transportation,unloading at site , returning cable drum to tata power warehouse/ RVNL store ,Running Meter its from concernauthority ,trefoil for Running Meteration ,phase marking complete with Closing of Cutouts with Fire Sealing materials and providing Fire retardant paint over the 110KV Cables .(Note:-110 KV cable will be supplied by RVNL,4 Core FOCabel Will be supplied by RVNL )(Read Explanatory Notes for Work Scope)	km	10.04		
44	Supply of HDPE pipes for EHV cable (OD 200 mm & 5 mtr length) (Read Explanatory Notes for Work Scope)	No's	700		
45	Services for construction of cable jointing chamber (RCC types) along with Below ground Earth mat with copper flat/ copper bare conductor (along with supply of material as per specification) for Joint bay of suitable dimensions as mutually agreed for 1 circuits i.e., 3 no of cable with link boxes, earthing as per approved drawing of TATA Powerand MMRDA specifications. Including supply & filling submerged (Including supply and filling of Sand) [10.0 mtr] (Read Explanatory Notes for Work Scope)	No's	4		

46	Services for de-watering & channelizing the leakage suitably (Bailing out of water using engine & pump of capacity minimum 4000 litres per hour set including conveyance to the site & erection, cost of fuel, lubricating oil & other stores, pay staff etc., or manual de-watering) complete (If Required) (Read Explanatory Notes for Work Scope)	per day (8 hrs)	100		
47	Supply of Three Phase link box with SVL for cross bonding (Read Explanatory Notes for Work Scope)	No's	6		
48	Supply of Coaxial Cable along with Lugs and Connectors (Read Explanatory Notes for Work Scope)	Meter	300		
49	Supply of Single Phase link box with SVL and with out SVL for sheath bonding. (Read Explanatory Notes for Work Scope)	No's	38		
50	Services for OFC splicing & termination (Read Explanatory Notes for Work Scope)	No's	6		
51	Construction of FO cable hand hole (Read Explanatory Notes for Work Scope)	Each	2		
52	Supply of 110 KV 630 Sqmm Cable Cleats (Read Explanatory Notes for Work Scope)	No's	150		
53	Supply of Galvanised Steel structure for cable cleating arrangement (Read Explanatory Notes for Work Scope)	MT	5		
54	Supply of Fiber termination panels (Read Explanatory Notes for Work Scope)	No's	1		
55	Supply of FOP joint boxes (Read Explanatory Notes for Work Scope)	Nos	4		
56	Supply of cable tiles (Read Explanatory Notes for Work Scope)	Nos	7000		
57	Supply of FO termination kit (Read Explanatory Notes for Work Scope)	No's	8		
58	Transportation of cable and other required items (Read Explanatory Notes for Work Scope)	lumpsum	1		
59	Services for installation of straight joint/cross bonding joint of 110 kV UG cable. (Read Explanatory Notes for Work Scope)	No's	12		
60	Services for installation of GIS/Outdoor termination of 110 kV UG cable (Read Explanatory Notes for Work Scope)	No's	22		
61	Services for 40 mm dia duct for 48F optical fibre cable complete (Read Explanatory Notes for Work Scope)	Meter	5200		
62	Services for termination rack for 48F optic fibre cable complete (Read Explanatory Notes for Work Scope)	No's	1		
63	Services for FO Termination box (Read Explanatory Notes for Work Scope)	Set	8		

64	Services for Joint box for FO cable(Read Explanatory Notes for Work Scope)	Set	4		
65	C C Road Cutting with Diamond cutter over & above excavation(Read Explanatory Notes for Work Scope)	Meter (Considering 2 sides of cutting portion as 1 mtr )	800		
66	Installation of 1-phase and 3- Phase Link Boxes in Termination including sheath earthing(Read Explanatory Notes for Work Scope)	No's	44		
67	Installation of Fabrication of Structural Steel for cable cleating arrangement(Read Explanatory Notes for Work Scope)	Metric Tonne	5		
68	Testing & Commissioning for 2nos circuits of 110 Kv 630 Sqmm. (Read Explanatory Notes for Work Scope)	Lumpsum	1		
69	Services for un-coiling & laying optical fibre cable 4 Runs of 48 Core Fibre of specified type along the cable trench through HDPE pipe as per approved drawing & specification including Loading from store ,transportation,unloading at site , returning cable drum to tata power warehouse ,permits from concern authority , labour charge complete, Tests as per Tata Power/KEC requirement. (Read Explanatory Notes for Work Scope)	KM ( Consider 2 Runs /ckt as 1 KM )	2.68		
70	Services for laying of tiles 660x500x60 mm complete (including shifting, transportation and laying in trench). (Read Explanatory Notes for Work Scope)	No's	7000		
71	Supply of HDPE pipes for HDD (OD 250 mm) (Read Explanatory Notes for Work Scope)	Meter	200		
72	Detailed surveying of the Cable route along the alignment fixed by the owner & preparation of profile drawing for cable laying and preparation of final cable route in 6 sets of hard & soft copy in a scale of 1:10 indicating the position of cable jointing chambers, earthing details, position of cable route marker, land marks etc., after completing the work & energizing for the use of permanent record, GPS mapping of utilities to be indicated in the drawing complete. (Based on preliminary route survey, total route length 1500 m) (Read Explanatory Notes for Work Scope)	RM	1300		
73	Supply of HDPE pipes for FO cable (dia 40 mm) (Read Explanatory Notes for Work Scope)	Meter	5200		

74	Supply and installation of the ,Lighting fixtures, Distribution boards at BKC RSS building. (Read Explanatory Notes for Work Scope)	LS	1		
	Total Amount in Rs. (EXCL GST)				
	GST@18%				
	Total Amount in Rs. (Incl GST)				
In Words:					

## Explanatory Notes

sr.no	Item Description	Explanatory Notes
1	<p>Excavation for trenches and trenches under Road crossing and laying of HDPE Pipes , Shoring and shuttring and hard barrication fixing (if required) as per approved drawings with proper, de-watering arrangement &amp; sufficient clearances from all sites .</p> <p>Excavation in all types of soil - hard murrum, earth rock, debris, backfilled earth, where underground service lines are likely to be present, demolising PCC/brick work/rubble masionary encountererd while making the trenches, disposal of excavated earth within 24 hours.</p> <p>Laying of PCC bed and HDPE pipes &amp; erecting side tiles approved trench drawing. Backfilling with (sand metal mix) ,Warning tape, Top will be Reinstated with Soling &amp; Compaction , Asphalt,&amp; PCC M 20 or Satutory requirement on Top Crossing drawing complete. (For Double Circuit) Trench Cross sectionDrawings shall be prepared by Bidder as per Specifications and approved by Owner.</p>	<p>The work includes arranging of machinery, Excavated soil shifting, laying of PCC M-20, Shoring And Shuttering ,watch and ward until trench reinstatement, Providing of hard barrication along the Trenches , Providing of FTB and STB as required over the cables, laying and Connecting HDPE Pipes ,obtaining Permision from Civic authorities, road diversion , reinstatement of the area that is demolished for Cable laying etc. in all aspects to excavate the trench.</p>

2	<p>Services for un-coiling &amp; laying 110 kV, 630 Sq.mm XLPE insulated cable and 4 core Fo cable for Distributed Temperature Sensing system as per approved drawing, &amp; specification in open trench &amp; through HDPE pipe laid along the route, including Loading from store, transportation, unloading at site, returning cable drum to tata power warehouse/ RVNL store, Running Meter its from concern authority, trefoil for Running Meteration, phase marking complete with Closing of Cutouts with Fire Sealing materials and providing Fire retardant paint over the 110KV Cables. (Note:-110 KV cable will be supplied by RVNL)</p>	<p>The Work includes for arranging for Cable drums shifting from Store to the Work location i.e Loading from store, transportation, unloading at site.</p> <p>The arrangement of Jack, spindle, rollers, making trefoil, phase marking complete, returning cable drum to RVNL store/sites and any damages to the cable while laying will be repaired on their own cost and expenditure.</p> <p>All statutory Cable tests before and after cable laying.</p> <p>The work and cost includes Supply and provision of Fire retardant Paint of 3mm thick having 3 hrs Fire Resistant over the all 110 KV cables inside the Cable cellar.</p> <p>The work and cost includes Supply and provision of Fire proof mortar and Fire sealant for Closing of all 110KV Cable duct inside the GIS floor.</p>
3	<p>Supply of HDPE pipes for EHV cable (OD 200 mm &amp; 5 mtr length)</p>	<p>It includes cost/expenditure for supply of HDPE pipes for EHV cable (OD 200 mm &amp; 5 mtr length) as per the Approved GAD, GTP from TATA power, MMRDA</p>
4	<p>Services for construction of cable jointing chamber (RCC types) along with Below ground Earth mat with copper flat/ copper bare conductor (along with supply of material as per specification) for Joint bay of suitable dimensions as mutually agreed for 1 circuits i.e., 3 no of cable with link boxes, earthing as per approved drawing of TATA Power and MMRDA specifications. Including supply &amp; filling submerged (Including supply and filling of Sand) [10.0 mtr]</p>	<p>The work and cost includes excavation, Material shifting, Reinforcement erection as per the approved drawing. (attached in Drawing Section). Concreting the Jointing chamber with M-25 Grade. Provision of STB over the Cables,</p> <p>Supply and laying of the Copper bare conductor of 195sqmm /16mm dia Copper rod /40X6 mm Copper flat Earth mat as per the approved drawing.</p> <p>Provision of Pit cover over the Link box also.</p>
5	<p>Services for de-watering &amp; channelizing the leakage suitably (Bailing out of water using engine &amp; pump of capacity minimum 4000 litres per hour set including conveyance to the site &amp; erection, cost of fuel, lubricating oil &amp; other stores, pay staff etc., or manual de-watering) complete (If</p>	<p>The work and cost includes Provision of 30HP, 10 HP motors for continuous removal of water from The trenches. conveyance to the site, cost of fuel, lubricating oil &amp; other stores, pay staff, Watch and ward. Register to be maintained at site duly Certified by the Site Incharge.</p>

	Required)	
6	Supply of Three Phase link box with SVL for cross bonding	It includes cost/expenditure for supply of Three Phase link boxes of Rating 3.3KV or 6.6 KV as per the Approved GAD,GTP from TATA power, MMRDA. (Drawing is attached in Drawing Section.)
7	Supply of Coaxial Cable along with Lugs and Connectors	It includes cost/expenditure for supply of Coaxial Cable along with Lugs and Connectors 6.6 KV 300 Sqmm 1Core Cable as per the Approved GAD,GTP from TATA power, MMRDA.(Drawing is attached in Drawing Section.)
8	Supply of Single Phase link box with SVL and with out SVL for sheath bonding.	It includes cost/expenditure for supply of Three Phase link boxes of Rating 3.3KV ,6.6 KV,1,1 KV as per the Approved GAD,GTP from TATA power, MMRDA. (Drawing is attached in Drawing Section.)
9	Services for OFC splicing & termination	It includes cost/expenditure for works involving in OFC splicing & termination as per TATA Power specification.
10	Construction of FO cable hand hole	It includes cost/expenditure for construction of FO hand hole as per the approved drawing.
11	Supply of 110 KV 630 Sqmm Cable Cleats	It includes cost/expenditure for supply of Cable Cleats for the size of 110 KV 630 Sqmm Cable of 103MM dia Cable .The Size of Cable cleat is 110MM dia of HDPE material. as per the Approved GAD,GTP from TATA power, MMRDA .(Drawing is attached in Drawing Section.)
12	Supply of Galvanized Steel structure for cable cleating arrangement	It includes cost/expenditure for supply of Galvanised Steel structure of GSM 610mm or Micron 80 for cable cleating arrangement at GIS, Tower end and as required at site and as per the Approved GAD,GTP from TATA power, MMRDA, drawing.
13	Supply of Fiber termination panels	It includes cost/expenditure for supply of Fiber Termination panels as per the Approved GAD,GTP from



		TATA power, MMRDA. (Drawing is attached in Drawing Section.)
14	Supply of FOP joint boxes	It includes cost/expenditure for supply of Fiber Optic Joint Boxes as per the Approved GAD,GTP from TATA power, MMRDA. (Drawing is attached in Drawing Section.)
15	Supply of cable tiles	It includes cost/expenditure for supply of Cabel Tiles of 600X500X50MM Size as per the Approved GAD,GTP from TATA power, MMRDA. (Drawing is attached in Drawing Section.)
16	Supply of FO termination kit	It includes cost/expenditure for supply of FO Termination kit as per the Approved GAD,GTP from TATA power, MMRDA . (Drawing is attached in Drawing Section.)
17	Transportation of cable and other required items	It includes cost/expenditure for Transportation of cable drums , and other cable accessories from store, providing watch and ward round the clock and handing over the same to the store.
18	Services for installation of straight joint/cross bonding joint of 110 kV UG cable.(Material will be supplied by RVNL)	The work and Cost Includes Arrangement of Jointers from the Raychem as the Joints are being supplied by the OEM M/s. Raychem. Provisoin of necessary arrangements i.e Power supply, Supporting manpower, AC and Tents and Water pumps for continues removal of Water from Cabel trench. All Joints will be done as per the OEM standards and in the Presence of TATA Power.
19	Services for installation of GIS/Outdoor termination of 110 kV UG cable (Material Will be Supplied by RVNL)	The work and Cost Includes Arrangement of Jointers from the Raychem the Joints are being supplied. Provision of necessary arrangements i.e Power supply, Supporting manpower, AC and Tents ,Scaffolding material and Water pumps for continues removal of Water from Cabel trench. All Joints will be done as per the OEM standards here M/s. RAYCHEM and in the Presence of TATA Power and MMRDA .(GIS and Outdoor Terminations are Supplied by RVNL)

20	Services for 40 mm dia duct for 48F optical fibre cable complete	The Work and Cost includes Transportation, Laying, jointing of 40mm dia duct for Provision of laying of 48 core Fo cable.
21	Services for termination rack for 48F optic fibre cable complete	It includes cost/expenditure for Transportation , installation of Fibre Termination rack for 48F optic fibre cable , Earthing of the Panel.
22	Services for FO Termination box	It includes cost/expenditure for Transportation , installation of FO Termination box inside the Termination Panel. Providing of All pig tails, Joints in the FO Termination Box and LIU for facilitating Communication between MMRDA BKC RSS end and at TATA Power BKC RSS end.in the Presence of TATA Power, MMRDA.
23	Services for Joint box for FO cable	It includes cost/expenditure for Transportation , installation of FO Joint Box suitable for 48 Core Cabel. Providing of All pig tails, Joints in the FO Joint Box at MMRDA BKC RSS end and at TATA Power BKC RSS end.in the Presence of TATA Power, MMRDA.
24	CC Road Cutting with Diamond cutter over & above excavation	It includes cost/expenditure for CC Road Cutting with Diamond cutter over & above and barrication and lifting of debris and reinstatement of the CC Road.
25	Installation of 1-phase and 3- Phase Link Boxes in Termination including sheath earthing	It includes cost/expenditure for Transportation , installation of Link boxes with Sheath Cabel which is supplied by RVNL as per the approved drawing. Necessary earthing as per the approved drawing to be done.
26	Installation of Fabrication of Structural Steel for cable cleating arrangement	It includes cost/expenditure for erection of Galvanised Steel structure of GSM 610mm or Micron 80 for cable cleating arrangement at GIS, Tower end, TATA Power BKC RSS End and as required at site and as per the Approved GAD,GTP from TATA power, MMRDA, drawing
27	Testing & Commissioning for 2nos circuits of 110 KV 630 Sqmm.	The work and Cost Includes the Sheath Test, Hypot Test, Insulation Resistant Test, VLF test , Cabel fault Identification Test as Pre Commissioning and Post Commissioning Test for 110KV Cable and GIS , Straight Through Joints , Outdoor Termination.
28	Services for un-coiling & laying optical fibre cable 4 Runs of 48 Core Fibre of specified type along the cable trench through HDPE pipe as per approved drawing &	The Work and Cost includes the Transportation of 48 Core Fibre , and other cable accessories from store, watch and ward round the clock and handing over the same to the store

	specification including Loading from store ,transportation,unloading at site , returning cable drum to tata power warehouse ,permits from concern authority , labour charge complete, Tests as per Tata Power/KEC requirement.(	if any balance is available .All Pre laying and Post laying Tests to be performed. Provision of Circuit Identification tags for FO Cable. Any damages to the Cable during laying to be rectified at their Own cost.
29	Services for laying of tiles 660x500x60 mm complete (including shifting, transportation and laying in trench).	The Work and Cost includes the shifting, transportation, laying of 660x500x60 mm cable tiles along the Cable trench.
30	Supply of HDPE pipes for HDD (OD 250 mm)	It includes cost/expenditure for supply of HDPE pipes for EHV cable (OD 250mm) as per the Approved GAD,GTP from TATA power, MMRDA.(Drawings are attached in Drawing Section).
31	Detailed surveying of the Cable route along the alignment fixed by the owner & preparation of profile drawing for cable laying and preparation of final cable route in 6 sets of hard & soft copy in a scale of 1:10 indicating the position of cable jointing chambers, earthing details, position of cable route marker, land marks etc., after completing the work & energizing for the use of peRunning Meteranent record, GPS mapping of utilities to be indicated in the drawing complete. (Based on preliminary route survey, total route length 1500 m)	The work and cost includes for Preliminary Route survey with GPR and Confirmation of utilities, preparation of final construction /cable layout drawings indicating cable pull boxes, joint locations, any uncharted utilities, utility/route diversions if any and co-coordinating with the various State and Central Government Departments & utilities whenever and wherever necessary on the behalf of MMRDA. The co- ordination with city agencies shall also be done for the purpose of crossing over/under or minor shifting of utilities for cable laying etc. Preparations of Final /AS built drawings with all fixed structures in the route drawing.
32	Supply of HDPE pipes for FO cable (dia 40 mm)	The work and cost includes for supply of HDPE pipes for FO cable (dia 40 mm) as per the Approved GAD,GTP from TATA power, MMRDA. (Drawings are attached in Drawing Section).
33	Supply and installation of the Lighting fixtures at BKC RSS building	The work and cost includes for supply and installation of all Lighting Fixtures as per the approved drawing. (Drawings are attached in Drawing Section).
34	Supply of HDPE pipes for EHV cable (OD 200 mm & 5 mtr length)	It includes cost/expenditure for supply of HDPE pipes for EHV cable (OD 250mm) as per the Approved GAD,GTP

		from TATA power, MMRDA.(Drawings are attached in Drawing Section).
35	Services for construction of cable jointing chamber (RCC types) along with Below ground Earth mat with copper flat/ copper bare conductor (along with supply of material as per specification) for Joint bay of suitable dimensions as mutually agreed for 1 circuits i.e., 3 no of cable with link boxes, earthing as per approved drawing of TATA Power and MMRDA specifications. Including supply & filling submerged (Including supply and filling of Sand) [10.0 mtr]	It includes cost/expenditure for Transportation , installation of Link boxes and Copper mesh earthing of size as per the approved drawing.
36	Supply and installation of the ,Lighting fixtures, Distribution boards at BKC RSS building.	The Work and Cost Includes the Supply and Installation of all Lightning Fixtures, Distribution boards as per the drawing attached.

	<b>Payment Terms and Conditions:</b>
1	<b>Price:</b> The prices shall remain FIRM till completion of the job.
2	<b>GST:</b> Price is inclusive of GST
3	<b>Quantity-</b> The quantity specified above is approximate as per site condition . The payment shall be made by us based on the rate for the actual work done as certified by the engineer in charge of the work.
4	<p><b>Payment Terms and Conditions :</b></p> <p>For BOQ Item No. 1 to 41</p> <p>For Providing and laying portion:-</p> <p>(I)70 % Payment made after Supply of material .</p> <p>(II) 15 % Payment made after Erection .</p> <p>(iii)10% payment made after Final Testing and Commissioning</p> <p>(iii) 05% Payment made after and Successful handover to MMRDA.</p> <p>For BOQ Item No. 42 to 74</p> <p>A) For Supply portion:-</p> <p>(I) 80 % Payment made after Supply of material.</p> <p>(II) 15 % Payment made after erection..</p> <p>(iii) 05% Payment made after Final Testing and Commissioning and Successful handover to MMRDA.</p> <p>B ) For Services and Installation Portion:</p> <p>I) 90 % Payment made after erection</p> <p>(II) 10 % Payment made after Final Testing and Commissioning Succesful handover to MMRDA.</p>

5	<b>Progress Report:</b> Review of Progress will be done on daily basis
6	<b>Tools and Tackles:</b> You shall arrange all necessary tools& tackles required for the work at your cost
7	<b>Insurance:</b> You shall arrange insurance for you tools& tackles and workmen at your cost. Workmen compensation policy should be submitted before commencement of work.
8	<b>Watch &amp; ward:</b> You shall arrange watch & ward and security for the equipment's and no extra payment will be made. All charges for watch &ward is inclusive of the Contract cost.
9	<b>Drawings/ Approvals:</b> All drawings will be Provided by RVNL. It shall be your responsibility to ensure that the job is done according to specification/ approved drawings and the same meets the approval of RVNL/Tata Power/MMRDA . In the event of rejection, necessary rectification shall be done by your cost. For cable laying specifications and specifications related to accessories bidder shall refer the Drawing Section of Volume –II i.e works requirement.
10	<b>Precaution:</b> Every precaution shall be taken by you during excavation & cable laying to avoid any damage to the cable or any other equipment or any other underground installations. In case of any damages, you shall make necessary arrangement for rectification of the same and the charges of the same shall be borne by you. Proper barricading throughout the work area is must and should be done as per MMRDA. Contractor should appoint one Barricading officer and one Safety Engineer, one Execution Engineer at Site with out fail.
11ss	<b>Records &amp; Accounts of materials:</b> You shall maintain all records & accounts for the materials till handing over of the system to Tata Power.

13	<b>Records &amp; Accounts of working personnel's:</b> You shall maintain all records and accounts of persons working at site and shall follow rules and regulations as per Tata Power requirements. All relevant documents should be available for scrutiny to any Govt. authorities and to Tata power. You shall submit copies of ESI/PF payment paid receipts monthly.			
14	Liasoning with local authorities and controlling traffic movement etc. is in the scope of contractor. No extra payment for Liasoning .			
15	<b>Defect Liability Period:</b> 24 Months from the issue of work completion certificate			
16	The Contractor shall provide the following personnels for project requirement.			
	Designation	Experience level	Qualification	Min Personnel Required
	Civil Engineer	Min 10 years out of which 5 Years of Metros/ BMC works/ Railways	Graduate in Civil Engineering	01
	Safety officer	Min 10 years out of which 5 Years of Metros/ BMC works/ Indian Railways	Diploma in Safety	01
	Quality Engineer	Min 10 years out of which 5 Years of Metros/ BMC works/ Railways	Graduate in Civil Engineering	01
	Electrical Engineer	Min 8 years out of which 5 Years of Metros/ BMC works/ Railways	Graduate in Electrical Engineering	02

# **Section 2**

## **General Specifications**



## CHAPTER-1: GENERAL SPECIFICATION

### 1.1 SCOPE

- 1.1.1 The objective of the contract is the design, construction completion, testing and commissioning of the permanent works by the Contractor (including without limitation, the design, construction and removal of the Temporary Works) and the rectification of defects appearing in Permanent Works in the manner and to the standards and within the time stipulated by the Contract. In full recognition of this objective, and with full acceptance of the obligations, liabilities and risks which may be involved, the Contractor shall undertake the execution of the Works.
- 1.1.2 This Specification covers the general aspects of the tender viz., description of the Works, submittal requirements of Design & Drawings, Management Plans, Project Planning and Progress Monitoring, Site Management, Draughting and CAD Standards, and Contractor's obligations for safety, health and environment etc. This General Specification shall be read in conjunction with the General Conditions of Contract (GCC), Special Conditions of Contract (SCC), Technical Specification, and Instructions to Tenderers.
- 1.1.3 The Scope of Works under this Contract covers design, manufacture, factory testing, supply, testing and commissioning of 2 nos. of RSS at BKC & Mandale with 110kV cable laying, Overhead Catenary System (OCS) with associated cable laying, Auxiliary Sub-Station (ASS) with associated cable laying and POWER SCADA. The Scope also covers supply of spares, special tools, testing and diagnostics equipment, jigs and fixture etc for maintenance and repairs of the RSS, OCS, Equipment's in the ASS and the SCADA System.

### 1.2 APPLICATION OF THE GENERAL SPECIFICATION (GS)

- 1.2.1 The General Specifications shall be read in conjunction with the General Conditions of Contract (GCC), the Special Conditions of Contract (SCC), the Employer's Requirements, the Drawings and any other document forming part of the Contract.
- 1.2.2 In the event of a conflict between the General Specifications, Technical Specifications and any Design Criteria, the Design criteria shall prevail.
- 1.2.3 In the event of a conflict between any Design Criteria and any other standards or specifications quoted, the requirement of the Design Criteria shall prevail.
- 1.2.4 Notwithstanding the precedence specified above the Contractor shall always immediately seek advice from the Engineer in the event of conflicts between Specifications.
- 1.2.5 The order of precedence is:
  - a. Design Criteria;
  - b. Technical Specifications;
  - c. General Specifications;
  - d. Indian and other International Standards referenced herein;
  - e. Indian and other International Standards.

**1.3 ABBREVIATIONS**

Common abbreviations used in the GS and in the TS shall have the following meanings:

Acronym	Definition
AC	Alternating Current
ACB	Air Circuit Breaker
ACOCB	Alternating current outgoing circuit breaker
ACR	Area of Control Region
ACRC	Alternating Current Rectifier Contactor
ACRCB	Alternating current rectifier circuit breaker
ACS	Access Control System
ADB	Asian Development Bank
AFC	Automatic Fare Collection
AFNOR	Association française de normalisation
AMC	Annual Maintenance Contract
AMCP	Air Monitoring and Control Plan
AMS	Auxiliary Main Substation
ANSI	American National Standards Institute
APC	Auxiliary Power Control
ASHRAE	American Society for Heating, Refrigeration and Air-conditioning Engineers
ASM	Assistant Station Master
ASS	Auxiliary Sub-station
AST	Asset Management
ASTM	American Society for Testing and Materials
AT	Auxiliary Transformer
ATC	Automatic Train Control
ATCB	Auxiliary Transformer Circuit Breaker
ATIS	Auxiliary Transformer Isolator
ATO	Automatic Train Operation
ATP	Automatic Train Protection
ATR	Automatic Train Regulation
ATS	Automatic Train Supervision
AVO	Amperes-Voltage-Ohms (meter)
BBMP	Brihan Mumbai Mahanagar Palika
BCC	Back-Up Control Centre

Acronym	Definition
BCP	Brake Cylinder Pressure
BCU	Bay Control Unit
BEC	Buried Earth Conductor
BEST	Brihan Mumbai Electric Supply & Transport Undertaking
BFB	Broad Flange Beam
BFN	Briefing Note
BIS	Bureau of Indian Standards
BMC	Brihan Mumbai Municipal Corporation
BMS	Building Management System
BOQ	Bill of Quantities
BPU	Bay Protection Unit
BS	British Standard(s) (Institution)
BSNL	Bharat Sanchar Nigam Ltd.
CAD	Computer Aided Design
CADD	Computer Aided Design and Draughting
CAMS	Computer Aided Maintenance System
CAR	Corrective Action Request
CATC	Continuous Automatic Train Control
CB	Circuit Breaker
CBI	Computer Based Interlocking
CBTC	Communication Based Train Control
CBTCS	Communication Based Train Control System
CCB	Coupling Circuit Breaker
CCIR	Consultative Committee on International Radio
CCL	Commercial - Claims
CCTV	Closed-Circuit TV
CDA	Civil Defence Approval
CDM	Codification Manual
CDR	Concept Design Reports
CDRS	Centralised Digital Recording System
CENELEC	European Committee for Electrotechnical Standards (Comité Européen de Normalisation Electrotechnique)

<b>Acronym</b>	<b>Definition</b>
CER	Central Equipment Room
CFM	Change Management
CIBSE	Chartered Institute of Building Service Engineer
CIIBC	Chief Inspector of Inspection of Building and Other Construction of Govt Of Maharashtra
CIS	Coupling Isolator
CMH	Cubic Meter Hour
CMS	Company Management System
COS	Construction Site
CPA	Payment Application
CPCB	Central Pollution Control Board
CPM	Critical Path Method
CR	Contractor Representative
CRS	Commissioner of Railway Safety
CRZ	Coastal Regulation Zones
CRZA	Coastal Zone Management Authority
CSD	Combined Services Drawing
CSL	Cross Hole Sonic Logging
CSMT	Chhatrapati Shivaji Maharaj Terminus
CSR	Construction Surveillance Report
CSS	Communications System supervisor
CT	Current Transformer
CTATP	Current Transformer for protection of Auxiliary Transformer
CTC	Current Transformer for Coupling
CTD	Capacitor Tripping Device
CTIM	Incoming Current Transformer for Measures
CTS	Comprehensive Transportation Study
CTT	Current Transformer for Traction Transformer
CTTTP	Current Transformer for Protection of Traction Transformer
CUV	Curriculum Vitae
DAT	Data Sheet
DB	Dry Bulb

Acronym	Definition
DB (A)	A-weighted Decibels
DBR	Design Basis Report
DC	Direct Current
DCA	Design Certificate Application
DCAC	Direct current auxiliary contactor
DCACB	Direct Current charging Air Circuit Breaker
DCACC	Direct Current Auxiliary Coupling Contactor
DCC	Design Certificate (of) Consent (Sheet)
DCC	Depot Control Centre
DCCLAN	Depot Control Centre Local Area Network
DCM	Document Control
DCOCB	Direct Current Outgoing Circuit Breaker
DCRC	Direct Current Rectifier Contactor
DCS	Data Communication System
DCU	Door Control Unit
DDC	Detailed Design Consultant
DDL	Drawing / Document List
DEP	Depot
DEQ	Depot Equipment
DET	Determinations
DIN	German Industrial Standards
DLP	Defect Liability Period
DM	Driving Motor Car
DMI	Driver Machine Interface
DMT	Depot Maintenance Equipment
DMU	Diesel Multiple Unit
DOT	Department of Telecommunications
DP	Double Pole Insulator
DPC	Digital Protection Control System

Acronym	Definition
DPR	Detailed Project Report
DRCA	Design Review Certificate Application
DRS	Document Review Sheet
DS	Disconnect Switch
DSY	Depot & Stabling Yard
DTC	Depot Traffic Controller
DTN	Data Transmission Network
DWG	Drawing
DWP	Detailed Works Programme
EAR	Earthworks
EB	Emergency Brake
ECC	Emergency Control Centre
EED	Emergency Escape Door
EER	Energy Efficiency Ratio
EFO	Excess Fare Office
EHV	Extra High Voltage
EIA	Environment Impact Assessment
EIRR	Economic Internal Rate of Return
EIS	Earthing Isolator
ELCB	Earth Leakage Circuit Breaker
ELE	Electrical
ELV	Low Voltage
EMC	Electro-Magnetic Compatibility
EMI	Electro-Magnetic Interference
EMIS	Energy Management and Information System
EMP	Environmental Management Plan
EMS	Environment
EMT	Engineering Management
EMU	Electric Multiple Unit
EMV	Electrical Medium Voltage
EMW	Emergency Walkway
EN	European Standards (Organization)

Acronym	Definition
ENDM	Environment Department, Government of Maharashtra
ENG	General Engineering
ENN	Engineering Notes
ENR	Energy
EPD	Environmental Planning & Design
EPP	Emergency Preparedness Plan
ERP	Emergency Response Plan
ERS	Engineer Review Sheet
ES	Earthing Switch
ESC	Escalator
ESIA	Environmental And Social Impact Assessment
ESSs	Emergency Stop Switches
EST	Estimate
ETCS	European Train Control System
FAT	Factory Acceptance Test
FCR	Field Change Request
FDA	Fire Detection & Alarm Systems
FIDIC	Fédération Internationale Des Ingénieurs-Conseils (International Federation of Consulting Engineers)
FLS	Fire & Life Safety
FMEA	Failure Modes Effects Analysis
FMECA	Failure Modes Effects and Criticality Analysis
FOCS	Flexible Overhead Catenary System
FOTS	Fibre Optic Transmission System
FP	Feeding Post
FRACAS	Failure Reporting And Corrective Action System
FRB	Failure Review Board
FRDM	Fire Department
FRLS	Flame Retardant Low Smoke
FRS	Functional Requirement Specification
GC	General Consultant
GCC	General Conditions of Contract

Acronym	Definition
GEN	General
GIS	Gas Insulated Switchgear
GNS	General Services
GoA	Grade of Automation
GOF	General Consultant's Office
GoI	Government of India
GoM	Government of Maharashtra
GR	General Rules of the Indian Railways/Metrorail Act
GRC	General Remote Control
GS	General Specification
GTKM	Gross Ton Kilometer
GUI	Graphical User Interface
HAZ	Hazardous Material
HFA	Human Factors
HIRA	Hazard Identification and Risk Assessment
HMI	Human Machine Interface
HSCB	High Speed Circuit Breaker
HV	High Voltage
HVAC	Heating Ventilation and Air Conditioning
Hz	Hertz (Frequency)
I/O	Input / Output
IC	Integrated Circuit
ICB	Incoming Circuit Breaker
ICC	Integrated Control Centre
ICD	Interface Control Documents
IEC	International Electro-technical Commission
IED	Intelligent Electronic Device
IEEE	Institute of Electrical and Electronics Engineers
IEIS	Incoming Earthing Isolator
IET	International Emission Trading
IGBT	Insulated Gate Bi-Polar Transistor



Acronym	Definition
IMC	Infrastructure Maintenance Centre
IMD	India Meteorological Department
IMFRC	Infrastructure Maintenance Fault Report Centre
IMP	Interface Management Plan
IMR	Incident Management Room
INV	Invoice
IOL	Insulated Overlap
IPS (LCD)	In-Plane-Switching (type of Liquid Crystal Display)
IPT	Intermediate Public Transport
IR	Indian Railways
IRC	Indian Road Congress
IRE	Inspection Request (Request for Inspection)
IRP	Incident Review Panel
IRS	Indian Railway Standards
IS	Indian Standard
IS 10500:2012	Drinking Water Standards
ISBT	Inter –State with Bus Terminus
ISM	Industrial Scientific and Medical radio bands
ISO	International Standards Organisation
IST	Instruction
IT	Interrupter
ITC	Coupling interrupter
ITP	Inspection & Test Plan
ITU	International Telecommunication Union
KLD	Kilo Litres Per Day
KMPH	Kilo Meter Per Hour
KPI	Key Performance Indicators
KVA	Kilo Volt Ampere
L	Hand operated traction isolator
L10	The noise level just exceeded for 10% of the measurement period
L90	The noise level just exceeded for 90% of the measurement period
LA	Lightening Arrester

Acronym	Definition
LAA	Land Acquisition Act
LAAT	Lightning Arrester for Auxiliary Transformer
LAN	Local Area Network
LATT	Lightning Arrester for Traction Transformer
LBCB	Lighting Bridge Circuit Breaker
LBCCB	Lighting Bridge Coupling Circuit Breaker
LBCCT	Lighting Bridge Coupling Current Transformer
LBCT	Lighting Bridge Current Transformer
LBCVT	Lighting Bridge Coupling Voltage Transformer
LBEIS	Lighting Bridge Earthing Isolator
LBS	Load Break Switch
LBVT	Lighting Bridge Voltage Transformer
LCB	Line Circuit Breaker
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LEIS	Line Earthing Isolator
LEQ	Equivalent continuous sound level
LFCB	Lighting Feeder Circuit Breaker (spare)
LFEIS	Lighting Feeder Earthing Isolator
LILO	Loop In Loop Out
LIS	Line Isolator
Lmax	The maximum sound level, during a measurement period or a noise event
Lmin	The minimum sound level, during a measurement period or a noise event
LOA	Letter of Acceptance
LOG	Logistics
LOMA	Limit of Movement Authority
LOS	Level of Service
LPG	Liquid Petroleum Gas
LRT	Light Rail Transit
LRU	Line Replaceable Unit

Acronym	Definition
LRU	Line Replaceable Unit
LV	Low Voltage
LVACB	Low Voltage Auxiliary Circuit Breaker
LVACCB	Low Voltage Auxiliary Coupling Circuit Breaker
LVAT	Low Voltage Auxiliary Transformer
LVATCB	Low Voltage Auxiliary Transformer Circuit Breaker
LVATEIS	Low Voltage Auxiliary Transformer Earthing Isolator
LVCB	Low Voltage Circuit Breaker
LVCCB	Low Voltage Coupling Circuit Breaker
M	Motor Car
M.C.	Metropolitan Commissioner
MAHADISCOM	Maharashtra State Electricity Distribution Co. Ltd
MAN	Metropolitan Area Network
MC	Metro Corridor (Underground Alignment Line 2)
MCB	Miniature Circuit Breaker
MCCB	Moulded Case Circuit Breaker
MCGM	Municipal Corporation of Greater Mumbai
MCIS	Main coupling isolator
MCS	Master clock system
MDBCF	Mean Distance Between Component Failures
MDBF	Mean Distance Between Failures
MEFG	Ministry of Environment and Forests, Government of India
MEP	Mechanical, Electrical & Plumbing
MESA	Monthly Electrical Safety Audit
MET	Main Earth Terminal
MMI	Man Machine Interface
MML2B	Mumbai Metro Line 2B
MMR	Mumbai Metropolitan Region
MMRDA	Mumbai Metropolitan Region Development Authority
MOEF	Ministry Of Environment And Forest
MOHUA	Ministry of Housing Urban Affairs, Was MOUD

Acronym	Definition
MOM	Minutes of Meeting
MOR	Ministry of Railways
MOS	Method of Statement
MOU	Memorandum of Understanding
MOUD	Ministry of Urban Development, now MOHUA
MPR	Monthly Progress Report
MQR	Monthly Quality Report
MRTS	Mass Rapid Transit System
MRVC	Mumbai Rail Vikas Corporation
MSD	Motorized Sliding Door
MSDS	Material Supply Data Sheet
MSEB	Maharashtra State Electricity Board
MSETCL	Maharashtra State Electricity Transmission Company Limited
MSRDC	Mumbai State Road Development Corporation
MSRTC	Maharashtra State Road Transport Corporation
MSS	Maximum Safe Speed
MSW	Municipal Solid Waste
MTBF	Mean Time Between Failures
MTBMA	Mean Time Between Maintenance Action
MTBSAF	Mean Time Between Service Affecting Failures
MTNL	Maha-nagar Telephone Nigam Limited
MTRC	Mobile Train Radio Communication
MTTR	Mean Time to Restore
MUTP	Mumbai Urban Transport Project
MVA	Mega Volt Ampere
MVCB	Medium Voltage Circuit Breaker
MWI	Maintenance Works Instruction
NABL	National Accreditation Board for Testing and Calibration Laboratories
NC	Normally Closed
NCR	Non-Conformance Report
NCT	Neutral Current Transformer
NFPA	National Fire Protection Association

Acronym	Definition
NGO	Non-Government Organization
NGR	Neutral Grounding Resistor
NHAI	National Highway Authority of India
NIT	Notice Inviting Tender
NMCP	Noise Monitoring and Control Plan
NMS	Network Management System
NO	Normally Open
NRV	Non-Return Value
NS	Neutral Section
NTC	Notice
NTP	Notice to Proceed
NVR	Network video recorder
O&M	Operations & Maintenance
O/C	Over Current
OCC	Operation Control Centre
OCCLAN	Operations Control Centre Local Area Network
OCR	Over Current Relay
OCS	Over-head Catenary system
ODA	Official Development Assistance
ODC	Over Dimensional Consignment
OEM	Original Equipment Manufacturer
OFC	Optical Fibre Cable
OHE	Overhead Equipment
OHL	Over Headline
OHSAS	Occupational Health and Safety Assessment Series
OLED	Organic Light Emitting Diode
OLTC	On Load Tap Changer
OMM	Operation & Maintenance Manual
OMPD	Operating Modes and Principles Document
ONAF	Oil Natural Air Forced
ONAN	Oil Natural Air Natural
ORG	Organization Chart

<b>Acronym</b>	<b>Definition</b>
OSHA	The Occupational Safety & Health Administration
OSR (S)	Operational Safety Report (Software)
OTH	Any other not mentioned above
OTI	Oil Temperature Indicator
PAC	Payment Certificate
PAD	Passenger Alarm Device (Rolling Stock device)
PAR	Parabolic Aluminised Reflector
PAS	Public Address System
PCB	Printed Circuit Board
PCC	Particular Condition of Contract
PCW	Power Control Workstation
PDCA	Plan, Do, Check, Act
PDM	Precedence Diagramming Method
PEA	Passenger Emergency Alarm
PEP	Platform Emergency Plunger
PF	Power Factor
PFD	Process Flow Diagram
PHPDT	Peak Hour Peak Direction Traffic
PI	Panel Interlocking
PICOP	Person In Charge of Protection
PIDS	Passenger Information Display System
PIS	Passenger Information System
PIV	Photographs, Images & Videos
PLC	Programmable Logic Controller
PLN	Planning, Consents & Approvals
PM	Project Manager
PMT	Project Management Team
PNCT	Primary Neutral Current Transformer
PNEIS	Primary Neutral Earthing Isolator
PNLA	Primary neutral surge arrester
PPE	Personal Protective Equipment
PPT	Presentation

Acronym	Definition
PQP	Project Quality Plan
PRC	Procurement & Delivery
PRM	Program Management
PRO	Procedure
PRS	Public Relations
PS	Particular Specifications
PSA	Power Supply Authority
PSB	Platform Supervisor's Booth
PSD	Platform Screen Door
PSS	Power Supply System
PSTN	Public Switched Telephone Network
PSU	Power Supply Unit
PT	Potential Transformer
PTFE	Poly Tetra Fluoro-Ethylene
PTW	Permit to Work
PV	Personalized Vehicles
QA	Quality Assurance
QC	Quality Control
QMS	Quality Management System
QOS	Quality of Service
QRT	Quarterly Report
QRY	Query List
QSR	Quarterly Supervision Report
R&R	Rehabilitation and Resettlement
RAD	Radio
RAF	Recommendation for Approval
RAM	Random Access Memory
RAM	Reliability, Availability, Maintainability
RAMS	Reliability, Availability, Maintainability, Safety
RAP	Resettlement Action Plan
RBD	Reliability Block Diagram
RC	Rail Corridor

Acronym	Definition
RCCB	Residual Current Circuit Breaker
RCEIS	Rail corridor earthing isolator
RDSO	Research Design and Standards Organisation (IR)
RF	Radio Frequency
RFC	Request for Change
RFI	Request for Information
RFM	Request for Mobilization
RFP	Request for Proposal
RH	Relative Humidity
RM	Restricted Manual Mode
RMU	Ring Main Unit
ROM	Read Only Memory
ROP	Rail Operation
ROS	Run on Sight Mode
RPM	Respirable particulate matter
RS	Rolling Stock
RSK	Risk Management
RSRM	Remote Speed Restriction Mode
RSS	Receiving Sub Station
RST	Rolling Stock
RS-VTS	Rolling Stock-Video Transmission System
RTCC	Remote Tap Changer Control
RTU	Remote Terminal Unit
S&TC / PSD	Signalling & Train Control including Platform Screen Doors
SAP	System Assurance Plan
SAR	Supplier / Sub Contractor Approval Request
SAS	Substation Automation System
SAT	Site Acceptance Test
SBD	Safe Braking Distance
SCADA	Supervisory Control and Data Acquisition System
SCC	Special Conditions of Contract
SCH	Program / Schedule



Acronym	Definition
SCR	Station Control Room
SDH	Synchronous Digital Hierarchy
SDLC	System Development Life Cycle
SDS	Safety Data Sheets
SEC	Security
SECP	Software Engineering Change Proposal
SED	Structure Erection Drawing
SEIAA	State Environmental Impact Assessment Authority
SER	Signalling Equipment Room
SF-6	Sulphur Hexa-Fluoride
SHE	Safety Health & Environment
SHM	Safety Health & Management System
SI	International System of Units (System Internationale)
SLAN	Station Local Area Network
SMR	Signal Maintenance Room
SNCT	Secondary neutral current transformer
SNEIS	Secondary Neutral Earthing Isolator
SNG	Snagging List
SNLA	Secondary Neutral Lightning Arrester
SNMP	Simple Network Management Protocol
SNX	Safety Notice
SOR	Site Observation Report
SP	Sectioning and Paralleling Post
SP	Sectioning Post
SPV	Special Purpose Vehicle
SRS	Structural - Rail Systems
SSA	Safety & Systems Assurance
SSP	Sub-Sectioning and paralleling Post
STC	Signalling and Train Control
STM	Synchronous transport module
STN	Station
SUB	Submittal

Acronym	Definition
SUR	Survey
SWS	Traction Switching Station
SYE	Systems Engineering Management
SYS	Systems
T	Trailer Car
T/out	Turnout
TBM	Tunnel Boring Machine
TC	Traffic Controller
TCB	Traction Circuit breaker
TCMS	Train Control Management System
TCN	Train Consist Number
TCP/IP	Transmission Control Protocol / Internet Protocol
TCS	Train Control System
TEC	Tunnel Earth Conductor
TEIS	Transformer Earthing Isolator
TEN	Tender
TER	Telecommunication Equipment Room
TETRA	Terrestrial Trunked Radio
TIMS	Train Information Management System
TMC	Thane Municipal Corporation
TMP	Template
TOC	Take Over Certificate
TOD	Train Operation Display
TOM	Ticket Office Manual
TOR	Terms of Reference
TOST	Ticket Office Store / Cash Handling Room
TPC	Traction Power Controller
TPD	Traffic Police Department
TPI	Third Party Inspection
TR	Power Transformer
TR	Ton of Refrigeration
TR	Train Radio

Acronym	Definition
Train ID	Train Identification Number
TRANSCO	Transmission Company (erstwhile DVB)
TRG	Training
TRK	Track and Track works
TRN	Train Running Numbers
TRN	Transmittal
TRP	Traction Power
TS	Technical Specification
TSS	Traction Sub Station
TT	Traction transformer
TTCB	Traction Transformer Circuit Breaker
TTCCB	Traction Transformer Coupling Circuit Breaker
TTIS	Traction Transformer Isolator
TTM	Temporary Traffic Management
TVM	Ticket Vending Machine
TVS	Tunnel Ventilation System
TWA	Time - Weighted Average
TWC	Train Wayside Communication
U/V	Under voltage
UA	Urban Agglomeration
UIC	International Union of Railways (Union Internationale des Chemins de Fer)
UIF	Urban Interface
UPF	Unity Power Factor
UPS	Uninterrupted Power Supply
UTI	Utilities
UTO	Unattended Train Operation
V	Volts
VAC	Ventilations and Air-conditioning
VCB	Vacuum Circuit Breaker
VDU	Video Display Unit
VLAN	Virtual Local Area Network

Acronym	Definition
VT	Voltage Transformer
VTB	Voltage Transformer for traction busbar
VTBB	Bus Bar Voltage Transformer
VTC	Voltage transformer for coupling
VVVF	Variable voltage variable frequency
WAN	Wide Area Network
WB	Wet Bulb
WB	World Bank
WFSL	Western Freeway Sea Link
WILD	Wheel Impact Load Detector
WMP	Waste Management Programme
WPC	Wrong Phase Coupling
WSR	Wheel Slip Relay
WTI	Winding Temperature Indicator
XLPE	Cross-linked polyethylene
YM	Yardmaster
ZVR	Zero Velocity Relay

### 1.3 Table 1 General Abbreviations

- 1.3.1 Further abbreviations may be defined within the body of the GS or TS where there is only local applicability. Where such abbreviations exist, the Contractor shall exercise great care that the abbreviation is not used out of context when communicating with the Employer, the Employer's Representative or any Third Party.
- 1.3.2 Abbreviations of units of measurement used in the GS shall have the meanings as defined under the SI system of units.

### 1.4 DEFINITIONS

Words and phrases defined in the GCC or SCC shall retain the same meaning within the GS and TS unless specifically redefined within this GS or under the provisions of clause 1.1.1 above for the purpose of a particular clause or group of clauses.

1. "Access Dates" are dates that are to be achieved by other than the Contractor and which are considered to be essential to the successful completion of the Contract to the original planned schedule. A list of the activities completion of which are considered to give rise to an Access Date are included in the FOT. (To be checked about access dates).

2. "Commissioning" means the process of setting to work the complete transportation system through a series of integrated tests that demonstrate the installation and performance in accordance with the specified criteria.
3. "Day" means calendar day unless expressly stated otherwise.
4. "Defined Area" means an area within which Works Trains will be operated and the Employer's defined area working safety rules will apply.
5. "Factory Acceptance Tests" means the tests to be performed at the Contractor's factories prior to delivery to the Site to verify compliance with the Specification and quality standards.
6. "Installation Tests" means the tests to be performed to verify the conformity of completion of an installation/assembly to the design documents previously reviewed without objection by the Employers Representative prior to the start of Commissioning. Installation Tests do not form part of the Tests on Completion to be performed by the Contractor in order to achieve Employer's Taking Over of the Works or any Section however they must be successfully completed before the Tests on Completion can commence.
7. "Key Dates" are dates which are to be achieved by the Contractor and which are considered to be essential to the successful completion of the project to the original planned schedule. A list of the activities, completion of which gives rise to a Key Date, is included in the FOT.
8. "Partial Acceptance Tests" means the functional tests to be performed on components and parts of systems to meet the specified criteria. Partial Acceptance Tests form part of the Tests on Completion to be performed under the Contract in order to achieve Employer's Taking Over of the Works or any Section.
9. "Service Trial" means the phase after completion of the System Acceptance Tests where the training and operating procedures are validated through the running of the trains to the published timetable. Service Trial form part of the Tests on Completion to be performed under the Contract in order to achieve Employer's Taking Over of the Works or any Section.
10. "Quality Control Point" means a point in time when a notice or other document is to besubmitted to the Employer's Representative in accordance with the Contract before the Contractor can commence, proceed with or terminate an activity.
11. "Quality Hold Point" means a point in time when a notice of no objection by the Employer's Representative is required.
12. "S' curve" means the graphical relationship between the planned (and actual where appropriate) quantity of completed work (or resources) and time. The curve produced is to be illustrated on an accumulative basis where the slope of the line indicates the rate of undertaking the work or rate of expenditure of the resources.
13. "Specification (the)" means the aggregate sum of the documents and any amendments thereto, issued to Tenderers by MMRDA as part of the Tender process before the final date forsubmission of Tenders. This shall include but not be limited to; Employer's Requirements, Employer's Tender Drawings, Preliminary Operating Plan and Clarification of Tender Documents issued in accordance with the ITT but shall not include the ITT itself nor any minutesof meetings.
14. "Specification (this)" means the particular document within which the reference is made.
15. "System Acceptance Tests" means those tests that demonstrate the performance of the installation/equipment to the specified requirements as detailed in the TS. SATs form part of the

Tests on Completion to be performed under the Contract in order to achieve Employer's Taking Over of the Works or any Section.

16. "Integrated Testing and Commissioning" means those tests that demonstrate the integration of the complete transport system meeting the requirements of the Specification in an operating environment. Integrated Testing and Commissioning form part of the Tests on Completion to be performed by the Contractor in order to achieve Employer's Taking Over of the Works or any Section.
17. "Validation" means the process of confirmation by examination and provision of objective evidence that the application produced achieves the particular requirements specified.
18. "Verification" means the process of confirmation by examination and provision of objective evidence that the specified requirements have been incorporated.

## **1.5 GLOSSARY OF TERMS**

- 1.5.1 Words and expressions to which meanings are assigned in any paragraph of the GS shall have the same meanings in other paragraphs of the GS except when the context otherwise requires.
- 1.5.2 Utilities are electricity, lighting, traffic control, telephone and other communication cables, gas, water, sewage and drainage pipes and ducts, including all associated protection, supports, ancillary structures, fittings and equipment.

## **1.6 STANDARDS, CODES OF PRACTICE**

- 1.6.1 Unless otherwise stated in the Contract, reference in the GS to International Standards, European Standards, British Standards, British Standard Codes of Practice and similar standards shall be to that edition of the document stated in the TS, including all latest amendments issued by the relevant authority. In the event that no specific edition reference is given, the current edition as at the date of issue of the Letter of Acceptance shall apply.
- 1.6.2 Latest editions of International Standards, European Standards, other national or international Standards or Codes of Practice and other similar standards, or standards which are considered to be equivalent, shall not apply unless reviewed without objection by the Employer's Representative. The Employer's Representative shall give or withhold his notice of no objection after the Contractor has provided him with a copy of the relevant standard for information. If a notice of no objection is given, the Contractor shall provide two copies of the document for use by the Employer's Representative.
- 1.6.3 Permanent Works, Temporary Works, Contractor's Equipment, hardware, firmware, software, apparatus of all kinds, and, where appropriate, materials and workmanship shall be in accordance with the Standards quoted in the Specification and the requirements identified in the TS or, where no Standard is identified, the Contractor shall make a proposal which shall be subject to review by the Employer's Representative.

## **1.7 EMPLOYER'S DRAWINGS:**

- 1.7.1 The Employer's Drawings assist in describing the scope of the Works in general and clarify constraints, interface arrangements and the conceptual nature of the finished structures/system outline.

1.7.2 The Contractor shall carefully check all Employer's Drawings and advise the Employer's Representative of discrepancies, omissions, errors or ambiguities should any be found.

1.7.3 The Contractor shall note that any drawings included but marked "For information only" do not form part of the Contract.

1.7.4 Dimensions shall not be obtained by scaling from the Employer's Drawings. Dimensions that are not shown or are not calculable from dimensions shown on Employer's Drawings shall be obtained from the Employer's Representative.

## **1.8 SPECIFICATIONS IN METRIC AND IMPERIAL UNITS**

- 1.8.1 Specifications in imperial units shall not be substituted for specifications in metric units stated in the Contract without the prior consent of the Employer's Representative.
- 1.8.2 Conversion of metric units to imperial units and of imperial units to metric units shall be in accordance with the Standard International Practice..
- 1.8.3 **SYSTEM SAFETY**
- 1.8.4 Safety philosophy -Safety of passengers, staff and the general public is paramount for railway operation. Prime consideration shall be given to all issues that can have an effect on safety. During the construction phase the safety of all staff involved in the Works and any members of the general public affected by the Works shall be the prime feature of all working methods, including storage and transport to site as well as all temporary works not incorporated into the final construction.
- 1.8.5 Safety Management -The Contractor shall implement the Contract Systems Safety Management Requirements, as referenced in the Project Safety Manual and elsewhere in the Specification, in consultation with the Employer's Representative. Prescriptive Safety Criteria. The Contractor shall identify and list all applicable statutory and regulatory requirements and codes of practice relevant to the Works and to work within the constraints and limitations imposed by the requirements and codes. The safety of the Contractor's supplied systems and equipment shall be developed by the Contractor in accordance with the requirements contained in clause 4.4.5 below and the TS.

## **1.9 CLIMATIC CONDITION / OPERATING ENVIRONMENT**

- 1.9.1 General
- 1.12.1.1 The following information on climatic conditions in Mumbai shall be taken into account by the Contractor when constructing any part of the Permanent Works. The Contractor shall ensure that due allowance is made for more severe local conditions when Permanent Works are required to operate, for example, with restricted ventilation that may lead to higher local ambient temperatures, and any other factors that may affect the operating environment in any way.
  - i. Unless specific figures are provided elsewhere, the Permanent Works will generally be required to function at its rated value with the values of ambient temperature and relative humidity appropriate to the location of the equipment within the classifications shown in Table 1.2. Certain parts of the Permanent Works may need to be rated for more or less onerous conditions as required by the TS.
  - ii. **Clause 1.12.2** below gives the different classifications of environment to be encountered. For any type of item, examples of which are installed in more than one environmental class, all examples of the type shall be suitable for installation in the most severe environmental class conditions encountered by any example of the type.
  - iii. The Contractor's attention is drawn to the more severe environmental conditions that may exist during the construction period and shall take adequate measures to protect the Permanent Works against any deleterious effects of such conditions during the time between installation and final completion of the Project.



- iv. Air throughout the Project will contain considerable moisture content and the atmosphere will be corrosive. The Permanent Works shall be tropicalised and vermin proof.
- v. The indicative information on climatic conditions in Mumbai is derived from Mumbai may be obtained from published data of India Meteorological Department publication for the years 1950 to 2019 or latest.

#### 1.9.2 Classification of Equipment Environment

The locations at which equipment may be installed have been divided into three environmental classes as shown in Table 1.2. The classes of environment are considered to become more extreme from A to C.

CLASS	LOCATION OF EQUIPMENT
A	Air-Conditioned Offices, Computer and Equipment Rooms
B	Ventilated Equipment Rooms in buildings at the surface or at the underground station or structures.
C	Outdoors

**Table 1.2 Classes of Environment**

The following are the minimum requirements for equipment to be installed in each class of environment. Where any class does not have a value for a parameter the most extreme value quoted for the lesser class environments should be used.

#### 1.9.3 Requirements for Class A

Minimum Temperature	5°C
Ambient Temperature	24±2°C
Maximum Temperature	35°C
Relative Humidity	Minimum 0%, Nominal 65%, Maximum 95% (Non- Condensing)

#### 1.9.4 Requirements for Class B

Minimum Temperature	5°C
Ambient Temperature	30°C
Maximum Temperature	45°C
Relative Humidity	Nominal 70%, Maximum 100% (Non-Condensing)
Air Quality	Polluted and dusty - SO <sub>2</sub> :80-120mg/m <sup>3</sup> Suspended Particulate Matter: 360-540mg/ m <sup>3</sup>
Electrical Noise	Impulse 1kV, 1.2/50 rise/decay, 500Ω source impedance, 0.5 J source energy. Radio & High frequency as Class A.

#### 1.9.5 Requirements for Class C

##### Environmental Conditions:

Ambient air temperature	-5°C to 55°C
Average ambient air temperature over a period of 24 hours	35°C
Maximum relative humidity	100%
Annual rainfall	Ranging from 1750 mm to 6250mm.

Maximum number of thunder storm days per annum	85
Maximum number of dust storm days per annum	35
Number of rainy days per annum	120
Basic wind pressure	As per IS: 875 latest edition
Altitude	Not exceeding 100m
Pollution severity level	*VERY HIGH* as per IEC 60815 Latest edition
Vibration level	All equipment to be installed on viaduct must be designed for reliable operation up-to vibration level of 3g.

#### 1.9.6 Electromagnetic Compatibility (EMC)

Electronic equipment in a railway environment shall be immunized against the usual electromagnetic influences to be expected from the rail operations. For this, the following EMC classification in accordance to IEC 61000 or similar, for the equipment rooms shall be achieved

##### 1.12.6.1 Electrostatic discharge

The electronic equipment rooms shall be constructed in accordance to IEC 61000-2 or similar.

The electronic equipment rooms shall be constructed in accordance to IEC 61000-3 or similar.

##### 1.12.6.2 Fast transient interference (Burst)

The electronic equipment rooms shall be constructed in accordance to IEC 61000-4 or similar.

##### 1.12.6.3 High energy transient interference

The electronic equipment rooms shall be constructed in accordance to IEC 61000-4 or similar.

##### 1.12.6.4 Switching processes in high-voltage installations

The location of computer systems in the neighbourhood < 1m of high-voltage installations, such as medium voltage or transformer stations as well as direct parallel exposure of power and data cables should be avoided.

##### 1.12.6.1 Magnetic fields

The following magnetic field strengths at the place of installation of cathode ray tube (CRT) based visual display units (VDU) should not be exceeded:

DC fields: 10 A/m or 12  $\mu$ T

AC fields: 1 A/m or 12  $\mu$ T

If the image quality is impaired by values exceeding the above the Contractor shall provide any necessary shielding or alternative corrective measures to restore the picture quality.

Note flat screen VDU using LED technology or similar may be acceptable if a sufficiently high resolution and image size can be obtained.

1.10 SURVEY AND SITE INVESTIGATIONS

- 1.10.1 For reference to surveys external to the Contract, the Contractor shall refer all Levels to Mean Sea Level (MSL) Datum, which is that generally used throughout Mumbai.
- 1.10.2 The datum used for the Contract shall be Mean Sea Level Datum.
- 1.10.3 The Contractor shall carry out all further site investigations necessary for the construction of the Permanent Works and to enable the determination of the methods of construction and the nature, extent and design of Temporary Works.
- 1.10.4 The Contractor shall investigate environmental factors also to determine suitable methods of manufacture and installation, both for Temporary and Permanent Works. In particular the Contractor shall ensure that the dusty and polluted environment of Mumbai has no detrimental effect to the functionality, reliability or long-term maintainability of the Permanent Works.

## CHAPTER 2- PLANNING, PROGRAMME AND PROGRESS MONITORING

### 2.1 PLANNING

2.1.1 The Contractor shall develop in detail, a logical method of executing the Works taking into account their complex nature and different phases and shall provide programmes which reflect the detailed planning undertaken.

2.1.2 The programmes, shall start with the Commencement Date of the Works as day one, are to be realistic, achievable and shall be accompanied by the detailed supporting Plans referred to in Chapter 3 below.

2.1.3 The Contractor shall execute the Works in two phases, the Design Phase and the Construction Phase.

### 2.2 PROGRAMMING GENERAL REQUIREMENTS

2.2.1 Programme activities shall be discrete items of work, which when combined, produce definable elements, components, Milestones, Stages and Sections of the Works and clearly identify the completion obligations of the Contractor.

2.2.2 Access Dates and Key Dates shall be an integral part of all programmes and all activities, and sequencing and interrelationships required to achieve each completion obligation shall be shown. Milestones shall not impose constraints that in any way affect the programme logic and float or limit the achievement of Key Dates. Milestones shall not be introduced into any programme as constrained dates.

2.2.3 The critical path shall be clearly identified in the programme and fully described in the accompanying programme narrative.

2.2.4 Activity descriptions shall clearly convey the nature and scope of the Works. Programmes shall take into account the activities of precursor, concurrent, adjacent and follow on Project Contractors as well as utility service diversions, new utilities and connections and any other activity that may affect the progress of the Works.

2.2.5 The Contractor shall also incorporate the Employer's Representative's requirements for additional activities, to further explain or subdivide complex or long duration tasks, without affecting completion dates.

2.2.6 Programming software shall be Primavera P6 Professional Project Management (PPM) P6 v8.0 or above for latest Windows Version (upgradable to new version), obtainable from Oracle Systems Inc or their authorized partner.

2.2.7 All terminology, definitions and conventions shall be in accordance with BS 6079-1:2010 (Glossary of terms used in Project Network Techniques) or the Associated General Contractors (AGC) manual entitled "The use of CPM in Construction".

2.2.8 In compiling its Works Programme, and in all subsequent up-dating and reporting, the Contractor shall make provision for the time required for coordinating and completing the design, manufacturing, supply, testing, commissioning, and integrated testing of the Works with training, including inter alia, design co-ordination periods, during which the Contractor shall co-ordinate its design with those of Designated Contractors, the review procedures determining

and complying with the requirements of Government Departments and all others whose consent, permission, authorization or license is required prior to the execution of any work. The Works Programme shall take full account of the Design Submission Programme.

2.2.9 Planning and Programming Staff - The Contractor shall employ sufficient number of planning and programming staff competent in the use of the programming software and with a good knowledge of the type of work required to be performed by the Contractor under the Contract. The Engineer shall have the discretion to require the Contractor to replace his planning and programming staff if the Engineer considers that they do not have the training or skill required for this very specialised nature of work.

2.2.10 Project Calendar - Project Weeks shall commence on a Monday. A day shall be deemed to commence at 0001 hours on the morning of the day in question. Where reference is made to the completion of an activity or Milestone by a particular week, this shall mean by midnight on the Sunday of that week. A 7-day week calendar shall be adopted for various Work Programme Schedules for scheduling purposes.

2.2.11 The Contractor shall revise his programmes whenever necessary, with the consent of, or as required by the Engineer to ensure completion of the Works within the times for completion prescribed in the Contract.

2.2.12 Failure of the Contractor to submit any programme, or any required revisions there to within the time limits stated shall be sufficient reason for certification that the Contractor is not performing the work required in a timely manner. The Engineer may certify retention of payment under the Milestone-related Schedule of Payments, proposed for the Contractor, until his programmes are accepted by the Engineer, and may also cause imposition of Liquidated Damages.

2.2.13 The Contractor shall note that at the time of submission of his Work Programme, it may be that such Programme has yet to be coordinated with the System-wide and Civil Contractors. These shall not prevent the Contractor from submission of detailed preliminary programmes using tentative dates for work of the System-wide and Civil Contractors (where such dates are not available), which has impact on the Contractor's programmes. Such programmes shall be amended subsequently to take into account the actual schedules of the System-wide and Civil Contractors. It is the Contractor's responsibility to ensure timely co-ordination with the System-wide and Civil Contractors to finalise his preliminary programmes so as not to affect the progress of the Works or those of the System-wide and Civil Contractors.

2.3 PROGRESS MONITORING The Contractor shall monitor its and its subcontractors' performance and against programmes to ensure its compliance with its obligations under the Contract. Monitoring of the Works shall include direct, daily monitoring of the progress of the Works and the preparation of written and computerised reports to be submitted to the Employer's Representative. The reports shall include all necessary supporting data to apprise the Employer's Representative of the status of the completion of the Works as described in clause 2.12 below.

## 2.4 WORKS PROGRAMME

2.4.1 The Works Programme to be submitted under the Contract shall be developed from the Outline Works Programme submitted and developed during the Tender period. Sub- Programmes, Supplementary Programmes may be required to be submitted, if asked for by the Employer's representative. The Works Programme shall take full account of the Design Submission Requirement.

### 2.4.2 Submission Dates

2.4.2.1 Within 45 days of the Commencement Date of the Works, the Contractor shall submit for review by the Employer's Representative the proposed full version of the Works Programme. Based on the review comments of the Employer's representative, the Contractor should re-submit the full version of the Works Programme, for approval as the Final Works Programme (Baseline Programme).

2.4.2.2 Should the Contractor fail to submit the full version of the Works Programme within the time frame nominated above, the Employer may nominate the Outline Works Programme as the first issue of the Works Programme required under the Contract.

2.4.2.3 In the event that the Employer's representative does nominate the Outline Works Programme as the first issue of the Works Programme under the Contract, the Employer's Representative may include any amendments that he sees fit to change external constraining dates, duration of activities by parties other than the Contractor and subdivide the Contractors' own activities to provide additional detail and links to other activities but without altering the duration or sequencing of the activities shown on the Outline Works Programme. The nominated Programme shall be taken by the Contractor as his own work and any responsibility for further maintenance of the Works Programme as nominated shall remain the Contractor's

2.4.2.4 Final Works Programme shall result from either a nomination by the Employer of the Outline Works Programme with amendments (as described above) or the approved re-submitted programme as described in Clause

2.4.2.1. After review by the Employer's representative, the approved Final Works Programme shall be deemed as the Baseline Programme for the Project.

#### 2.4.3 Content

2.4.3.1 The Works Programme shall demonstrate by reference to its Sub-Programmes, Supplementary Programmes and associated Management Plans, the sequence and duration of activities and any restraints thereto, that the Contractor shall adopt to achieve Key Dates and to fulfil all Contract obligations. The Works Programme shall become the Employer's Representative's basis of administration of the time-related aspects of the Contract.

The Contractor shall provide the Employer's Representative with substantiation for each constraint whether target start, target finish or mandatory constraint entered by the Contractor into the Works Programme. The number of constraints shall be kept to an absolute minimum in order that the CPM networks developed can be freely analysed.

The Programme Analysis Report shall explain the basis of the Contractor's submittal:

- i. Early Work and Baseline Submittals – explains determination of activity duration and describes the Contractor's approach for meeting required Key Dates as specified in the Contract.
- ii. Updated Works Programme Submittals – state in narrative the Works completed and reflected along Critical Path in terms of days ahead or behind allowable dates. Specific requirements of narrative are:
  - a. If the Updated Works Programme indicates an actual or potential delay to Contract Completion date or Key Dates, identify causes of delays and provide explanation of Work affected and proposed corrective action to meet Key Dates or mitigate potential delays. Identify deviation from previous month's critical path.
  - b. Identify by activity number and description, activities in progress and activities scheduled to be completed.
  - c. Discuss Variation Order Work Items, if any.
- iii. Delayed response on Employer's Letters/Correspondence shall be included in Monthly Progress report, if it is more than 14 days from the receipt of Engineer's Letter.
- iv. The Programme Status which shall: a. Show Works Programme status up to and including the current report period, display Cumulative progress to date and a forecast of remaining work. b. Be

presented as a bar-chart size A3 or A4 and as a time-related logic network diagram on an A1 media, including activity listings.

c. The Activity Variance Analysis which shall analyse activities planned to start prior to or during the report period but not started at the end of the report period as well as activities started and/or completed in advance of the Works Programme.

2.4.3.2 The Works Programme shall include activities for all the phases and stages of the Works, clearly showing all logical interdependencies and stages in the development of the Contractor's Preliminary Design, Definitive Design, simulation Study, procurement, installation, commissioning and setting to work. As a minimum, it shall include:

- a. all work comprising the Permanent Works;
- b. preparation, submission and review of Designs and Documents showing all items where review by the Employer's Representative is required;
- c. procurement of all major materials and items of Contractor's Equipment for the Works, including the dates orders are to be placed, manufacture period and the expected delivery date to the Site for each item;
- d. any software development requirements and Validation time frames;
- e. all manufacture or prefabrication of materials or components;
- f. all activities associated with the securing of necessary permits and other statutory approvals for the Works;
- g. access and availability dates for all Project Contractors;
- h. all interfaces related to the Project that may affect the progress of the Works;
- i. testing and commissioning activities which demonstrate an understanding of the interfaces and requirements of Chapter 9 below; and
- j. Training and Transfer of Technology

2.4.3.3 The Works Programme shall be divided into Sub-Programmes of manageable sizes addressing in more specific detail, the content of the Management Plans as stated in Chapter 4 below. The Sub-Programmes shall be as follows:

2.4.3.3.1 Design Programme - The Design network/bar chart shall detail the various design, submission and acceptance stages including approval by local authorities and the Engineer, preparation, submission and approval of drawings, manuals and all other activities related to the design.

2.4.3.3.2 Procurement and Manufacturing Programme – It shall establish milestones for monitoring the progress of the manufacturing process.

2.4.3.3.3 Installation Programme.

2.4.3.3.4 Testing and Commissioning Programme - The Factory and On-Site Testing and Commissioning network/bar chart shall present the relationship and duration of those items relating to Commissioning tests including those related to other Designated Contractors.

2.4.3.3.5 Integrated Testing - The Integrated Testing network/bar chart shall indicate the activities required to verify the functioning of the Signalling & TC in conjunction with activities of the System-wide and Civil Contractors and

2.4.3.3.6 Training and Transfer of Technology Programme.

2.4.3.4 The submission of the full version of the Works Programme shall include the Design, Procurement, and Manufacturing Programme along with a preliminary version of the Design Philosophy, the Installation Programme and the Testing and Commissioning Programme identifying all major installation, testing activities and associated interfaces.

2.4.3.5 In addition, the contractor shall submit any other programmes as required by the employer's Representative from time to time.

2.4.3.6 The Contractor's Works Programme shall comply with the following:

2.4.3.6.1 all programmes shall be computerised Critical Path Method (CPM) networks developed using the Precedence Diagramming Method (PDM) and submitted in both hard copy and electronic data format.

2.4.3.6.2 all programmes shall be prepared using the latest version of CPM scheduling software Primavera Project Planner / or similar.

2.4.3.6.3 a standard Gregorian calendar shall be used for planning and execution of the Works. All programme submissions shall include details of the Contractor's allowance for Public Holidays and non-work periods. If a Key Date or falls on a Public Holiday or non-workday, it shall be effective the next working day.

2.4.3.6.4 the planning unit for the duration of all programme activities shall be the day. Any activity having a duration of more than thirty (30) days shall be divided into sub-activities that shall not exceed (30) days

2.4.3.6.5 CPM programmes shall reflect status using remaining duration and percent complete.

2.4.3.6.6 all programmes shall be fully resource loaded as appropriate or required by the Employer's Representative covering all stages and aspects of the Contract and shall include, but not be limited to:

- a. major manpower for installation.
- b. number of items of Contractor's Equipment.
- c. number of drawings and other deliverables.
- d. principle quantities of components or parts.
- e. principle quantities of bulk materials inclusive of cabling, pipe, ductwork and equipment items, etc.

2.4.3.6.7 All programmes constituting the Works Programme shall be organised in a logical work breakdown structure including work stages or phases. Each activity shall be coded to indicate, as a minimum, the work group or entity responsible for the activity, the area, facility or location in which the activity is included, from information provided in the Definitive Design Report. Key Dates and Access Dates shall be coded so as to be separately identifiable. The Contractor may be required to assign additional activity codes as required by the Employer's Representative.

## 2.5 SUBMISSION PROGRAMME

2.5.1 The Contractor shall, within 30 days of the Commencement Date of the Works, submit a Submission Programme covering all proposed submissions to the Employer's Representative.

2.5.2 The Submissions Programme shall include the proposals for Preliminary Design, vendor approvals and procurement activities of all sub-contractors and suppliers.

2.5.3 The Submissions Programme shall include each submission for every item listed in the Specification, as being required to be submitted.

2.5.4 The Submissions Programme shall ensure that all submissions are properly co-ordinated with the Contractor's overall Works Programme, particularly in respect of the following: -

2.5.4.1 progress of Design, manufacture, installation and testing work.

2.5.4.2 co-ordination with other Contractors; and

2.5.4.3 including due allowance for the Employer's Representative's review process to be undertaken, including the time needed for any re-submissions.

## 2.6 DESIGN, PROCUREMENT AND MANUFACTURING PROGRAMME

2.6.1 Within 60 days of the Commencement Date of the Works, the Contractor shall submit for review by the Employer's Representative Design, Procurement and Manufacturing Programme that shall be an integrated part of the overall Works Programme.

2.6.2 The Design, Procurement and Manufacturing Programme shall show the interdependencies between engineering disciplines as well as between the Contractor and its sub-contractors and suppliers. This programme shall demonstrate compliance with the requirements of the Submissions Programme in clause 2.5 above. The Design, Procurement and Manufacturing Programme shall



include the proposals for vendor approval. The contractor is required to submit the Preliminary Designs, Simulation Study Reports initially, followed by proposals for vendor approvals for all equipment, assemblies, sub-assemblies' spare parts, M&P and any other item required for the project. Inter alia the details should include design, manufacturing and testing facilities available with the vendor. Quality Assurance Plans adopted by the vendor and its sub-vendors shall also be submitted for employer's review. In case of offshore vendors, the contractor is required to submit details regarding facilities available in India and the experience in transfer of technology of the vendor proposed. The proposal should also include training and other technical support to be provided by the vendor. In case of offshore vendors, the proposed scope of technology transfer shall also be included. The Contractor should ensure that the equipment/systems proposed for elevated/at-grade/sections shall be, as far as possible, similar to the ones used in other Mumbai Metro Projects.

2.6.3 The Contractor is required to take the Approval on the submitted Preliminary Design Report initially from the Client's Representative. Once it is approved, the Contractor can proceed with the Definitive Design Report.

2.6.4 The Contractor shall submit a weighted bar chart of the Contractor's, procurement and manufacturing activities. Each activity weight shall normally not be more than 5% of the total man-hour content or value of the respective work.

2.6.5 The Procurement and Manufacturing Programme shall include a separate breakdown, supported by the Delivery of Preliminary Design Report, Material Control Schedule, which shall be a complete amplification of the Contractor's programme and equipment list, including those items which are subject to long lead time or component parts which are manufactured from countries outside the country of assembly and testing.

2.6.6 The Material Control Schedule shall be automated and shall detail the following information for each permanent major and minor material and significant component. The format of such a schedule shall include: i. name, description, supplier/sub-supplier details. ii. drawing information (where appropriate), title, drawing status, submission dates, shop drawings/ fabrication drawing preparation, etc. iii. Employer's Representative's inspection, delivery schedules.

2.6.7 The Contractor shall continuously maintain this schedule and report upon the status of each item as part of the Contractor's regular progress reporting.

2.6.8 From this base data, the Contractor shall prepare an exception report detailing all components that are in delay. This report shall be annotated with the reason for the delay and indicate what action the Contractor is taking to recover the lost time.

2.6.9 The Contractor shall submit, as part of the Procurement and Manufacturing Programme, a Factory Testing Programme that shall support all aspects of the Factory Testing Plan. This Programme shall clearly demonstrate the logic and include the topics listed in clause 4.5.1 below.

## INSTALLATION PROGRAMME

2.7.1 The Installation Programme shall be submitted as stated in the TS or as directed by the Employer's Representative. The Installation Programme shall comply with the requirements of clause 2.4.3.6 above.

2.7.2 The Installation Programme shall include detailed activities describing all aspects of the installation of the Works, to meet all Milestones and Key Dates given in the Contract. It shall be clearly linked to the Procurement and Manufacturing Programme and Testing and Commissioning Programme to form an integrated part of the Works Programme.

2.7.3 The Installation Programme shall be fully supported by the Construction and Installation Management Plan as specified in clause 4.6 below.

2.7.4 The Installation Programme shall indicate the physical areas to which the Contractor requires

access, access date, duration required and the required degree of completion for civil or architectural finishes prior to the access date.

2.7.5 The Installation Programme shall take into account the requirements for arrival at port, delivery, storage, preservation and positioning of large items of Contractor's Equipment and Permanent Works and shall set out the Contractor's proposed delivery route for such items to the Site. 2

2.7.6 Installation Tests shall be clearly shown in the Installation Programme and shall include those interface tests required to be carried out by others to establish a timetable for these tests. 2.7.7 Activities that may be expedited using overtime, additional shifts or by any other means shall be identified and explained.

2.7.8 In preparing the Installation Programme, the Contractor should note that the following conditions shall apply:

1. the Contractor shall not have exclusive access to any part of the Site except by the specific consent of the Employer's Representative.
2. the Contractor shall take note that concurrent time allocations for certain areas may be given to more than one contractor. The Contractor shall co-ordinate the Contractor's work in such areas with that of Project Contractors through the Employer's Representative.
3. the absence of a programme date or installation period for the Contractor in a specific area shall not prejudice the right of the Employer's Representative to establish a reasonable programme date or installation period for that area.
4. the Contractor shall comply with the identified Key Dates. The Contractor shall also comply with the Access dates identified in the; and
5. the Contractor shall deliver all Contractor's Equipment and Permanent Works for stations and ventilation shafts by road and via temporary access openings unless otherwise reviewed by the Employer's Representative.

## 2.8 TESTING AND COMMISSIONING PROGRAMME

2.8.1 The Testing and Commissioning Programme shall be submitted as stated in the TS or as directed by the Employer's Representative and shall comply with the requirements of clause 2.7 above.

2.8.2 The Contractor shall submit the Testing and Commissioning Programme that shall fulfil all the on-Site testing and commissioning requirements of clause 10.3.2.2 below. The Testing and Commissioning Programme shall clearly demonstrate the logic and highlight the topics listed in the On-Site Testing and Commissioning Plan in clause 10.3.2.2 below.

2.8.3 The Testing and Commissioning Programme shall be fully detailed, with activities individually identifying all tests for which a certificate will be issued, and shall include activities for preparation, submittal and review of the test procedures

2.8.4 The Testing and Commissioning Programme shall demonstrate the logical dependencies between the individual tests of the Works and shall also show the interfaces and dependencies with all of the Project Contractors' tests required to commission the Works and support the Commissioning Plan.

## CHAPTER 4- MANAGEMENT PLANS & SUBMISSIONS

### 4.1 PROCUREMENT & MANUFACTURING PLAN

The Procurement and Manufacturing Plan shall be configured as a family of “stand-alone” plans and associated documents each covering one of the subjects listed below. The plans shall be co-ordinated with each other and shall collectively define, describe and encompass the Contractor’s proposed methods, procedures, processes, organization, sequencing of activities, etc. and shall show how these combine together to assure that the Works fully meet the requirements of the Specification in respect of the subjects listed.

#### 4.1.1. Factory Testing Plan

- 4.1.1.1. The plan shall contain but not be limited to the following topics:
  - a. the plan for the production and submission of the inspection and test procedures to the Employer’s Representative for review including the submission of the inspection and test reports and records; and
  - b. Type Tests, Routine Tests, First Article Inspections and any other tests constituting the Factory Acceptance Tests.
- 4.1.1.2. The Contractor shall arrange for all equipment and systems manufactured for incorporation into the Permanent Works to undergo a Factory Acceptance Test (FAT) before shipment from the place of manufacture. Any particular requirements for inspection and testing at the place of manufacture are prescribed in the TS.
- 4.1.1.3. The Contractor shall be responsible for re-inspecting and re-testing any failed inspection and Factory Acceptance Test including regression testing on previously passed items.
- 4.1.1.4. Inspections and tests that are to be witnessed by the Employer or the Employer’s Representative shall be sensibly grouped and scheduled so that as many inspections and tests as possible may be witnessed during a single visit.
- 4.1.1.5. Unless otherwise specified in TS, Type Tests as detailed in **clause 10.2.6** below shall be performed on all items of equipment to be installed as part of the Permanent Works under the Contract.
- 4.1.1.6. For all production items a First Article Inspection shall be undertaken as detailed in **clause 10.2.7 below**. Routine production testing methods shall be detailed for review by the Employer’s Representative. Routine testing shall ensure that all samples of a production item are within the tolerances required for complete interchangeability.
- 4.1.1.7. The Contractor shall prepare two copies of an inspection or test report immediately after the completion of each inspection or test whether or not witnessed by the Employer or the Employer’s Representative. If the Employer or the Employer’s Representative has witnessed the inspection or test, he will countersign the inspection or test report to indicate his review of the information and conclusions (i.e. whether or not the equipment being inspected or tested has passed satisfactorily) contained therein. If the Employer or the Employer’s Representative has not witnessed the inspection or test (i.e., if a waiver has been granted, or the Employer or the Employer’s Representative has not witnessed the inspection or test for some other reason in accordance with the Contract), the Contractor shall forward two copies of the inspection or test report without delay to the Employer’s Representative. The Employer’s Representative will countersign the report to indicate his review of the information and conclusions (i.e. whether or not the equipment being inspected or tested has passed satisfactorily) and return one copy to the Contractor. Where the results of the inspection or test do not meet the requirements of the Specification, the Employer or the Employer’s Representative may call for a re-inspection or re-test. In the test report submission, the contractor has to certify that the tests have been

conducted as per the tests requirements as per applicable standards. The results found are complying with the contract requirements and contract clauses

- 4.1.1.8. For standard equipment, which is serial, or bulk manufactured, manufacturer's type test certificates (or equivalent) may, subject to review by the Employer's Representative, be accepted. It is to be ensured that type test should not be more than 5 years old.
- 4.1.1.9. Materials and equipment shall not be released for shipment until all applicable inspections and tests including Factory Acceptance Tests have been satisfactorily completed.
- 4.1.1.10. It is to be ensured that type test should not be more than 5 years old from date of Letter of Acceptance (LOA) of the contract.

#### 4.1.2. Procurement, Manufacturing and Delivery Plan

- 4.1.2.1. The Contractor shall prepare procurement, manufacturing and delivery plans in respect of all items and goods. Separate parts of the plan shall be prepared for Contractor or sub-contractor off-Site activities. Each plan shall identify the scope of work to be applied. In relation to such scope of work, it shall, without limitation, define:
  - a. the purchasing of items and goods and ensuring they comply with the requirements of the Specification, including (without limit) purchasing documentation and specific Verification arrangements for Contractor/Employer's Representative inspection of material or manufactured product prior to release for use;
  - b. the manufacturing process so as to ensure compliance with the design.
  - c. the manufacturing process so as to ensure clear identification and traceability of material and manufactured parts.
  - d. the inspection and testing of incoming materials, in process and final product so as to ensure specified requirements for the material and/or manufactured product are met.
  - e. the identification of the inspection and test status of all material and manufactured products during all stages of the manufacturing process to ensure that only products that have passed the required inspections and tests are dispatched for use and/or installation.
  - f. review and disposal of non-conforming material or product so as to avoid unintended use.
  - g. the assessment and disposal of non-conforming material and manufactured product and approval for reworking or rejection as scrap.
  - h. the identification of preventive action so as to prevent recurrence of similar nonconformance; and
  - i. the handling, storage, packaging, preservation and delivery of manufactured product.
- 4.1.2.2. Once the inspection and any required remedial actions are completed to the satisfaction of the Employer's Representative, the Employer's Representative shall give a notice of no objection for unit shipment. The Employer's Representative will not withhold his notice of no objection for shipping unreasonably, provided all pre- delivery assembly and testing has been successfully completed.
- 4.1.2.3. Any unit delivered without the Employer's Representative's notice of no objection shall be rejected at the Site and all expenses thereby incurred shall be borne by the Contractor.

## 4.2 CONSTRUCTION & INSTALLATION MANAGEMENT PLAN

The Construction and Installation Management Plan shall be configured as a family of "standalone" plans and associated documents each covering one of the subjects listed below.

The plans shall be co-ordinated with each other and shall collectively define, describe and encompass the Contractor's proposed methods, sequencing of activities, etc. and shall show how these combine together to assure that the Works truly meet the requirements of the Specification in respect of the subjects listed.

#### 4.2.1. Construction and Installation Plan

- 4.2.1.1. The Contractor shall prepare plans for the construction and installation activities on and off the site, as referenced in clause **15.1.1 below**, and shall ensure that these are properly related to the subsequent testing and commissioning activity.
- 4.2.1.2. Separate parts of the plan shall be prepared for other contractor(s) or sub-contractor(s) offsite activities.
- 4.2.1.3. Each construction plan shall identify the scope of activity to be controlled. In relation to such scope of activity, it shall, without limitation, define:
  - a. the interfacing or co-ordination required with the Contractor's other related plans;
  - b. the specific methods of construction and installation to identify any relevant method statements and develop those method statements to a sufficient degree of detail reviewed by the Employer's Representative.
  - c. a detailed method statement which shall include but not be limited to:
    1. description of main operations and sub-operations;
    2. sequence of sub-operations;
    3. quantities of the work and production rates to be achieved;
    4. resources to be employed; and
    5. quality checks to be carried out, supervision being exercised and safety precautions to be employed;
  - d. the list of procedures and work instructions to manage and control the quality of construction and installation works, including without limitation:
    1. the construction processes including Temporary Works so as to ensure compliance with drawings and Specification. In addition, any software to be used in the construction, installation and commissioning process shall be identified and details of the Verification and Validation processes for the software application shall be given;
    2. the construction and installation process so as to ensure clear identification and traceability of material and manufactured product;
    3. the identification of the inspection and test status of all material and manufactured products during all stages of the construction and installation process to ensure that only products that have passed the required inspections and tests are despatched for use and/or installation;
    4. review and disposition of non-conforming material or product so as to avoid unintended use/installation;
    5. the assessment and disposition of non-conforming material and product and approval for reworking or rejection as scrap;
    6. the identification of preventive action so as to prevent recurrence of similar non-conformance; and
    7. the handling, storage, packaging, preservation and delivery of product; and
  - e. the security control of the Site and the works area for Contractor's accommodation, storage, car park and other works facilities, etc. in accordance with clause **16.1.2 & 16.10 below**.

- 4.2.1.4. Where all or part of the Works is within the MMRDA Protection Zone, the Contractor shall follow the guidelines issued by the Employer's appropriate authority. The Contractor shall submit to the Employer's Representative for review his construction method statement and detailed design of any Temporary Works proposed to be erected within this zone adjacent to MMRDA properties.
- 4.2.1.5. The following particulars shall be submitted to the Employer's Representative for review within 14 days of the Commencement Date of the Works:
- a. drawings showing the layout within the Site of the Employer's Representative's and Contractor's accommodation, Project signboards, access roads and major facilities required early in the Contract;
  - b. drawings showing the layout and the construction details of the Employer's Representative's accommodation; and
  - c. drawings showing the details to be included on Project signboards.
- 4.2.1.6. Drawings showing the location of stores, storage areas, work areas and other major facilities shall be submitted to the Employer's Representative for review as early as possible, but in any case, not later than 28 days before construction of the facilities.

4.2.2. Health and Safety Documentation

- 4.2.2.1. The Contractor shall submit Health and Safety Documentation to fully comply with the requirements of the Project conditions and proposed work activities in accordance with **Section- 6C**.
- 4.2.2.2. The Contractor shall submit to the Employer's Representative the Health and Safety Documentation for review within 30 days of the Commencement Date of the Works.

4.2.3. Traffic Management

The Contractor shall carry out the Works so as to minimize disruption to road and pedestrian traffic. The Contractor shall prepare his traffic management plan based on his proposed construction methodology in co-ordination with Engineer and in conjunction with Local Traffic Police. He shall comply strictly with the approved plan during construction of his works. The design shall provide for temporary road decking wherever necessary to provide minimum numbers of traffic lanes as agreed with Local Traffic Police.

4.7.1. Commissioning Plan

- 4.7.1.1. The Contractor shall ensure the timely preparation of the Commissioning Plan in a format and to a level of detail in accordance with **clause 10.3** below. The Contractor shall submit the first draft of the Commissioning Plan to the Employer's Representative within 180 days of the Commencement Date of the Works.
- 4.7.1.2. The Commissioning Plan shall consist of the following:

1. On-Site Testing and Commissioning Plan

Installation Tests Schedule:

The Contractor shall submit to the Employer's Representative a comprehensive schedule of Installation Tests as required by **Clause 10.4.3** below and the TS and in accordance with the Installation Programme as stated in clause **2.7 above**. The schedule shall be submitted within the period of time laid down in the TS, or, if none is given, not later than two months in advance of the date for the commencement of the Installation Tests.

## 2. Partial Acceptance Tests Plan

The Contractor shall submit to the Employer's Representative a comprehensive Partial Acceptance Tests Plan including all requirements detailed in **clause 10.4.4** below and the TS. The plan shall be submitted within the period of time laid down in the TS, or, if none is given, not later than four months in advance of the date for the commencement of the Partial Acceptance Tests.

## 3. System Acceptance Tests Plan

The Contractor shall submit to the Employer's Representative a comprehensive System Acceptance Tests Plan including all requirements detailed in **clause 10.4.5** below and the TS. The plan shall be submitted within the period of time laid down in the TS, or, if none is given, not later than four months in advance of the date for the commencement of the System Acceptance Tests.

## 4. Integrated Testing & Commissioning Plan

The Contractor shall submit to the Employer's Representative a comprehensive Integrated Testing & Commissioning Plan including all requirements detailed in **clause 10.4.6** below and the TS. The plan shall be submitted within the period of time laid down in the TS, or, if none is given, not later than four months in advance of the date for the commencement of the Integrated Testing & Commissioning.

### 4.7.2. Operation and Maintenance Manuals Plan

4.7.2.1. The Contractor shall develop an Operation and Maintenance Manuals Plan to suit staged commissioning of the system and to ensure the timely preparation of the Contractor's Operation and Maintenance Manuals and the 'As-Built' drawings in a format and to a level of detail reviewed without objection by the Employer's Representative and in accordance with **Chapter 12** below.

4.7.2.2. The Contractor shall submit the Operation and Maintenance Manuals Plan by the date stated in the TS, or, if none is given, not later than nine (9) months prior to the issue of the Taking Over Certificate for the Works and according to staged commissioning of the proposed systems.

### 4.7.3. Training and Transfer of Technology Plan

4.7.3.1. The Contractor shall ensure the timely preparation of the Contractor's Training and Transfer of Technology Plan in a format and to a level of detail reviewed without objection by the Employer's Representative and fulfilling the requirements of **clause 11.1** below.

4.7.3.2. The Contractor shall submit the Training and Transfer of Technology Plan by the date stated in the TS, or, if none is given, not less than six (6) months prior to the issue of the Taking Over Certificate for the Works and also to suit the staged commissioning of the relevant systems.

### 4.7.4. Defects Liability Management Plan

The Contractor shall submit for review by the Employer's Representative a Defects Liability Management Plan to repair, replace and perform any remedial item upon the Works identified by the Employer's Representative during the Defects Liability Period (DLP). The first submission of this plan is required upon issuance of the Taking Over Certificate for the Works. The Contractor shall:

1. endeavour to complete all necessary work in a timely responsible manner;

2. not proceed with any remedial work without the consent of the Employer's Representative;
3. submit a plan that details the methods and timing of any proposed work; and
4. update the plan monthly, showing progress of the work and the time to completion.



## CHAPTER 5 – DOCUMENTS SUBMISSION AND REVIEW

### 5.1 DOCUMENTS, SUBMISSIONS AND CORRESPONDENCE

Copies of correspondence relevant to the execution of the Works and not of a confidential nature received from or despatched to Government departments, utility undertakings and Project Contractors employed by the Employer shall be submitted to the Employer's Representative for information as soon as possible but, in any case not later than 7 days after receipt.

### 5.2 SUBMISSIONS TO THE EMPLOYER'S REPRESENTATIVE

#### 5.2.1. General requirements

5.2.1.1. All submissions shall be made to the Employer's Representative in a format reviewed without objection by the Employer's Representative and in accordance with the requirements in:

1. the Contract;
2. the Computer Aided Design & Drafting (CADD) Manual; and
3. the Document Submittal Instructions to Consultants and Contractors.

5.2.1.2. Paper and drawing sizes shall be "A" series sheets as specified in BS 3429.

5.2.1.3. The following software (versions quoted or higher) compatible for use with Intel-Windows based computers shall be used, unless otherwise stated, for the various electronic submissions required:

Document Type	Electronic Document Format (latest versions of)
Text Documents	MS Word
Spread Sheets	MS Excel
Data Base Files	MS Access
Presentation Files	MS PowerPoint
Programmes	Primavera for Windows
AutoCAD Graphics	CorelDraw / AutoCAD
Photographic	Adobe Photo Shop
Desktop Publishing	QuarkXPress
CADD Drawings	Micro Station/Autodesk

#### Media for Electronic File Submission

#### **PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS)**

The contractor shall adopt a reputed system for PMIS and get the same approved by the engineer. The Contractor shall devise and utilize the PMIS such that all documents generated by the Contractor can be transmitted to the Engineer by electronic means (and vice versa) and that all documents generated by either party are electronically captured at the point of origin and can be reproduced later, electronically and in hard copy. A similar link shall also be provided between the Engineer office at site and the Employer's Office by the Contractor.

5.2.1.4. If required, two copies of all internal and external orders placed by the Contractor for equipment or materials required for the Works shall be forwarded to the Employer's Representative at the time of issue. All orders shall state the Employer's Representative's requirements for inspection and testing, shall bear the Contractor

reference, Contractor's name and address and shall indicate, where applicable, the sub-section of the Works for which the equipment or material is required.

- 5.2.1.5. The Contractor shall have the obligation to upgrade, at his own cost, all the relevant software to the latest version upon instruction by the Employer's Representative, after the new version of the relevant software has been launched for more than six months in Mumbai.
- 5.2.1.6. The Contractor shall submit a drawing register to the Employer's Representative in electronic copy and hard copy with each submission of drawings and at an interval agreed by the Employer's Representative. The drawing register shall be in a format submitted for review and agreed without objection by the Employer's Representative and shall include each document reference number, version, date, title and data-file name.
- 5.2.1.7. Specific additional requirements in respect of the numbering scheme shall be as defined in the TS.

#### 5.2.2. Content

- 5.2.2.1. Unless otherwise specified or permitted by the Employer's Representative, each submission shall comprise:
  - a. for drawings - one A1 master on vellum (signed by the contractor), one A1 copy on vellum, one paper A1 copy, six paper A3 copies and an electronic data copy of all drawings; and
  - b. for documents - the unbound original, six bound copies and an electronic copy when applicable.
- 5.2.2.2. The A3 copies of drawings shall be produced as reduced versions of the A1 original.

### 5.3 RECORDS AND REPORTS

- 5.3.1. Reports and records that are to be submitted to the Employer's Representative shall be in a format reviewed by the Employer's Representative. Reports and records shall be signed by the Contractor's agent or by a representative authorised by the Contractor.
- 5.3.2. Within 30 days of the Commencement Date of the Works, the Contractor shall submit a Project document control procedure to the Employer's Representative for review, which shall include but not be limited to the following:
  - a. a document approval system which shall specify the level of authority for approval of all documents and material before submission to the Employer's Representative;
  - b. a system of issuing documents to ensure that pertinent documents are issued to all appropriate locations;
  - c. a document change or re-issue system to ensure that only the latest revision of a document can be used; and
  - d. a submission identification system which identifies each submission uniquely by the following:
    - 1. contract number;
    - 2. discipline;
    - 3. submission number; and
    - 4. revision indicator.

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- 5.3.3. Project records will eventually be used by the Employer to manage, operate and maintain the Works after the completion of the Project under construction and for future reference.
- 5.3.4. The Contractor shall submit the documents as required by the Employer's Representative as Project records in full and on time. The Employer's Representative shall determine the adequacy of the Project record.
- 5.3.5. Submission and review procedure**
- 5.3.5.1. Except where specific procedures are given for certain items, all submissions shall be submitted and reviewed according to the procedure laid down in the following clauses.
- 5.3.5.2. Each submission shall be accompanied by a brief introduction to explain which sub-system, part or Section of the Works to which the submission refers, listing the documents enclosed with the submission, and describing in outline how all relevant requirements of the Specification are achieved by the proposals.
- 5.3.5.3. For each stage of submittal, the Contractor shall prepare a Submission Review Request (SRR) carrying the date of submission, the submission reference number as defined in **APPENDIX -2**, the submission title, the stage of submission, and the authorised signature of the Contractor's responsible engineer in the format shown in Appendix of this Specification, to confirm that, in the opinion of the Contractor, the submission:
1. complies with all relevant requirements of the Specification;
  2. conforms to all interface requirements;
  3. contains, or is based on auditable and proven or verified calculations.;
  4. has been properly reviewed by the Contractor, according to the Contractor's QA system, to confirm its completeness, accuracy, adequacy and validity; and
  5. has taken account of all requirements for approval by statutory bodies or similar organisations, and that where required, such approvals have been granted.
- 5.3.5.4. The Employer's Representative's response to the submission will normally be made within 30 calendar days of receipt of the submission, provided that the submission is made no later than the date shown on the Submissions Programme described in **clause 2.5 above**. The Employer's Representative may extend the review period depending on the amount of documentation accompanying the submission.
- 5.3.5.5. The Contractor shall record all of the Employer's Representative's observations and any agreed actions resulting from the Employer's Representative's review meeting and shall address each of these fully before submission of the respective documents for formal review.
- 5.3.5.6. If, in the Employer's Representative's opinion, following receipt of a submission there is benefit to be gained from a meeting with the Contractor to clarify or discuss any of the contents of the submission, he will notify the Contractor accordingly with not less than 5 days advance notice, and the Contractor shall attend at the time and place appointed by the Employer's Representative.
- 5.3.5.7. No submission may be made by the Contractor in respect of the Works or any sub-system, part or Section thereof unless a notice of no objection has been received for the previous stage of the same Works or any sub-system, part or Section thereof.
- 5.3.6. Employer's Representative's Response
- 5.3.6.1. The Employer's Representative will respond in one of the following three ways:
1. "Reviewed without Objection"
  2. "Reviewed without Objection, Subject to"
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### 3. "Rejected"

- 5.3.6.2. If the Employer's Representative, having reviewed the submission, has not discovered any non-compliance with the Contract, the SRR will be returned endorsed with the Employer's Representative's signature and the words "Reviewed without Objection". Receipt of such notice of no objection does not in any way imply the Employer's Representative's approval of the submission, nor does it remove any responsibility from the Contractor for complying with the Contract. Issue of a "Notice of No Objection" entitles the Contractor to proceed to the next stage of the programme of work.
- 5.3.6.3. If the Employer's Representative discovers minor non-compliance, discrepancies, omissions, etc. that, in his opinion, are not of a fundamental nature, he may return the SRR endorsed with the Employer's Representative's signature and the words "Reviewed without Objection Subject to", and including a list of the features that are required to be amended, included or improved to comply with the Contract. Issue of a "Notice of No Objection Subject to" entitles the Contractor to proceed to the next stage of the programme of work provided that all of the Employer's Representative's comments are taken into account fully and implemented exactly.
- 5.3.6.4. If the Employer's Representative issues a "Notice of No Objection Subject to", the Contractor shall resubmit the affected parts of the submission, clearly demonstrating how the Employer's Representative's comments have been taken into account and resubmit amended or corrected material within 10 working days of issue of the Employer's Representative's comments, using the process described in **clause 5.3.5 above**.
- 5.3.6.5. If the Employer's Representative discovers major non-compliance, discrepancies, omissions, etc. that, in his opinion, are of a fundamental nature, he may return the SRR endorsed with the Employer's Representative's signature and the word "Rejected", and including a list of the features that are required to be amended, included or improved to comply with the Contract. Issue of a "Notice of Rejection" does not entitle the Contractor to proceed to the next stage of the programme of work until all of the Employer's Representative's comments are fully taken into account and a satisfactory re-submission has been made (i.e. one which results in a "Notice of No Objection" or "Notice of No Objection Subject to").
- 5.3.6.6. If the Employer's Representative issues a "Notice of Rejection", the Contractor shall resubmit the complete submission, clearly demonstrating how the Employer's Representative's comments have been taken into account and resubmit amended or corrected material within 10 working days of issue of the Employer's Representative's comments, using the process described in **clause 5.3.5 above**.

## 5.4 RECORDS

- 5.4.1. The Contractor shall establish and maintain a place for the storage and archiving of all the documents relating to the Works and not required to be submitted to the Employer's Representative under **clause 5.1** above which shall be:
- 5.4.1.1. the same place or office where the Contractor is performing the work and storing documents reviewed by the Employer's Representative, or;
- 5.4.1.2. at the Site or elsewhere in Mumbai, a records office, which contains all other, documents that the Contractor is required to maintain in accordance with the Contract.
- 5.4.2. All documents shall be filed, indexed and suitably stored to permit easy identification and necessary audits.

- 5.4.3. The Contractor shall maintain in Mumbai his archive of all documents in connection with and arising out of the Contract, until 28 days after the issue of the Final Certificate or until final settlement of all Disputes, whichever is later.

## CHAPTER 6 – QUALITY MANAGEMENT

### 6.1 INTRODUCTION

6.1.1 The Contractor shall maintain and implement a Quality Management System that shall remain in effect during the execution of the Works. The Contractor's Quality Management System shall be based on the International Standard ISO 9001/9002:2000 "Model for quality assurance in design, development, production, installation and servicing." The Contractor shall submit its Quality Management System documentation for the Employer's Representative's review as specified in this Chapter. The Quality Management System documentation shall include, but shall not be limited to the following:

1. quality manual;
2. quality procedures and work instructions;
3. quality plans; and
4. inspection and test plans.

6.1.2 The Contractor shall plan, perform and record all quality control activities to ensure that all work is performed in accordance with the requirements of the Contract and is detailed in the quality plans which are required under this Chapter. Such activities shall include, without limitation, the inspections and/or tests expressly or implicitly required by the Contract.

6.1.3 Without prejudice to such requirements, the Employer's Representative may from time to time instruct the Contractor in relation to such further or other inspections and/or tests as are in his opinion appropriate.

6.1.4 Quality audits will be conducted by the Employer's Representative to verify the Contractor's implementation and compliance with the quality management system as specified herein.

### 6.2 GENERAL REQUIREMENTS

6.2.1 All quality system documents and plans to be submitted shall embrace all activities of the Contractor and sub-contractors of any tier, including its suppliers.

#### 6.2.2 Quality Plans

6.2.2.1 The quality plans to be submitted by the Contractor shall comprise of:

1. a Management Quality Plan, for the control of all management related activities within 30 days of the Commencement Date of the Works;
2. Manufacturing Quality Plan and Site Quality Plan, for the control of activities within each category of work or discrete element of procurement, manufacturing, delivery, construction and installation of the Works, including Temporary Works.

6.2.3 Within 30 days of the Commencement Date of the Works, the Contractor shall submit for review by the Employer's Representative:

1. a quality manual;
2. the quality system procedures and any associated system instructions and/or forms which he proposes to use for the Works;

- 6.2.4 The Contractor shall submit separate Manufacturing Quality Plan and Site Quality Plan covering all elements of the Works. These shall be in accordance with the specific requirements of this Chapter and shall be submitted to the Employer's Representative for review 60 days prior to the commencement of the manufacturing and construction works covered by the quality plans. In addition, the Contractor shall prepare inspection and test plans for the management and control of the inspection and/or testing by the Contractor of the Works identified in each quality plan.
- 6.2.5 The Contractor shall promptly supply the Employer's Representative with two (2) controlled copies of his quality manual, quality plans, inspection and test plans and related procedures/instructions/forms upon such documents being reviewed without objection by the Employer's Representative. The Contractor shall maintain such controlled documents throughout the duration of the Contract. For any amendment to quality system documentation, the Contractor shall as soon as reasonably practicably prepare and submit the proposed amendment for review by the Employer's Representative. In addition, the Employer's Representative may request further copies of the quality system documents and these documents shall reach the Employer's Representative's office within fourteen (14) days of notification.
- 6.2.6 The Contractor shall appoint (a) suitably qualified and experienced person(s) as Quality Manager(s), who shall be directly responsible to senior management level and is able to discharge his duties without hindrance or constraint and provide such other resources as may be required to ensure effective implementation of the Quality Management System and all quality plans. Details of the qualifications, experience, authority and responsibility of the proposed Quality Manager(s) shall be submitted for review by the Employer's Representative within 30 days of the Commencement Date of the Works.
- 6.2.7 During the Contract period, upon receipt of a Corrective Action Request (CAR) or similar document issued by the Employer's Representative as a result of quality audits, the Contractor shall submit a proposed corrective and preventive action plan within 14 days to the Employer's Representative for review.

### 6.3 MANAGEMENT QUALITY PLAN

- 6.3.1 The Management Quality Plan shall define the Contractor's management structure for the execution of the Works and for the control of the quality of the Works and shall, without limitation, define:
1. the appointment of a Quality Manager in accordance with **clause 6.2.6** above;
  2. the organisation of the Contractor's managerial staff with particular reference to any joint venture partners and main sub-contractors. An organisation chart shall be produced to illustrate the sub-division of the Works into elements for effective technical and managerial control, the reporting structure and the interface relationship between all parties involved.
  3. the hierarchy of the overall quality management system documentation to be applied to the Works.
  4. the quality management system of the Contractor in monitoring and controlling subcontractors and suppliers; and
  5. the list of quality system procedures and work instructions to be applied to manage the quality of the Works.

### 6.4 SITE QUALITY PLAN

- 6.4.1 The Contractor shall prepare a Site Quality Plan for its construction and installation works. The Site Quality Plan shall, without limitation, define:
1. the organisation of the Contractor's staff directly responsible for the day-to-day management of the construction and installation activities on or off the Site.

2. the specific allocations of responsibilities and authorities given to identified personnel or sub-contractors for particular construction and installation work;
3. the hierarchy of quality management system documentation for managing and controlling construction and installation works, including construction and installation works of sub-contractors of any tier; and
4. the list of procedures and instructions to be applied to manage and control the construction and installation works together with the procedures and instructions that have not been previously submitted for review.

6.4.2 The Contractor shall also prepare inspection and test plans to manage and control any test and inspection activities in accordance with **clause 6.5.1** below.

## 6.5 INSPECTION AND TEST PLANS, RECORDS AND REPORTS

6.5.1 Inspection and test plans shall be produced for every activity requiring test and/or inspection. Each inspection and test plan shall identify the quality objectives and include, without limitation:

1. the personnel responsible for undertaking and certifying the inspection and/or test.
2. the procedure or instructions for the inspection and/or test.
3. the test method or a reference to the relevant standard of testing.
4. the inspection and/or test required prior to commencement of an activity.
5. the inspection and/or test during an activity and its frequency.
6. the inspection and/or test required to complete an activity.
7. all Quality Control Points, Quality Hold Points and any notices or other documents to be given to the Employer's Representative in relation to Quality Control Points and Quality Hold Points.
8. the compliance criteria.
9. the method of analysis of test data.
10. the procedure for correction or disposal of any work which fails the compliance criteria.
11. examples of the documentation to be used for reporting the results of inspections, tests and analysis of test data;
12. examples of the documentation to be used for recording the status of inspections and tests in accordance with clause 6.7.1 below; and
13. the procedure for the distribution, filing and storage of inspection reports, test reports and reports on analysis of test data.

6.5.2 Each report of the inspection and/or test shall be prepared in accordance with **clause 10.4**.

6.5.3 The Contractor shall ensure that a signed copy of each report of inspection and test is filed in his filing system within 3 (three) working days of the date of inspection and test.

6.5.4 In relation to all Quality Control Points and Quality Hold Points involving inspection and/or test by the Contractor, the Contractor shall give the Employer's Representative notice of when the relevant work will be inspected and/or tested in accordance with **clause 10.8.1 below**.

## 6.6 REVIEW, VERIFICATION & AUDIT

6.6.1 The Contractor shall continuously monitor the performance of each quality plan related to the execution of the Works and shall include in each Monthly Progress Report the status of all quality system documentation, an up-to-date audit schedule and status and an up-to-date nonconformity register providing the status of all non-conformities identified by the Employer's Representative and the Contractor. The Contractor shall make an appraisal of such performance and identify in particular any non-conformities or other shortcomings in the quality management system, the actions being taken to dispose of these non-conformities, any necessary corrective action taken or proposed to be taken to prevent



the re-occurrence of these non-conformities or shortcomings and, any other items as instructed by the Employer's Representative.

- 6.6.2 The Contractor shall ensure that audits of all the activities in each quality plan are carried out at quarterly intervals, or at such other intervals as the Employer's Representative may require, to ensure the continuing suitability and effectiveness of the quality management system. Reports of each such audit shall be submitted promptly for review by the Employer's Representative.
- 6.6.3 The Contractor shall ensure that the requirements for supervision and verification of work by the Contractor and/or his sub-contractors of any tiers are identified in the quality plans and adequate resources and trained personnel are provided for these activities.
- 6.6.4 The Contractor shall submit for review by the Employer's Representative details of the authority, qualifications and experience of personnel assigned to review, verification and to audit activities.
- 6.6.5 The Employer's Representative may, by notice to the Contractor, require external audits of the Contractor's quality management system to be carried out either by the Employer's staff or by his representative. In such case, the Contractor shall afford to such auditors all necessary facilities and access to the records to permit this function to be performed.

#### 6.7 QUALITY CONTROL REGISTER

- 6.7.1 The Contractor shall provide and maintain at all stages of the Works a quality control register or registers to identify the status of inspections, sampling and testing of the work and all certificates. Such registers shall be updated by the Contractor to show all activities in previous months and shall reach the Employer's Representative's office before the 7th working day of each month. Each register shall:
  - 1. list the certificates received for each batch of goods and materials incorporated in the Works and compare this against the certification required by the Contract and the Contractor's quality plans;
  - 2. list the inspection and testing activities undertaken by the Contractor on each element of the Works and compare these activities against the amount of inspection and testing required by the Contract and the Contractor's quality plans;
  - 3. show the results of each report of inspection and/or test and any required analysis of these results and compare these results against the pass/fail criteria; and
  - 4. summarize any actions proposed by the Contractor to overcome any non-conformity identified in clauses 6.6.1, 6.6.2 & 6.6.3 above.

#### 6.8 SUMMARIES OF INSPECTION AND/OR TEST

The Contractor shall submit to the Employer's Representative for his information summaries based on quality control register in accordance with the Summaries of Inspection and/or Test described in **clause 10.6.11 below**.

#### 6.9 NOTIFICATION OF NON-CONFORMITIES

- 6.9.1 If, prior to the issue of the Taking Over Certificate for the Works or the relevant Section, the Contractor has used or proposes to use or repair any item of the Works which does not conform to the requirements of the Contract, he shall immediately submit to the Employer's Representative such proposal, supplying full particulars of the non-conformity and, if appropriate, of the proposed means of repair which shall include any calculation analysis or other documentation to support the repair or acceptability of the non-conformity.

- 6.9.2 If the Employer's Representative issues non-conformity reports or similar documents to notify the Contractor of any item of the Works which he considers to constitute a non-conformity and which has not been reported in accordance with clause 5.9.1 above, the Contractor shall promptly investigate the matter and, within 14 days of notification by the Employer's Representative, submit to the Employer's Representative for review the remedial measures to be taken and stating the reasons for such measures.

## CHAPTER 7 – MATERIALS & EQUIPMENT

### 8.1 MATERIALS AND EQUIPMENT PROVIDED BY THE EMPLOYER

- 8.1.1 Materials and equipment which are to be provided by the Employer will be as stated in the Contract.
- 8.1.2 Materials and equipment provided by the Employer shall be collected by the Contractor from the locations stated in the Contract and delivered by the Contractor to the Site. The Contractor shall inspect the materials and equipment before taking receipt and shall immediately inform the Employer's Representative of any shortage or damage.
- 8.1.3 Materials or equipment provided by the Employer which are damaged after collection shall be repaired by the Contractor and submitted to the Employer's Representative for review. Materials or equipment which are lost or which in the opinion of the Employer's Representative are not capable of being or have not been repaired satisfactorily shall be replaced by the Contractor.
- 8.1.4 The Contractor shall dispose of crates and containers for materials or equipment provided by the Employer.
- 8.1.5 Equipment / materials provided by the Employer, surplus to the requirements of the Works shall be returned to the locations stated in the Contract.
- 8.1.6 The Contractor shall protect and maintain equipment provided by the Employer while it is on the Site and shall provide operatives, fuel and other consumables required to operate the equipment.

### 8.2 MATERIALS

#### 8.2.1 General

- 8.2.1.1. Materials for inclusion in the Permanent Works shall be new unless otherwise stated in the Contract or having been reviewed without objection by the Employer's Representative.
- 8.2.1.2. Certificates of tests by manufacturers, which are submitted to the Employer's Representative, shall relate to the material delivered to the Site. Certified true copies of certificates may be submitted if the original certificates cannot be obtained from the manufacturer. A letter from the supplier stating that the certificates relate to the material delivered to the Site shall be submitted with the certificates.
- 8.2.1.3. Materials, which are specified by means of trade or proprietary names, may be substituted by materials from a different manufacturer, provided that the materials are of the same or better quality and comply with the specified requirements and have been reviewed without objection by the Employer's Representative.
- 8.2.1.4. In addition to any special provisions in the Contract for the sampling and testing of materials, the Contractor shall submit samples of all materials and goods which it proposes to use or employ in or for the Works. Such samples, if having been reviewed without objection, shall be retained by the Employer's Representative and shall not be returned to the Contractor or used in the Permanent Works unless reviewed by the Employer's Representative. No materials or goods of which samples have been submitted shall be used in the Works unless and until the Employer's Representative shall have reviewed such samples without objection.

8.2.1.5. The Employer's Representative may reject any materials and goods which in his opinion are inferior to the samples previously reviewed and the Contractor shall promptly remove such materials and goods from the Site.

8.2.1.6. If any material required for this Contract is not available in metric specifications from any known sources, at the time the material is required for the Contract, the Employer's Representative may, upon application from the Contractor, give permission to the use of an equivalent material in imperial specifications as a substitute, provided that:

no statutory specification shall be altered except in accordance with relevant legal provision, if any.

1. the Employer's Representative is satisfied that the Contractor has made every reasonable effort to obtain the material in metric specifications.
2. in the opinion of the Employer's Representative, the substitute material is suitable for the Works in all respects.
3. in the opinion of the Employer's Representative, the substitute material complies with all the specifications for the material substituted, allowing minor discrepancies between the specified metric measurements and the corresponding imperial measurements of the substitute, provided that such discrepancies can be effectively and satisfactorily compensated for by the provision of extra quantity of the material; and
4. the Contractor shall be responsible for all extra quantities of the material required for meeting specification requirements of the Works due to the use of the substitute.

8.2.1.7. Hardwood shall not be used for Site Hoardings, shoring of trenches and pits, false work or form work.

**8.2.2 Notice of place of manufacture and/or source of supply.**

The Contractor shall notify the Employer's Representative of the places of manufacture and/or the source of supply of all goods and materials previously reviewed without objection by the Employer's Representative to be incorporated into the Permanent Works. The Contractor shall give reasonable notice (which shall not in any event be less than 56 days) to the Employer's Representative before the start of any manufacturing and/or the supply of goods and materials.

**8.2.3 Certificates for Manufactured Goods or Materials**

The Contractor shall obtain certificates for each batch of goods and materials incorporated into the Permanent Works. Each certificate shall certify that the materials comply with the requirements of the Contract and shall include all reports of inspections and/or tests carried out at the place of manufacture.

**8.3 EQUIPMENT**

**8.3.1 Identification labels**

8.3.1.1. Each and every individual item of equipment forming part of the Permanent Works shall be fitted with permanent identification labels in accordance with a system based on the contract identification. In this respect, the term "individual item of equipment" refers to a complete assembly of components and to each removable sub-module within the complete assembly.

8.3.1.2. The proposed labelling system shall be submitted for review by the Employer's Representative at least 3 months before the scheduled date for the shipment of the first item of equipment to site.

8.3.1.3. The identification label shall be permanently attached in such a way that it shall not become detached or illegible during the lifetime of the system from any cause

including wear and tear, environmental effects (such as rain, direct sunlight, etc.) or any other influence. Preference shall be given to embossed or engraved metallic labels mechanically fastened by riveting or similar means to the item to which they refer.

8.3.1.4. All labels shall be easily cleaned to remove dirt and debris (including grease and oil) without disturbing the legibility properties.

8.3.1.5. All labels shall incorporate the inscription "Property of M.M.R.D.A.".

#### 8.4 ELECTRONIC CONTROL RACKS AND CABINETS.

##### 8.4.1 Cables

8.4.1.1. Unless otherwise specified in TS, no joints or splices shall be permitted in cables or wires except at recognised termination points.

8.4.1.2. All cable cores shall be terminated including all spare conductors.

8.4.1.3. Each cable core shall be uniquely numbered and identified with a label giving details of the circuit carried.

8.4.1.4. Terminals carrying voltages exceeding 50 volts shall be uniquely identified and protected against accidental contact by persons, test equipment or other unintended physical contact. Similarly, all bus bars shall be suitably identified and protected.

#### 8.5 STANDARDS

8.5.1 Equipment, materials and systems shall be designed, manufactured and tested in accordance with the latest issue of International and/or National codes and standards. The Contractor shall submit hard copies in original to the Engineer of all codes and standards used for the work.

## CHAPTER 9 – PACKAGING, STORAGE, SHIPPING AND DELIVERY

### 9.1 STORAGE OF EQUIPMENT

- 9.1.1 The Contractor shall provide and maintain acceptable storage facilities for the Permanent Works, equipment and materials of all kinds intended for use in carrying out the Works or for incorporation into the Works.
- 9.1.2 The Contractor shall prepare, protect and store in an agreed manner all Permanent Works, Contractor's Equipment, equipment and materials so as to safeguard them against loss or damage from repeated handling, from climatic influences and from all other hazards arising during shipment or storage on or off the Site.
- 9.1.3 Secure and covered storage shall be provided by the Contractor for all Permanent Works, Contractor's Equipment, equipment and materials which are other than those having been reviewed without objection by the Employer's Representative as suitable for open storage.

### 9.2 GENERAL PRECAUTIONS

- 9.2.1 Spare parts shall be tropicalised in their packing for prolonged storage in accordance with BS 1133 or, equivalent International /Indian standard and shall be suitably and individually labelled to indicate:
  - 1. shelf life and date of manufacture;
  - 2. type or condition(s) of storage and special handling information;
  - 3. description of item and relevant part number;
  - 4. serial number, if applicable;
  - 5. inspection/test certificate number and batch number; and
  - 6. Contract number, variation order number and item number.
- 9.2.2 Appropriate precautions in accordance with the Contractor's safety regulations, the regulations of the Employer, and statutory regulations shall be taken in respect of all hazardous, toxic, inflammable, etc. materials.

### 9.3 PACKAGING PROCEDURES

- 9.3.1 All required inspection/test certificates shall be supplied and packed together with individual material. All packaging materials and procedures shall be subject to review by the Employer's Representative.
- 9.3.2 All required inspection/test certificates shall be supplied and packed together with individual material. All packaging materials and procedures shall be subject to review by the Employer's Representative.

### 9.4 SHIPPING

- 9.4.1 The Contractor shall notify the Employer's Representative ten days in advance of any expected shipment date and give further notification of the actual shipment date and routing when such information is subsequently established. This shall complement the inspection requirements prior to delivery as specified herein.
- 9.4.2 Two copies of packing lists and quality certificates shall be attached to each case or package to be shipped. One copy shall be placed inside the package and the second copy shall be enclosed in a watertight enclosure on the outside of each case or package. A copy of packing lists and quality certificates shall be sent to the Employer's

Representative after each package of the Works, the equipment, spare parts and other items to be shipped have been shipped.

9.4.3 Without prejudice to any other provisions of the Contract, the Contractor shall be responsible for all legal requirements, duties, dues, taxes and other such requirements and expenditures required for the importation of the Works, the equipment, spare parts and other items to be supplied under the Contract in Mumbai.

9.4.4 The Contractor shall clear the Works, the equipment, spare parts and other items to be supplied under the Contract through Mumbai customs/Indian sea port in accordance with all Government of India Enactments.

## 9.5 DELIVERY

9.5.1 The Contractor shall deliver the Works and all items to be supplied under the Contract to the Site.

9.5.2 The Contractor shall unload the Works and all items to be supplied under the Contract at the designated delivery point and positioning or storing them.

9.5.3 Any part of the Works or any item to be supplied under the Contract that is damaged in transit shall not be considered as delivered until repairs or replacements have been made and all necessary spare parts or items have been delivered to the Site.

9.5.4 All documents, manuals, drawings and other deliverables shall be delivered to an address in Mumbai to be designated by the Employer's Representative in writing.

9.5.5 The Contractor shall store and secure the Works, equipment, spare parts and other items until the same have been inspected and are considered delivered at the designated point by the Employer's Representative.

9.5.6 The Contractor shall remove temporary fittings required for shipment and re-assembly of equipment and shall complete this prior to the equipment or parts thereof being inspected and before they are considered delivered.

9.5.7 An item shall be considered delivered when all damage has been repaired and all documentation and post-delivery preparation has been completed to the satisfaction of the Employer's Representative.

## CHAPTER 10 – TESTING AND COMMISSIONING

Testing and Commissioning shall comply with all the requirements of the GCC supplemented, amplified, modified or superseded as applicable by this Specification and the TS.

### 10.1 GENERAL

The Employer and the Employer's Representative will bear their own costs for attendance at witnessed inspections or tests (other than re-tests) scheduled in accordance with the agreed Works Programme and subject to notice in accordance with the Specification.

### 10.2 MANUFACTURING TEST PLAN

10.2.1 The Manufacturing Test Plan is the Contractor's plan for carrying out the necessary procedures to ensure that the items presented for acceptance by the Employer and the Employer's Representative are in compliance with the requirements of the Specification.

10.2.2 During the process of procurement and manufacture of the system components the Contractor shall undertake such testing and inspection as is required by the Quality Plan referred to in **clause 6.4 above 6.5**.

10.2.3 The Employer and the Employer's Representative will not become involved in the Contractor's Manufacturing Tests except in respect of the following:

1. Type Tests; and
2. First Article Inspection.

10.2.4 Before shipment of any items to Site the Contractor shall present the items for the first stage of Acceptance according to the Commissioning Plan as detailed in **clause 10.3** below.

#### 10.2.5 Inspection

10.2.5.1. The Contractor shall be wholly responsible for all inward inspection of items to be incorporated into the system as a whole.

10.2.5.2. Equipment issued by the Employer shall not be subject to Type Tests or First Article Inspection however the Contractor shall undertake Inspection as referenced in **clause 8.1 above**. Should the Employer's issued equipment be subsequently incorporated into another manufactured item then the whole item shall be subject to both Type Tests and First Article Inspection.

#### 10.2.6 Type Tests

10.2.6.1. Type tests may not be required in those cases where the Contractor can produce certified evidence that the required type tests have been performed successfully on same equipment and produced in the factory where the equipment to be supplied under the contract is to be manufactured, provided the type test(s) have been carried out in accredited / reputed laboratory and / witnessed by reputed test agencies. The final decision regarding applicability and acceptance of the type test certificate produced shall rest with "Engineer". Validity of Type tests certificates shall be till unless changes are made in materials or design or manufacturing process which might change the performance characteristics or shall not be more than 5 years old from the date of Letter of Acceptance (LOA) of the contract, whichever is earlier.



- 10.2.6.2. Where only some of the required tests have been carried out, the Employer's Representative may agree to selected type tests being carried out individually rather than as part of a sequence.
- 10.2.6.3. For each test, the Employer's Representative will determine whether the item under test has passed or failed. In general, the test will be considered to have failed if either:
  - a. The result of the test is not in accordance with the expected result described in the test procedure, or
  - b. The result of the test is in accordance with the expected result described in the test procedure, but some other unexpected or unexplained event occurred which the Employer's Representative considers to be a fault.
- 10.2.6.4. If during Type Tests, any failure occurs or the equipment is changed, it shall be reported to the Employer's Representative who may, at his discretion, require repetition of the previous tests at the Contractor's cost.

#### 10.2.7 First Article Inspection

- 10.2.7.1. FAI shall be performed jointly by the Employer and the Employer's Representative and the Contractor on all major equipment items or sub-systems identified by the Employer's Representative.
- 10.2.7.2. Equipment shall be shipped from the point of manufacture only after a FAI has been completed or the requirement waived in writing by the Employer's Representative.
- 10.2.7.3. The Contractor shall provide a minimum of 15 working days' notice to the Employer's Representative before any FAI.
- 10.2.7.4. At least 15 days prior to each FAI, the latest drawings, inspection and test procedures, specifications and quality documentation required for adequate inspection of the equipment under inspection shall be submitted to the Employer's Representative. The drawings shall be complete to the lowest level replaceable unit.
- 10.2.7.5. The Contractor shall ensure that he and his subcontractors are prepared for all FAIs. The Contractor shall not schedule more than one FAI on the same day without prior notice of No Objection by the Employer's Representative.
- 10.2.7.6. The Contractor shall be responsible for the cost and scheduling, to the Employer and the Employer's Representative's convenience, of any repeat testing of items which fail FAI.

#### 10.2.8 Factory Acceptance Test

Before shipment all manufactured items or systems shall undergo FAT in accordance with the requirements of the TS.

### 10.3 COMMISSIONING PLAN

- 10.3.1 The Commissioning Plan is the Employer and the Employer's Representative's tool for managing and co-ordinating the Testing, Commissioning, Training and Service Trial activities. The Commissioning Plan will be divided into the following sub-plans:
  - 1. Factory Testing Plan (see **clause 4.5.1 above** and TS)
  - 2. On-Site Testing and Commissioning Plan

### 10.3.2 Testing and Commissioning Phases

10.3.2.1. Testing and Commissioning activities shall be undertaken in the following phases:

1. Factory Acceptance Test (which requirements are specified in **clause 4.5.1 above**);
2. Installation Tests.
3. Partial Acceptance Tests.
4. System Acceptance Tests.
5. Integrated Testing & Commissioning; and
6. Service Trial.

10.3.2.2. Items (3), (4), (5) and (6) as required by the TS constitute the Tests on Completion referred to in the GCC.

### 10.4 ON-SITE TESTING AND COMMISSIONING PLAN

10.4.1 The Contractor shall prepare and submit for review by the Employer's Representative the Contractor's On-Site Testing and Commissioning Plan detailing and explaining how the Contractor will plan, perform and document all tests and inspections that will be conducted to verify and validate the Works on Site. The On-Site Testing and Commissioning Plan shall consist of a narrative description supported by graphics, diagrams and tabulations as required.

10.4.2 The On-Site Testing and Commissioning Plan shall contain, but not be limited to, the following topics:

1. The Contractor's strategy for testing and commissioning all constituent parts of the Works and how this relates to the sequence of construction and installation.
2. the interdependency and interaction with other Contractors and their commissioning programmes; the type and extent of testing and commissioning to be undertaken and the parts of the Works to be proven by that testing; the objective of each test, what particular operating criteria the test or inspection will prove and how the success of the test will be demonstrated or measured.
3. the plan for the production and submission of the testing and commissioning procedures to the Employer's Representative for review including the submission of the testing and commissioning reports and records; and
4. the On-Site Testing and Commissioning Plan shall be organised and submitted in the stages described in **clauses 10.3.2** above, **10.4.3** below & **10.4.7** below.

#### 10.4.3 Installation Tests

10.4.3.1. The Installation Tests phase is defined as being the final stage of assembly/installation before the start of commissioning itself. The Installation Tests are to be performed by the Contractor under the Contract and may be witnessed by the Employer or the Employer's Representative. During this phase, the Contractor shall perform static testing of components and/or systems in preparation for Partial Acceptance Testing.

10.4.3.2. The particular requirements for Installation Tests are prescribed in the TS. Where performance across interfaces to other Contractors or to other parties is required to be verified, the Contractor shall liaise with the interfacing party to co-ordinate the test procedures and programme in the manner prescribed in **clause 4.3.2 above**.

10.4.3.3. The Contractor shall prepare three copies of a test report immediately after the completion of each test whether or not witnessed by the Employer or the Employer's Representative. If the Employer or the Employer's Representative

has witnessed the test, he will countersign the report to indicate his agreement to the information and conclusions (i.e., whether or not the equipment being tested has passed satisfactorily) contained therein. If the Employer or the Employer's Representative has not witnessed the test (i.e., if a written waiver has been granted), the Contractor shall forward three copies of the test report without delay to the Employer's Representative.

- 10.4.3.4. The Employer's Representative will countersign the report to indicate his agreement to the information and conclusions (i.e., whether or not the equipment being tested has passed satisfactorily) and return one copy to the Contractor. Where the results of the test do not meet the requirements of the Specification, the Employer or the Employer's Representative may call for a re- test.
- 10.4.3.5. Test equipment and instrumentation shall be subject to calibration test within a properly controlled calibration scheme, and signed calibration certificates shall be supplied to the Employer's Representative in duplicate. Such calibration checks shall be undertaken prior to testing and, if required by the Employer or the Employer's Representative, shall be repeated afterwards.
- 10.4.3.6. The Contractor shall submit to the Employer's Representative a comprehensive schedule of tests as required by the TS giving full details and procedures for each test to be carried out under the Contract and including the pass / fail criteria (i.e. the standards or limits to be achieved).

#### 10.4.4 Partial Acceptance Tests

- 10.4.4.1. Partial Acceptance Tests are defined as the performance of functional tests of sections, areas, or stages of a system. The Partial Acceptance Tests are part of the Tests on Completion to be performed by the Contractor under the Contract in order to achieve Employer's Taking Over of the Works. During this phase, an energy source shall be introduced to enable functional testing to be performed. On satisfactory completion of the Partial Acceptance Tests, the tested items will be considered available for Systems Acceptance Testing.
- 10.4.4.2. The particular requirements for Partial Acceptance Tests prescribed in the TS are indicative only.
- 10.4.4.3. The Contractor shall submit to the Employer's Representative a comprehensive Partial Acceptance Tests Plan including all requirements detailed in the TS. The plan shall be submitted on a logical section-by-section basis, using a "top- down" approach describing the testing and commissioning strategies and processes clearly showing how these serve to provide the full verification of the systems and equipment.
- 10.4.4.4. The Partial Acceptance Tests Plan shall identify a comprehensive list of specifications, standards, method statements, procedures, pass/fail criteria, sample records, resources to be made available, drawings and records to be submitted to the Employer's Representative, and a programme showing the dates for testing and for submission of each test procedure.
- 10.4.4.5. Test procedures shall be carefully planned to ensure that the work can be executed in the time available. If the available time is restricted, this planning shall include contingency plans to be implemented if testing proceeds slower than anticipated or if defects are discovered that necessitate rectification and subsequent repeat testing, etc.
- 10.4.4.6. If any working equipment is relocated or altered by the Contractor during the execution of the Works, thorough re-testing shall be performed to verify that the equipment remains fully functional and operates safely according to its

specification. The testing to be performed shall be no less rigorous than the procedures used for the original testing and commissioning of the equipment.

- 10.4.4.7. The Contractor shall submit to the Employer's Representative by the date laid down in the TS (or if none is given, no later than two months before the commencement of the commissioning work whichever is earlier), 3 copies of its proposed Partial Acceptance Tests records. The records shall be appropriately sub-divided to make provision for the various parts of the systems and equipment covered by the Contract and shall cover all tests (mechanical, electrical or otherwise), positive identification of equipment, assemblies and sub-assemblies by serial number, drawing and specification reference numbers (and issue reference) and any other data to be certified by the Employer or the Employer's Representative during the course of commissioning.
- 10.4.4.8. The Contractor shall during the execution of the Works prepare such reports and records of, manufacture, installation, erection and testing as may be required in order that any relevant licences or approvals (including any statutory approvals) may be issued or granted. Such records shall be adequate to enable the system or its respective part to be commissioned and to meet the requirements of the licensing authority or statutory body.
- 10.4.4.9. Immediately following the successful Partial Acceptance Testing of the system or any constituent part, the Contractor shall complete the appropriate Partial Acceptance Tests records in the agreed format and submit 3 signed copies to the Employer's Representative.
- 10.4.4.10. The Contractor shall include a complete schedule of all Partial Acceptance Tests records and their current status within the Monthly Progress Report.

#### 10.4.5 System Acceptance Tests

- 10.4.5.1. System Acceptance Tests are defined as the tests undertaken to demonstrate that the Works in its entirety is capable of functioning in accordance with the specified requirements in the Contract in all respects. The System Acceptance Tests are part of the Tests on Completion to be performed by the Contractor under the Contract in order to achieve Employer's Taking Over of the Works. The System Acceptance Tests may commence before remote operations capability (if any) is fully functional, however, the system must be satisfactorily tested remotely (if specified to have such capability) before the System Acceptance Tests can be considered to be completed. On satisfactory completion of the System Acceptance Tests, the tested items will be considered available for Integrated Testing & Commissioning.
- 10.4.5.2. The particular requirements for System Acceptance Tests are prescribed in the TS are indicative only.
- 10.4.5.3. The Contractor shall submit to the Employer's Representative a comprehensive System Acceptance Tests Plan including all requirements detailed in the TS. The plan shall be submitted on a section by section basis to demonstrate how the System Acceptance Tests are to be carried out. The plan shall adopt a top down approach and describe the system completion strategy and process.
- 10.4.5.4. System Acceptance Tests shall comprise comprehensive testing of the assembled installation to ensure that it operates in accordance with the requirements of the TS.
- 10.4.5.5. The tests shall include, but not be limited to, the following:
  - 1. tests of all functional and performance requirements for the system;

2. tests of behaviour under failure conditions, e.g. changeover to redundant hardware; initiation of re-configuration functions or reverse modes of operation; and recovery of the equipment and system from failure.

- 10.4.5.6. The System Acceptance Test Plan shall identify a comprehensive list of specifications, standards, method statements, procedures, pass / fail criteria, sample records, resources to be made available, drawings and records to be submitted to the Employer's Representative, and programme showing the dates for testing and for submission of each test procedure.
- 10.4.5.7. Test procedures shall be carefully planned to ensure that the work can be executed in the time available. If the available time is restricted, this planning shall include contingency plans to be implemented if testing proceeds slower than anticipated or if defects are discovered that necessitate rectification and subsequent repeat testing, etc.
- 10.4.5.8. Immediately following the successful acceptance testing of the system, the Contractor shall complete the appropriate commissioning records in the agreed format and submit 3 signed copies to the Employer's Representative.
- 10.4.5.9. The Contractor shall include a complete schedule of all System Acceptance Test records and their current status within the Monthly Progress Report.

#### 10.4.6 Integrated Testing & Commissioning

- 10.4.6.1. Integrated Testing & Commissioning are defined as the final tests to be undertaken before the commencement of Service Trial. The Integrated Testing & Commissioning are part of the Tests on Completion to be performed by the Contractor under the Contract in order to achieve Employer's Taking Over of the Works. The Integrated Testing & Commissioning shall demonstrate the full compatibility between all interfacing systems. On satisfactory completion of the Integrated Testing & Commissioning, the tested items will be considered available for Service Trial.
- 10.4.6.2. The particular requirements for Integrated Testing & Commissioning are prescribed in the TS are indicative only.
- 10.4.6.3. The Contractor shall submit to the Employer's Representative a comprehensive Integrated Testing & Commissioning Plan as required by the TS. The plan shall be submitted on a logical section-by-section basis, using a "top-down" approach describing the testing and commissioning strategies and processes clearly showing how these serve to provide the full verification of the systems and equipment in context of the complete railway system.
- 10.4.6.4. The Contractor shall co-ordinate with the Employer and the Employer's Representative and with all interfacing parties to ensure that the proposed test programme and schedule truly demonstrate that the full specified performance requirements are achieved.
- 10.4.6.5. The tests shall include, but shall not be limited to the following: -
  1. test of all functional and performance requirements for the system;
  2. test to demonstrate compliance with all interface specifications; and
  3. test of behaviour under failure conditions (e.g. changeover to redundant hardware, initiation of re-configuration functions or reversionary modes of operation, recovery of systems and equipment from failure, demonstrations of planned emergency procedures, etc.).
- 10.4.6.6. The Integrated Testing & Commissioning Plan shall identify a comprehensive list of specifications, standards, method statements, procedures, pass/fail

criteria, sample records, resources to be made available, drawings and records to be submitted to the Employer's Representative, and a programme showing the dates for testing and for submission of each test procedure.

- 10.4.6.7. Test procedures shall be carefully planned to ensure that the work can be executed in the time available. If the available time is restricted, this planning shall include contingency plans to be implemented if testing proceeds slower than anticipated or if defects are discovered that necessitate rectification and subsequent repeat testing, etc.
- 10.4.6.8. Immediately following the successful Integrated Testing & Commissioning of the system or any constituent part, the Contractor shall complete the appropriate commissioning records in the agreed format and submit 3 signed copies to the Employer's Representative.
- 10.4.6.9. The Contractor shall include a complete schedule of all Integrated Testing & Commissioning records and their current status within the Monthly Progress Report.

#### 10.4.7 Service Trial

- 10.4.7.1. Service Trial is defined as the final test of the fixed equipment, the rolling stock, and the operational procedures including the final elements of the Tests on Completion to demonstrate that the system in its entirety can operate satisfactorily. The Service Trial is performed by the Employer with attendance by the Contractor under the Contract in order to achieve Employer's Taking Over of the Works. During this phase, the system will be run to the published timetable but without fare-paying passengers. This phase also allows for Validation of the training procedures in a real-time environment.
- 10.4.7.2. The Commissioning Team in conjunction with the Employer will develop the Service Trial Plan. Operations Department and will serve to organise and co-ordinate all on-Site activities.
- 10.4.7.3. The particular requirements for tests to be undertaken during the Service Trial are prescribed in the TS.
- 10.4.7.4. The Contractor shall provide special and general attendance to the Employer and the Employer's Representative during the Service Trial period as required by the TS.
- 10.4.7.5. The Contractor shall co-operate with the Employer and the Employer's Representative and with all interfacing parties to ensure that the proposed Service Trial programme and schedule truly demonstrates that the full, specified performance requirements and operating parameters are achieved.
- 10.4.7.6. The Contractor shall review and comment on the Employer's Representative's Service Trial Plan and shall identify specifications, standards, method statements, procedures, pass / fail criteria, to the Employer's Representative for inclusion in the Plan.
- 10.4.7.7. The Contractor shall not interfere with the Service Trial tests and Validations in any manner. Any need for remedial works required to be performed by the Contractor shall be co-ordinated with the Employer and the Employer's Representative in advance.
- 10.4.7.8. Immediately following the successful tests of the system or any constituent part during Service Trial the Contractor shall complete the appropriate commissioning records in the agreed format, submit 3 signed copies to the

Employer's Representative and may then apply for the Taking Over Certificate in accordance with the requirements of the GCC.

- 10.4.7.9. The Contractor shall include a complete schedule of all Service Trial records and their current status within the Monthly Progress Report.

## 10.5 ACTIVITY OF THE EMPLOYER AND THE EMPLOYER'S REPRESENTATIVE

- 10.5.1 The Employer and the Employer's Representative will establish a Commissioning Team and a Site Co-ordination Team at appropriate stages of the Project. These teams will comprise representatives of all interested parties including not more than two representatives of the Contractor, subject to review by the Employer and the Employer's Representative. In accordance with the Commissioning Plan, the Commissioning Team shall advise and plan to co-ordinate the activities of the Contractor to ensure the Employer and the Employer's requirements are met.
- 10.5.2 The Contractor shall participate in the activities of the Commissioning Team and Site Coordination Team in addition to its own testing and commissioning or as directed by the Employer or the Employer's Representative.

## 10.6 RECORDS AND REPORTS

- 10.6.1 The Contractor shall submit to the Employer's Representative for review not less than six (6) months before commissioning activities commence his proposed format for the commissioning records. The records shall be appropriately sub-divided to make provision for the various parts of the Permanent Works covered by the Contract.
- 10.6.2 The format of the records shall cover all mechanical and electrical tests, provide positive identification by serial number for assemblies and sub-assemblies of the Permanent Works and show modifications to Employer's Drawings and diagrams or "as built" data to be certified by the Employer or the Employer's Representative in the course of installation, testing and setting to work of the Works.
- 10.6.3 The Contractor shall, during the execution of the Works, prepare such reports and records of manufacture, installation and testing as may be required in order that a licence may be issued, or statutory requirements may be met, or approval given. Such reports or records shall be adequate to enable each part of the Permanent Works to be commissioned and to meet the requirements of the licensing authority or any standing statutory regulations and shall be reviewed by the Employer and the Employer's Representative.
- 10.6.4 The Contractor shall obtain reports of each inspection and/or test. Such reports shall show the results of all the inspections and/or tests carried out and shall certify that the work has been inspected and/or tested in accordance with the requirements of the Contract and that the work complies with the requirements of the Contract.
- 10.6.5 Any analysis of the results required to confirm that the work complies with the requirements of the Contract shall be compiled and reported to the Employer's Representative in accordance with Chapter 4.
- 10.6.6 A representative of the Contractor who has been allocated the required authority under the relevant quality plans shall sign each report of inspection and/or test.
- 10.6.6.1 Each report of inspection and/or test shall include the appropriate details of: -
1. the description of the item or goods subjected to the test or inspection.
  2. if applicable, the batch from which the samples were taken for test, the size and description of samples and the method of sampling.
  3. the place of testing.
  4. the date and time of tests.
  5. the environmental conditions.

6. the technical personnel supervising or carrying out the test or inspection;
7. the properties tested or inspected;
8. the method of testing or inspection;
9. all relevant checklists and work sheets used during the inspection and/or test, including the readings and measurements taken during the tests; and
10. the test results, including any calculations and graphs.

10.6.7 After Commissioning of a part of the Works, the Contractor shall complete each commissioning record in the agreed format and shall forward copies of the record to the Employer's Representative for review.

10.6.8 The Contractor shall submit within its Monthly Progress Report a complete schedule of his commissioning records showing completion dates, target completion dates and status.

10.6.9 Timing for Reports of Inspection and/or Test.

The Contractor shall ensure that a signed copy of each report of inspection and test is filed in his filing system within 3 (three) working days of the date of inspection and test.

10.6.10 Quality Control Register

The Contractor shall provide and maintain at all stages of the work a quality control register or registers to identify the status of inspections, sampling and testing of the work and all certificates in accordance with Quality Control Register in Chapter 6.

10.6.11 Summaries of Inspection and/or Test

The Contractor shall submit to the Employer's Representative for his information summaries based on each quality control register showing the type and amount of certification received and the inspection and/or testing undertaken on each element of the Works. Such summaries shall reach the Employer's Representative's office before the 7th working day of the month. The summaries shall identify and demonstrate the compliance of such certification, inspection and/or testing with the requirements of the Contract and shall identify any item which does not conform to the requirements of the Contract.

## 10.7 TEST EQUIPMENT AND FACILITIES

10.7.1 The Contractor shall provide all equipment and services required for testing, including, but not limited to:

10.7.1.1. Laboratory test instruments.

10.7.1.2. Special test equipment, emulators, simulators and test software, to permit full testing of System functions and performance.

10.7.1.3. Other items of the System, specified elsewhere as being part of the Contractor's supply, even if not part of the Subsystem under test.

10.7.1.4. Consumables.

10.7.2 All test instruments shall be subject to routine inspection, testing and calibration by the Contractor.

10.7.3 Details of all test instruments shall be submitted for review by the Employer's Representative and, if required by the Employer or the Employer's Representative, shall be calibrated at the expense of the Contractor by an independent standards laboratory.

10.7.4 All test equipment must be capable of operating from the mains supply (230V AC 50Hz).



- 10.7.5 All test software shall be subject to formal quality assurance requirements stipulated elsewhere in the Specification.
- 10.7.6 The Contractor shall ensure that all inspection and test equipment is calibrated in accordance with the specified standards or, if such standards are not applicable to certain test and inspection equipment, with systems and programmes of calibration which have been reviewed without objection by the Employer's Representative.
- 10.7.7 The Contractor shall ensure that documented evidence of instrument calibration is maintained and made available to the Employer or the Employer's Representative on request.

#### 10.8 WITNESSING BY THE EMPLOYER AND THE EMPLOYER'S REPRESENTATIVE

##### 10.8.1 Notice for Trial, Inspection and/or Test to the Employer's Representative

10.8.1.1. In relation to all Quality Control Points and Quality Hold Points involving inspection and/or testing by the Contractor, the Contractor shall give the Employer's Representative notice of when the relevant work will be inspected and/or tested using the form in **Appendix 3** of this Specification. The period of notice shall be as stated in the TS or such period as in the opinion of the Employer's Representative is reasonable and notified to the Contractor. In the absence of any such statement or notice, a reasonable period of notice shall be given by the Contractor provided that:

1. in the case of on-Site work, such notice shall be given not less than 72 hours of normal working time before the work is to be inspected and/or tested;
2. in the case of work carried out off-Site in Mumbai, such notice shall be given not less than 5 days before the work is to be inspected and/or tested; and
3. in the case of work carried out outside Mumbai, such notice shall be given not less than 14 working days before the work is to be inspected and/or tested.

10.8.1.2. In relation to all inspection and/or testing notified by the Contractor, the Employer and the Employer's Representative may elect to witness such inspections and/or tests but the Contractor may proceed with the inspections and/or tests notwithstanding the absence of the Employer or the Employer's Representative or of any response to the said notice.

10.8.1.3. If the Contractor is in any doubt whether inspection and/or testing by the Employer's Representative is required as a Quality Hold Point, the Contractor shall request that the Employer's Representative clarifies his requirements prior to submitting the relevant inspection and testing plan for review, and in any event not later than 30 days.

##### 10.8.2 Timing for Inspection and/or Test by the Employer and the Employer's Representative

10.8.2.1. The Contractor shall allow the Employer and the Employer's Representative a reasonable time to carry out any inspection and/or testing and to assess the result of any inspection and/or test before proceeding with the Works.

10.8.2.2. Unless the Employer's Representative's prior review without objection has been obtained, all inspections and/or tests to be carried out or witnessed by the Employer and the Employer's Representative shall be carried out between 08:00 and 18:00 hours.

##### 10.8.3 Failure to Notify the Employer's Representative

The Employer or the Employer's Representative may reject the test and test results in question, and require the test to be repeated in the event of any failure by the Contractor to notify the Employer's Representative in accordance with **clause 10.8.1.1** above.

#### 10.9 FAILURES

- 10.9.1 The Contractor shall correct all faults found during testing, and shall arrange for the relevant tests to be repeated. The relevant tests shall only be repeated when the fault has been remedied and the equipment demonstrated to function correctly.
- 10.9.2 Where remedial measures involve significant modifications that might, in the Employer's Representative's opinion, affect the validity of earlier tests, the Contractor shall repeat the earlier tests and obtain results satisfactory to the Employer and the Employer's Representative before repeating the test in which the fault was first identified.
- 10.9.3 The Employer or the Employer's Representative shall have the right to order the repeat or abandonment of any test in the event that results demonstrate that the equipment is significantly non-compliant with the Contract.
- 10.9.4 The Employer or the Employer's Representative shall have the right to suspend any test in the event that errors or failures have become unacceptable. The Employer or the Employer's Representative shall also have the right to suspend any test if a fault was detected by the Contractor but not reported to the Employer's Representative within 24 hours of the detection. In this event, the suspension shall remain in effect until reporting has been brought up to date to the satisfaction of the Employer and the Employer's Representative.

#### 10.10 REPEAT TESTS

- 10.10.1 The Contractor shall correct and re-test every fault detected during the tests.
- 10.10.2 If the test results in a failure of the item under test the provisions of **GCC Clause 7** shall apply.

#### 10.11 FAULT LOG

- 10.11.1 The Contractor shall maintain a fault log throughout each series of tests. Every fault detected during the tests will be entered in the log, together with the actions taken to clear and re-test the fault.
- 10.11.2 The fault log will be retained as part of the permanent quality assurance record for the system and be subject to regular inspection by the Employer's Representative.

#### 10.12 HARDWARE FAILURE REPORTS

- 10.12.1 For each hardware failure that occurs at any stage of testing, the Contractor shall investigate the failure and prepare a report on its cause(s) and implications, if any, resulting from such failure. The report shall clearly show:
  - 10.12.1.1. the observed symptoms.
  - 10.12.1.2. the most likely cause of the failure.
  - 10.12.1.3. the fault category
  - 10.12.1.4. an analysis of any stress that may have been caused to other components of the equipment being tested as a result of the failure.
  - 10.12.1.5. whether the failure is a result of any component operating outside its range; and
  - 10.12.1.6. whether any design changes should be made to avoid further failures.
- 10.12.2 All such reports will be retained as part of the permanent quality assurance record for the system, which shall be subject to inspection by the Employer's Representative.

### 10.13 SOFTWARE FAILURE REPORTS

- 10.13.1 For each software failure that occurs, once the software has been reviewed without objection for inclusion into the system and is subject to configuration control, the Contractor shall generate a software failure report.
- 10.13.2 All such reports will be retained as part of the permanent quality assurance record for the system, which shall be subject to inspection by the Employer's Representative.
- 10.13.3 The report shall clearly show:
  - 10.13.3.1. the observed symptoms.
  - 10.13.3.2. the likely cause.
  - 10.13.3.3. the operator input.
- 10.13.4 The report shall also clearly show the following information which shall be entered when the failure has been investigated:
  - 10.13.4.1. the actual cause of the failure.
  - 10.13.4.2. the corrective action taken; and
  - 10.13.4.3. all software modules affected at the location
  - 10.13.4.4. all similar software modules used in the project.

### 10.14 INSPECTION BY CMRS

- 10.14.1 The Contractor shall note that the Commissioner for Metro Railway Safety (CMRS) & EIG will inspect the Works from time to time for the purpose of determining whether the Metro Corridor Project complies in terms of operational and infra structural safety in accordance with the Laws of India. The contractor shall note that CMRS & EIG approval is mandatory for commissioning the system. Notwithstanding other provisions of the Contract, the Contractor shall ensure that the Works comply with the requirements CMRS & EIG in terms of construction to the drawings and shall assist the representatives of CMRS & EIG in carrying out their inspection duties and also comply with their instructions regarding rectifying any defects and making good any deficiencies.

## CHAPTER 13 – SUPERVISION AND PLANNING OF MAINTENANCE

### 13.1 SCOPE

- 13.1.1 The Contractor shall be responsible attending the defects for the installations covered under the contract during DLP. DLP period of the Contractor will start from the date of revenue services of the section.
- 13.1.2 The responsibility for the provision of defects attending shall be based on the scope of DLP/AMC provided in the tender.
- 13.1.3 Preventive maintenance of system to be performed by employer.

### 13.2 MAINTENANCE PLANNING & MANAGEMENT STAFF

- 13.2.1 The Contractor shall undertake the necessary tasks in planning the corrective maintenance activities for attending defects to ensure that the reliability of the operating railway is upheld including but not limited to:
  - 1. Provide recommendations in respect of philosophy and procedures for repairs of electronic systems, including PCBs, and the scale of facilities required to be set up in the Depot and Workshops for this purpose.
  - 2. Assisting employer in preparation of detailed operational plan for the routine servicing of any equipment which requires such service. The plan shall ensure that all items in use receive maintenance within the required time cycle by suitably trained and qualified staff and under the personal safety regime appropriate to the location of the equipment being maintained.
  - 3. Preparation of a detailed staffing for works covered under DLP. The plan shall also identify and quantify resources required by staff and groups of staff in terms of tools, tackle, protective clothing, etc.
  - 4. Preparation of a detailed quality plan, covering all maintenance activities. Based on the plan it shall be possible for the maintenance organisation to obtain ISO certification.
  - 5. Assist in preparation of a computer-based Stores Management Plan, which shall assist the management, ensuring a timely availability of spares, tools and consumable materials with a low level of inventory.
  - 6. Setting in position a computerised defects and failure analysis and documentation system, based on FMEA principles for all systems, sub-systems and components including individual PCBs.

### 13.3 SUPERVISORY STAFF

- 13.3.1 The Contractor shall provide maintenance staffs who are experts in the first and third line fault-finding, maintenance and repair of the various systems supplied under the Contract:
- 13.3.2 The experts provided for maintenance shall have adequate qualifications and experience in the relevant discipline in the maintenance depots / workshops of existing metro type undertakings.
- 13.3.3 The deployment of the experts shall be continuous.
- 13.3.4 The experts shall be available in Mumbai at short notice at any time during the Normal Operating hours and by arrangement to undertake extended investigations during Non-

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Revenue hours.

## CHAPTER 14 – SUPPLY OF SPARE PARTS

### 14.1 MANUFACTURE AND DELIVERY OF SPARE PARTS

- 14.1.1 The Spare Parts to be supplied under the Contract shall be manufactured at the same time as the Permanent Works. All Spare Parts shall be manufactured, works tested and inspected in accordance with the relevant quality system, suitably packed and labelled in accordance with **Chapter 9 above**, and delivered to the Employer by the Contractor. Before the Spare Parts are delivered to the Employer, the Contractor shall submit to the Employer's Representative a shipment advice notifying details such as date of despatch, date of arrival, vessel name, etc. as well as a packing list to indicate the contract number, variation order number, the lot size, quantity and weight. The Spare Parts shall be consigned to the Employer and delivered in accordance with The Employer's Representative's instructions to a programme which shall ensure that sufficient Spare Parts are delivered to facilitate normal routine maintenance of the Permanent Works by the Employer at all stages of completion. The Spare Parts shall be supplied in total not later than the date set out for stage commissioning of the system.
- 14.1.2 Spare Parts shall be fully interchangeable with their corresponding part. All Spare Parts shall be configured to the latest revision during the Defects Liability Period. For Spare Parts such as electronic components, lamps, fuses and other consumable and high-use items, the Contractor shall ensure that a minimum of two alternative sources of supply are available.
- 14.1.3 An adequate supply of Spare Parts shall be available throughout the design life of the Works, from the date of the Employer's Taking Over of the Works. The Contractor undertakes to notify the Employer at least 6 months prior to deleting any item used in the Works from general availability.
- 14.1.4 For any Spare Parts that the Contractor is unable to supply throughout the design life of the Works, or where the Contractor ceases availability support of that item before the end of such design life or if the Contractor ceases trading, the Contractor undertakes to transfer the relevant intellectual property rights, design rights and technology to the Employer and the Employer shall have the full right to manufacturing drawings, schedules, software and any other information needed to manufacture the relevant item. Such rights shall give the Employer complete freedom to manufacture the item in Mumbai or anywhere else world-wide. The Contractor shall also undertake to notify the Employer two years in advance of the intended cessation of spares availability of any item.
- 14.1.5 If any Spare Part is rendered obsolete by a design change or material change during the design life of the Works supplied under the Contract, the Contractor shall design a replacement item to match the identical mechanical and electrical interfaces as the former item.
- 14.1.6 If, as a result of changes in technology, any Spare Part is not completely interchangeable with the original item, or the performance of any Spare Part is different from the original item, then the Contractor shall purchase the same from the Employer, at a price agreed between the parties, such quantities of the obsolete Spare Part as the Employer may possess.

### 14.2 CONTRACT SPARES

- 14.2.1 Notwithstanding the quantities defined in the TS or by the following formulae the quantity of Spare Parts shall be sufficient for the full operation of the Permanent Works for the first 5 years following the expiry of the Defects Liability Period for the works ("Contract Spares").
- 14.2.2 The Contractor shall supply and deliver the Contract Spares on or before completion of the Systems Acceptance Test.

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#### 14.3 COMMISSIONING SPARES

- 14.3.1 In addition to the Contract Spares, the Contractor shall keep on the Site, under his own custody throughout the installation, erection and commissioning periods, sufficient stocks of Spare Parts to enable immediate replacement of any item in the Permanent Works found to be defective or in any way in non-conformance with the Specification during the installation, erection and commissioning period ("Commissioning Spares").
- 14.3.2 The Contractor shall supply and deliver the Commissioning Spares on or before the commencement of any Partial Acceptance Tests (PAT) or as defined in the TS.
- 14.3.3 The Contractor shall not be entitled to use any of the Contract Spares to replace any item in the Permanent Works during the installation, erection and commissioning periods.

#### 14.4 DEFECTS LIABILITY SPARES

- 14.4.1 In addition to the Contract Spares, the Contractor shall keep sufficient stocks of Spare Parts, in his own custody in an off-site location in Mumbai throughout the Defects Liability Periods to enable rapid replacement of any item in the Permanent Works found to require replacement as part of the Contractor's obligations during the Defects Liability Periods ('Defects Liability Spares').
- 14.4.2 The Contractor shall supply and deliver the Defects Liability Spares on or before the commencement of the Service Trial.
- 14.4.3 The Contractor shall submit to the Employer's Representative for review a list of all Defects Liability Spares that shall be maintained by the Contractor during the Defects Liability Periods.
- 14.4.4 The Contractor shall not be entitled to use any of the Contract Spares to replace any item in the Permanent Works during the Defects Liability Periods.

#### 14.5 CODING AND TAGGING OF SPARE PARTS AND SPECIAL TOOLS AND TEST EQUIPMENT

- 14.5.1 All Spare Parts and Special Tools and Test Equipment to be delivered to the Employer shall each carry a tag suitably marked, bar-coded (as directed by the Employer's Representative) and numbered.

14.5.2 The numbers on the tags shall correspond with those on the coding system developed by the Contractor for all components, parts and equipment's

#### 14.6 SPECIAL TOOLS AND TEST EQUIPMENT

- 14.6.1 The Special Tools and Test Equipment (together with the relevant calibration certificates) required to carry out all the functions described in the Operation and Maintenance Manual or as required by the TS shall be suitably packed and identified in accordance with **Chapter 9 above**, consigned to the Employer by the Contractor and delivered to the Employer in accordance with the Employer's Representative's instructions not later than the date scheduled for stage commissioning. The extent of supply shall include protective carrying cases as may be appropriate for the storage and use of each item.
- 14.6.2 All Special Tools and Test Equipment shall be supplied with Operation and Maintenance Manuals, complete diagrams, schematics, assembly and connection drawings, calibration instructions and circuit diagrams/descriptions for future maintenance.
- 14.6.3 Where the Contractor has used the Special Tools and Test Equipment for installation and commissioning of the Permanent Works, he shall refurbish and re-calibrate each item to the satisfaction of the Employer's Representative prior to handover to the Employer, accompanied by the Certificate of Calibration traceable to a recognised International or National standard.
- 14.6.4 Where any item of Special Tools and Test Equipment is provided by the Contractor, it shall be accompanied by drawings, manuals and full operating instructions to enable them to be used by suitably skilled (but not necessarily specially trained) personnel in a non-hazardous manner and to achieve the desired result in terms of accuracy and quality.
- 14.6.5 The Contractor shall provide the means and instructions which describe the parameters of each item of Special Tools and Test Equipment that are critical to their proper methods of use and which enable the Employer's staff using the Special Tools and Test Equipment to achieve the proper performance and operation. Such means and instructions shall include, but not be limited to, any routine checking or re-calibration needs for the Special Tool and Test Equipment itself.



## CHAPTER 15 – THE SITE

### 18.1 ACCESS TO SITE

The Contractor will be given access to the Site in accordance with following conditions:

1. The Site or Contractor's Equipment shall not be used by the Contractor for any purpose other than for carrying out the Works in the scope of this contract, except that, with the consent in writing of the Engineer.
2. The location and size of each stockpile of materials, including excavated materials, within the Site shall be as permitted by the Engineer. Stockpiles shall be maintained at all times in a stable condition.
3. Entry to and exit from the Site shall be controlled and shall be only available at the locations for which the Engineer has given his consent.

### 18.2 TRANSPORTATION TO SITE

- 18.6.1 The Contractor shall use such routes and rights of entry to the Site as may be decided by the Employer's Representative from time to time. Routes for very large or very heavy loads shall be discussed with the Employer's Representative in advance of the need arising and all arrangements therefor shall be submitted for review by the Employer's Representative.
- 18.6.2 The Contractor shall comply with the requirements of the Commissioner of Transport and /or the Commissioner of Police and / or any other Relevant Authority regarding any special traffic arrangements that may be necessary. The Contractor's attention is drawn to the Road Traffic (Regulation and Licensing of Vehicles) Regulations and the Road Traffic (Construction and Use) Regulations currently in use at Mumbai.
- 18.6.3 Extraordinary traffic may be moved from docks and between areas of the Site over public highways only by police escort and on a route and at a time determined by the Relevant Authority. The Contractor shall be responsible for obtaining permission from the Relevant Authorities to move extraordinary loads and traffic and for arranging police escorts as necessary.
- 18.6.4 The Contractor shall make all arrangements and assume full responsibility for transportation to the Site of all Contractor's Equipment, materials and supplies needed for the proper execution of the Works.
- 18.6.5 While travelling to and from the Site, the Contractor shall observe all posted speed limits, traffic regulations, stop signs, etc., and adherence to the access route indicated on the Employer's Drawings or as instructed by the Employer's Representative. No employee of the Contractor shall trespass into any part of the Employer's premises other than the Site or the designated route of access.
- 18.6.6 The Contractor shall ensure that all roads and pavements, etc. leading to and around the Site are kept free from obstructions and shall not cause inconvenience or hindrance to traffic or persons either by its vehicles or by its workmen, scaffolding, plant, materials, equipment, etc.
- 18.6.7 The Contractor shall repair damage to existing roads, footpaths, steps, cables, sewers, live drains, etc. and shall reinstate any damage caused by the Contractor's actions.

### 18.3 CONTRACTOR'S OWN ROLLING STOCK

- 18.7.1 Where the Contractor is to provide rolling stock (either self-propelled or trailing) for use during the installation and testing of the Works, the requirements of **clause 18.8** below shall

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apply. All the Contractor's own rolling stock shall not exceed the Construction Vehicle Load Gauge as shown in the Specification Drawings except with the Employer's Representative's written consent.

- 18.7.2 The Contractor shall submit full details of any rolling stock that is to be used during the installation and testing of the Works to the Employer's Representative for review within 90 days of the Commencement Date of the Works. Such details shall include a full description and drawings of the rolling stock, details of axle load, stopping distance, fail-safe braking system, kinematic envelope, and operating and maintenance instructions.
- 18.7.3 Prior to use, and following each maintenance examination, the Contractor's qualified engineer shall certify the Contractor's own rolling stock as fit-to-run. Thereafter, the Contractor's qualified engineer shall issue a registration tag. The expiry date, i.e. the date of the next inspection, shall be shown on the registration tag. The Contractor's own rolling stock shall not be used without a valid registration tag.
- 18.7.4 If the Contractor's own rolling stock is found to be operating in an unsatisfactory or unsafe condition, it shall be immediately removed until it has been restored to an acceptable condition to the satisfaction of the Employer's Representative.

## CHAPTER 17 – LIAISON WITH OTHERS

### 17.1 LIAISON WITH OTHERS

17.1.1 The Contractor shall make all necessary arrangements with and obtain the necessary approvals from Government departments, utility undertakings and other duly constituted authorities for the execution of the Works.

17.1.2 The Contractor shall maintain close liaison with Other Contractors and other contractors employed by the Employer, utility undertakings or other authorities who are carrying out work on or adjacent to the Site. The Contractor shall ensure as far as possible that the progress of the Works is not adversely affected by the activities of such other entities.

17.1.3 The design interface is an iterative process requiring regular exchange and update of interfacing information. The Contractor shall ensure that the information he requires from the Interfacing Contractors is made known at the outset of each design interface and vice versa so that the information can be provided in time for the Contractor and the Interfacing Contractors to complete their design to meet their various design submission stages.

### 17.2 WORK BY OTHER CONTRACTORS

17.2.1 The contractor shall keep note of the works which may be proceeding on various adjacent areas by others include, but is not limited to, those listed in the TS. The Employer's Representative will keep the Contractor informed of forthcoming work by Other Contractors in the proximity of the Site.

17.2.2 The Contractor shall provide reasonable access to such contractors and any other adjacent contractors and shall where necessarily liaise with the appropriate contractors, utility undertakings and other duly constituted authorities on details of interdependent phasing. The Contractor shall notify the Employer's Representative and other concerned entities at least 14 days in advance should he wish to alter these access arrangements during the course of the Works.

### 17.3 INTERFACE MANAGEMENT

17.3.1 The Contractor shall co-ordinate with Relevant Authorities and Other Contractors in the execution of the Works.

17.3.2 The Contractor shall interface and liaise with Other Contractors to ensure the effective and compatible co-ordination of all aspects of the installation and testing of the Works. The Employer's Representative shall be kept fully informed at all stages of the Works.

17.3.3 The Contractor shall assign a person as the interface contact for each Other Contractor to actively manage the progress of each interface to ensure adherence to the jointly developed Interface Management Plan.

17.3.4 Throughout the process, the Contractor shall liaise with Other Contractors to develop interface designs in conjunction and co-operation with the designers of interfacing systems. Interfacing systems include, but are not limited to, those listed in the TS. These interface designs will be monitored and reviewed by the Employer's Representative, but the Contractor shall work directly with the Other Interfacing Contractors to develop designs which are mutually acceptable to all parties. The Employer's Representative will provide details of the Other Contractors as contracts are awarded.

## CHAPTER 19 – DAMAGE & INTERFERENCE

### 19.1 DAMAGE AND INTERFERENCE

19.1.1 Transportation of Cable shall be carried out in such a manner that, as far as is practicable, there is no damage to or interference with the following, other than such damage as is necessitated to enable the execution of the Works:

1. watercourses or drainage systems;
2. utilities;
3. structures, roads including street furniture, or other property;
4. public or private vehicular or pedestrian accesses;
5. trees, graves or burial urns; and
6. existing railways and railway systems.

### 19.2 STRUCTURES, ROADS AND OTHER PROPERTY

19.2.1 The Contractor shall immediately inform the Employer's Representative of any damage to structures, roads or other property that is not required for the execution of the Works.

19.2.2 The Contractor shall use every reasonable means to prevent any of the highways or bridges connecting with, or on the routes to, the Site from being damaged by any traffic of the Contractor or any of his sub-contractors of any tier and the Contractor shall, in particular, select routes, choose and use vehicles and restrict and distribute loads so that the moving of Temporary Works, Permanent Works and Contractor's Equipment from and to the Site shall be organised as far as reasonably possible so that no unnecessary damage or injury may be occasioned to such highways and bridges. The Contractor shall in selecting such routes take advice from and follow the instructions of the Commissioner for Transport and other Relevant Authorities of Maharashtra Government and GOI.

## APPENDIX-1 MONTHLY PROGRESS REPORT

### A1.1 TOPICS

The Monthly Progress Report required under **clause 2.14** of the GS shall include as a minimum the following sections and topics:

### A1.8 Procurement Report

A1.8.1 A summary of all significant procurement activities along with the purchase technical specifications during the month, including action taken to overcome problems.

A1.8.2 A report listing major items of plant and materials, which will be incorporated into the Works. The items shall be segregated by type as listed in the Specifications and the report should show as a minimum the following activities:

- a. Purchase Order Date - Scheduled/Actual,
- b. Manufacturer/Supplier and Origin,
- c. Letter of Credit Issued date,
- d. Manufacturer/Supplier Ship Date - Scheduled/Actual,
- e. Method of shipment,
- f. Arrival date in India- Scheduled/Actual.

### A1.9 Production and Testing

A1.9.1 A review of all production and manufacturing activities during the month.

A1.9.2 Summaries of all production and manufacturing outputs during the month together with forecasts for the next month.

A1.9.3 Review of all testing activities (both at site or at the manufacture's premises) during the month.

## APPENDIX-2 SUBMISSION FOR REVIEW REQUEST FORM

Date:xx.xx.xxxx

Reference No.: see **Clause:5.3.2.**

Programme reference and scheduled date:

Submission Stage: see**Clause:4.5.1.1.**

We hereby submit for review by the Employer's Representative the documents or articles listed below:  
(Introduction and list of items submitted – see **Clause5.3.5.2** – continue on separate sheet if necessary) I  
confirm that the material submitted is in full compliance with the Contract.

Signed\_\_\_\_\_

*(Contractor's responsible engineer)*\_\_\_\_\_  
Employer's Representative's Response\_\_\_\_\_  
Dated: \_\_\_\_\_

The material submitted has been reviewed and the following decision is given:

"No Objection" / "No Objection Subject To" (see below) / "Rejected" (see below).

The following comments are made and a re-submission is to be made by the Contractor within 10  
working days demonstrating fully how all of these are taken into account:

*(Employer's Representative's comments)*\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Signed\_\_\_\_\_

(Employer's Representative)

## APPENDIX-3 REQUEST FOR INSPECTION OF WORKS FORM

### CONTRACTOR

To the Employer's Representative

Date:XX.XX.XXXX

Location:

Will be ready for your inspection

on \_\_\_\_\_

Description of Works:

At \_\_\_\_\_

Prior to \_\_\_\_\_

Labour and plant to be used:

On \_\_\_\_\_

At \_\_\_\_\_ hrs.

XXXXXXXXXX

Signed:

Received by

(for Contractor)

for Employer's Representative

Date:XX.XX.Time: XX:XX:XX hrs.

XXXXXXXXXX

**Filled in by Engineer:**

Please arrange inspection

Mr./Ms.

Please check setting out

Mr./Ms.

Signed:

**Filled in by Inspector:**

The above work was inspected, and permission was given / not given to proceed with next operation

The following remedial works were required:

Contractor informed verbally (To Mr. \_\_\_\_\_ by

Mr. \_\_\_\_\_

At \_\_\_\_\_ hrs.

Remedial works inspected, and permission given to proceed with next operation on

\_\_\_\_\_ at \_\_\_\_\_ hrs. by Mr./Ms. \_\_\_\_\_.

Date :

Time:

Verbal or written permission by the Employer's Representative or his staff shall in no way relieve the Contractor of his responsibilities under the Contract.

\* To be completed if applicable.

## APPENDIX-5 DESIGN CERTIFICATE

This design Certificate refers to design submission no. ....  
 ...., which comprises of Definitive Design submission / Construction Reference Drawings  
 submission, working drawing submission scheduled in the attached transmittal, in respect of :  
*[Description of Permanent Works to which the submission refers]*

**DESIGNER'S STATEMENT:**

We certify that:

1. the outline designs, design briefs and performance specifications of those elements of the Permanent works as illustrated and described in the documents scheduled in the attached transmittal, complies with the design basis criteria and other contract provisions.
2. an in-house check has been undertaken and completed to confirm the completeness, adequacy and validity of the design of the Permanent Works as illustrated and described in the documents scheduled in the attached transmittal.
3. all necessary and required approval relating to the design of the Permanent Works, as illustrated and described in the documents listed in the attached transmittal, have been obtained.
4. all effects of the design comprising the submission on the design of adjacent or other parts of the works have been fully taken into account in the design of those parts.

Signed by Designer's Authorized Representative

Name: .....

Position: .....

Date: .....

**CONTRACTOR'S CERTIFICATE:**

The Certifies that all design has been performed utilizing the skill and care to be expected of a professionally qualified and competent designer, experienced in work of similar nature and scope. This further certifies that all works relating to the preparation, review, checking and certification of design has been verified by us and the design proposed by the designer has been accepted by us vide **clause 4.2** of GCC.

Signed by Designer's Authorized Representative

Name: .....

Position: .....

Date: .....

Note: The Contractor shall insert one of the following, as applicable:

1. the Contractor's Technical Proposals
2. the Contractor's Technical Proposals and Design Packages Nos. .... for which a Notice of No Objection has been issued.
3. Design Packages Nos..... for which a Notice of No Objection has been issued if such Design Packages develop and amplify the Contractor's Technical Proposals.
4. The    Definitive    Design



## APPENDIX-6 QUALITY ASSURANCE

### A6.1 General

The Contractor shall implement a Project Quality Management Plan in accordance with ISO-9001 "Quality System - Model for Quality Assurance in Design/Development, Production, Installation and Servicing" to ensure that all materials, workmanship, plant and equipment supplied, and work done under the contract meets the requirements of the contract. This plan shall apply to all activities related to the quality of items, including designing, purchasing, inspecting, handling, assembling, testing, storing, and shipping of materials and equipment and different elements of construction work and installations of system components.

The Quality Plan to be prepared by the Contractor and submitted to the Engineer shall follow the requirements of ISO 9000 and address each element therein.

Registration of the Contractor's organisation, or subcontractors or sub-consultants is not required for this Project but the Project Quality Management Plan as submitted shall meet the intent of the ISO 9000 requirement in that there is a comprehensive and documented approach to achieving the project quality requirements.

### A6.2 Quality Assurance Management Plan

The Project Quality Management Plan (PQMP) shall as a minimum address the quality system elements as required by ISO 9001, generally noting the applicability to the Contractor's Works Programme for the Project. Procedures or Quality Plans to be prepared by others (Suppliers, Subcontractors, and Sub-consultants) and their incorporation in the overall PQMP shall be identified.

The Contractor shall provide and maintain a Quality Assurance Plan (QA) to regulate methods, procedures, and processes to ensure compliance with the Contract requirements. The QA Plan, including QA written procedures, shall be submitted to the Engineer for his review.

Adequate records shall be maintained in a readily retrievable manner to provide documented evidence of quality monitoring and accountability. These records shall be available to Employer at all times during the term of the Contract and during the Defects Liability Period and for a five-year period thereafter.

The Plan shall identify:

1. Design Process: that control, check and verify the accuracy, completeness and integration of the design shall be performed by certified personnel and in accordance with documented procedure that have the written consent of the Engineer.
2. Special Processes: that control or verify quality shall be performed by certified personnel and in accordance with documented procedures that have the written consent of the Engineer;
3. Inspection and Test: Inspection and testing instructions shall provide for reporting nonconformances or questionable conditions to the Engineer; Inspection shall occur at appropriate points in the installation sequence to ensure compliance with drawings, test specifications, process specifications, and quality standards. The Engineer shall designate, if necessary, inspection hold points into installation or inspection planning procedures;

4. Receiving Inspection: These procedures shall be used to preclude the use of nonconforming materials and to ensure that only correct and accepted items are used and installed;
5. Identification and Inspection Status: a system for identifying the progressive inspection status of equipment, materials, components, subassemblies, and assemblies as to their acceptance, rejection, or non-inspection shall be maintained;
6. Identification and Control of Items: an item identification and traceability control shall be provided;
7. Handling, Storage, and Delivery: provide for adequate work, surveillance and inspection instructions.

The Plan shall ensure that conditions adverse to quality such as failures, malfunctions, deficiencies, deviations, and defects in materials and equipment shall be promptly identified and corrected.

The Plan shall provide for establishing, and maintaining an effective and positive system for controlling non-conforming material including procedures for the identification, segregation, and disposal of all non-conforming material. Dispositions for the use or repair of non-conforming materials shall require the Engineers consent.

#### A6.3 Plan Implementation and Verification

The Plan shall clearly define the QA Organization. Management responsibility for the QA shall be set forth on the Contractor's policy and organization chart. The Plan shall define the requirements for QA personnel, their skills and training. Records of personnel certifications shall be maintained and monitored by the QA personnel. These records shall be made available to the Engineer for review, upon request.

The Q.A. operations shall be subject to the Engineers, Employer or Employer's authorized representative's verification at any time, including: surveillance of the operations to determine that practices, methods and procedures of the plan are being properly applied; inspection to measure quality of items to be offered for acceptance; and audits to ensure compliance with the Contract documents.

The contractor's Quality Audit Schedule shall be submitted to the Engineer for consent every three months or more frequently as required.

The results of Quality Audits shall be summarized in the Contractor's monthly reports. The Contractor shall provide all necessary access, assistance and facilities to enable the Engineer to carry out on-site and off-site surveillance of Quality Assurance Audits to verify that the quality system which has the consent of the Engineer is being implemented fully and properly.

## Appendix 7:- 110kV Cabling System

. This also includes all works such as excavation of ground, provision of HDPE pipes, restoration of ground and all other works required to make it fully functional Cable in all respects. The work shall include but not be limited to:

- Supply, Laying, Testing and Commissioning of EHV cables from GSS of Power supply Authorities to TATA LILO GIS to Metro Receiving Substation at Mandale
- Supply, Laying, Testing and Commissioning of EHV cables from GSS of Power supply Authorities to Metro Receiving Substation at BKC
- Interface with TATA Power for obtaining power supply at receiving substations including necessary requirements of protection schemes and insulation co-ordinations, traffic police, water supply authority, gas supply authority, Telecom utilities, Electricity supply utilities, etc. Employer/Employer's representative shall assist for this.
- Final location survey with GPR and confirmation of utilities, preparation of final construction /cable layout drawings indicating cable pull boxes, joint locations, any uncharted utilities, utility/route diversions if any and co-coordinating with the various State and Central Government Departments & utilities whenever and wherever necessary on the behalf of MMRDA. The co-ordination with city agencies shall also be done for the purpose of crossing -over/under or minor shifting of utilities for cable laying etc. in case of major problems, MMRDA shall assist.
- Payment deposited to civic agencies: Any amount deposited by contractor to civic agencies for obtaining cable laying permission shall be reimbursed by MMRDA to contractor on submission of documentary evidence.
- Design, Supply of complete kits with accessories for Jointing, Cross-bonding, mid-point bonding, single point bonding, termination of cables, cable termination structure and jumpering at GSS / LILO GIS of Power Supply Authority, its installation and commissioning using appropriate techniques as specified with the approval of employer.
- The joints to be located and secured in a pre-casted jointing bay (preferred) of suitable size as per approved drawing. Adequate Looping length at terminating points shall be provided.
- For bonding, Provision of required number of sheath voltage limiters (SVL's), All type of sections, earth electrodes/mesh shall be (Sheath voltage calculations) done as per IEEE 575(latest).
  - Design and Provision of multi-Conduit HDPE pipes of adequate mechanical impact strength embedded in concretes as laid in ground with proper separation for road crossing or abutment (in the case of Cable crossing the rail/road) and making a bridge to cross the cables over nallah or drains.
- Provision of Concrete Culvert or Heavy-duty GI pipes in case of underground Nallah cable crossing shall be provided.
- Ground penetration survey (GPR): The contractor shall carry out the GPR survey of the complete cable system and submit the drawing marking the coordinates showing distance, depth along the cable path.
- Provision of chamber boxes etc. if required for locating/housing the cable joints, cross bonding and earthing etc.

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- Providing necessary (RCC) protection covers, route markers & sand cushions for the cables.
  - Testing and commissioning of EHV cables.
  - Excavated area due to open excavation, trenchless, pulling pit or any other method shall be barricaded while executing the work. Each barricade shall be as per MMRDA SHE standards. Penalty as per various clause of SHE, if barricading not provided, shall be imposed. Foot patrolling of all the power cable route till handing over of the system (all type of cables)
  - Interface with TATA Power for obtaining power supply at receiving substations including necessary protection and insulation co-ordination. Employer/Employer's Representative shall assist.
  - Evaluation & checking of proposed design/ layouts as specified in tender, preparation of final or modified layout & construction drawings, protection schemes for approval of employer and final construction drawings.
  - Preparation of drawings, O&M training manuals, evaluation & checking of design and training of staff. A standalone desktop PC shall be provided at each RSS with the O&M procedures for equipment's under supply. The maintenance and the report forms shall be built in the O&M procedures.
  - Final location survey of the route for EHV cables between the Grid Substation of Power Supply Authority (TATA Power) and the Line 2B RSS (2 Nos.) for Mumbai Metro.
  - Submission of details of possible alternative routes, together with their implications on Work Methodology, Execution time, cost, utilities affected to be diverted and acceptable to civic bodies.
  - Preparation of cable paths in accordance with approved designs as per the route accepted by the Employer.
  - Laying of cables in accordance with the Methodology (pulling, running out or ploughing in) accepted by the Employer and the Power Supply Authority.
  - Straight through joints.
  - Cable terminations at either end.
  - Cable termination structure and jumpering at GSS of Power Supply Authority connecting cable to the supply point.
  - Single bonding or Cross-bonding as necessary with SVLs and earthing's as per approved design.
    - Laying of Control & Monitoring cables (copper-core or optic fibre) for protection and communication between the Receiving Substations of Power Supply Authority and Line 2B RSS for Mumbai Metro.
  - Supply of Operation and Maintenance Manuals for EHV cables.
  - Deal and resolve in co-ordination with the Employer the interface with Local Authorities like state power corporation and other state government authorities etc. to ensure progressing of the field works as per schedule
  - Deal and resolve in co-ordination with the Employer the interface with TATA Power and other Authorities, to ensure completion of works in their premises, as per schedule.
  - Interfacing with other Contractor / Detailed Design Consultants, as required.,

**Appendix -8 Civil construction and structural works at RSS**

1. Contractor shall develop the area to ensure that the finished ground level for RSS building is above the Highest flood level at the RSS which is proposed at BKC and Mandale Depot. Switch yard shall be maintained at higher than the finished ground level. Levelling and filling of RSS land shall be done by contractor as per requirement.

2. The Scope of work for Contractor shall include without limitation to:

- a. RSS control building in all respects.
- b. Transformer foundations including oil retention pits.
- c. RCC or equivalent and suitable Foundations for all equipment in RSS as required.
- d. All structural steel for outdoor electrical works.
- e. Structures for 110kV equipment, 33kV equipment and 25kV equipment.
- f. Fire walls of min. 4 hrs rating with RCC foundations.
- g. Provision for separate fire Exit.
- h. Anti-weeding.
- i. Micro grading.
- j. Gravel Spreading (Min 100-150 mm thick layer to reduce potential rise as per application duty requirement).
- k. Cable trenches with covers.
- l. Underground cable termination chambers and cable pull pits.
- m. ~~Earthing and bonding work.~~
- n. Complete Retaining wall, Compound wall and gates.
- o. Drains from RSS area are to be extended and connected to main drains.
- p. Interconnection of the utilities with the existing utilities.
- q. Rail track for power transformers with RCC foundations.
- r. Access roads and interconnection with the existing roads.
- s. Oil soak pits, Domestic Underground and Overhead water tank, septic tanks, sanitary pits, sumps, pull pits, cable joint pits with necessary treatment facilities.
- t. Rainwater harvesting system in substation premises.
- u. ~~Fire Protection system~~, PHE and RO arrangement for meeting the requirement of minimum 15 persons.
- v. Concrete duct banks for road, drain and utilities pipelines crossings.
- w. Landscaping within the RSS boundary area.
- x. Outside Store , Indoor Store Room, Security Room, Covered Parking Space, ~~Office Rooms including furniture's at both RSS & TATA LILO GIS.~~
- y. Cutting, filling & compacting to required levels, space provisioning for future expansion.
- z. Lattice structures for all outdoor Plants and mast etc.
- aa. All restoration works.
- bb. All civil works required for carrying out the installation activities.
- cc. Rest room & office room of suitable size with adequate facility shall be constructed at BKC RSS

**SECTION -3**

**DRAWINGS**