SPECIFICATION FOR SLOPE STABILISATION WORKS FOR RESTRORATION OF EXPOSED 42" PIPELINE

PROJECT : RESTRORATION OF EXPOSED 42" PIPELINE AT CH. 2.0KM

OWNER : M/s. ISPRL

JOB NO. : C046

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
0	27.03.2025	ISSUED FOR TENDER	AS	ROUT/RB	VKP

SPECIFICATION FOR SLOPE STABILISATION WORKS FOR ISPRL

1.0 GENERAL

M/s Indian Strategic Petroleum Reserves Limited (ISPRL), a Special Purpose Vehicle (SPV) established by the Oil Industries Development Board (OIDB), operates a 42" crude oil pipeline approximately 36 km long, running between the Intermediate Valve Station (IVS-4) and the Padur Cavern.

During the 2023 monsoon, unprecedented rainfall in the Mangalore region caused severe soil erosion, exposing approximately a 100-meter section of the pipeline around Ch. 2.0 km. Following site inspections, temporary measures were implemented by the Owner to stabilize and support the pipeline. Subsequently, ISPRL approached Engineers India Limited (EIL) for permanent restoration of the slope at the Bala Right of Use (RoU) area, including pipeline support, backfilling, and associated works. The site photographs are attached in APPENDIX II.

The location of the exposed pipeline is as under:

The scope of work for this tender includes permanent restoration of exposed 42" pipeline by stabilizing the slope at Ch.2.0 km at Bala. For subsoil profile, available field borelog sheet is attached in APPENDIX I for reference.

Bidder shall visit the site (before submitting the bid) to become fully acquainted with the existing site conditions. No extra claim at a later date shall be entertained due to non-familiarization with site conditions.

2.0 SCOPE

2.1 The brief scope of work under this tender shall, in general, but not limited to, construction of all relevant civil-structural works, including supply of all material and resources (plant/machinery/manpower) etc. related to the work of slope rectification and other associated Civil/Structural works, as per the specifications, standards and addendums included in the Bid Document and the directions of Engineer-in-charge, as per approved for construction (AFC) drawings.

2.2 Detailed Scope of Work

Contractor's scope of work shall include, but shall not be limited to the following:

3.2.1 Installation of contiguous piles, mechanically stabilized earth (MSE) wall, laying of geosynthetic materials, shotcreting with wire mesh, PCC, Self Drilling Anchor (SDA), grouting, nail head connection, load tests of SDA, horizontal drainage pipes, restoration of exiting drains and all associated civil works as per drawings, specification and instruction of Engineer-in-charge.

3.2.2 Earthwork in excavation in all types of soil, soft rock & hard rock including dewatering below ground level for all types of soil.

3.2.3 Backfilling at all depths with good soil and transportation of surplus earth, debris, rock etc. to the area identified by contractor.

3.2.4 PCC works including lean concrete at all depths and heights.

3.2.5 Dismantling/Demolishing of PCC, road etc., for all depths below plinth level and all heights above plinth level, including the transportation of waste materials, debris etc., to the location identified by contractor.

3.2.6 Obtaining all requisite permissions (if any), work permits etc. from concerned authorities in order to carry out slope rectification works.

3.2.7 Developing a detailed methodology for execution of the work keeping in view of the site conditions including accessibility of the site, availability of materials, accessibility of equipment and other environment parameters. The methodology for execution of works shall be submitted to Owner/Owner's representative for review and approval. The methodology shall also cover the construction equipment proposed to be deployed by the Contractor.

3.2.8 Any other work not specifically listed above but required for completion of the works to the satisfaction of the Owner.

3.2.9 Horizontal drainage pipes shall be installed in such a way that the grout of nails does not choke the perforations of the horizontal drainage pipes.

2.3 It is incumbent upon the bidder to seek all technical clarifications concerning the job prior to the bid preparation. No such clarifications shall be entertained after the award of job. Notwithstanding this, the decision of Engineer-in-Charge, in case of any disputes shall be final. However, it must be clearly understood by the contractor that any extra claim and/or time extension shall not be granted under any circumstances.

3.0 MATERIALS

4.1 Gabion

4.1.1 Gabion Box

Gabion box shall be made up with 2.7mm internal diameter steel woven wire with Zn + Ultraviolet resistant PVC coating. The mesh of 10x12 (100mmx120mm maximum size) is to be prepared by double twisting the wire and fabricated into gabion of size 1.0mx1.0mx1.0m.

The mesh panels are reinforced at all the edges with wires of larger diameter (i.e., Edge/Selvedge wire) than that used for manufacturing the mesh, to strengthen and to facilitate construction. The gabion boxes shall be tied after placement with the wire of same material (i.e., lacing wire) used for gabion making. The soft temper steel wire used for the manufacture of gabions and the lacing wire shall be as per IS 16014 (latest revision) and shall have a tensile strength of 350-550 MPa as per IS 280 (latest revision).

Gabion shall comply with IS 16014:2018 and bear the standard mark under a license or certificate of conformity from BIS.

4.1.2 Stones for Gabion box

Boulder/stone sizes for gabion shall vary from 250mm down to 120mm with preferably one face flat & shall be clean, sound, compact and hard rock of good quality. The rock shall meet the following requirement:

i) Specific gravity greater than 2.6
ii) Minimum density of stone 2600Kg/cum
iii) Minimum crushing strength of 60MPa
iv) Maximum water absorption of 4% by weight
v) Aggregate impact value less than 30%
vi) Los Angele abrasion value less than 30%

The rock samples shall be tested as per BIS codes. One set of laboratory test shall be carried out for every 1000T of rock and test results to be submitted to Engineer-in-charge for review/approval.

4.2 Geotextile

Geotextile (Terram 1000/Equivalent) shall be laid in line with the issued drawing for separation and filtration purpose. Jointing or stitching/overlapping etc. shall be as per manufacturer's specification. Any equivalent product proposed to be used shall be submitted to Engineer-in-charge for approval prior to application without any extra cost and time implication to the owner. Geotextile shall conform to the specified properties and IS 16393. Geotextile should bear the standard mark under a license or certificate of conformity from BIS. Properties of the geotextile shall be as follows:

Tensile strength	EN ISO 10319:	8 kN/m
Elongation	EN ISO 10319:	24%
Tensile strength at 5% elongation	EN ISO 10319:	3.4 kN/m
CBR Puncture Resistance	EN ISO 12236:	1500 N
Permeability (H50)	EN ISO 11058:	100x 10^{-3} m/s
Mass /unit area	EN ISO 9864:	120 g/m^2

4.3 HDPE pipe for horizontal drainage

Partially perforated HDPE drainage pipe of 15m in length & 110mm diameter (minimum 6 Kg/cm^2 pressure) wrapped in Geotextile of type Terram 1000/Equivalent shall be used as horizontal drainage pipe.

4.4 Self Drilling Anchors (SDA)

For material specification and installation methodology of self-drilling anchors refer document no. C046-000-81-47-SP-0012 attached with the tender.

4.5 Piling

For specification of bored cast-in-situ RCC piles, refer document no. C046-000-81-47-SP-0013 attached with the tender.

Available field borelog is attached in Annexure-I for reference. The contractor is required to deploy suitable rigs and machinery for the construction of the piles.

4.6 Geogrid Reinforcement

The flexible Geogrid shall be made from high molecular weight and high tenacity polyester (PET) yarn or high-density polyethylene (HDPE) with low creep and an environmentally inert coating, resistant to UV light and all micro-organisms and chemicals naturally present in the soil and temperature resistance up to 40° C. Geogrid shall comply with IS 17373:2020 and bear the standard mark under a license or certificate of conformity from BIS. The total warp strain (including creep) at 10,000 hrs loading shall not exceed 6 % at 50 % of ultimate tensile strength. The total post-construction strain for the design life of the structure at the allowable design load shall not exceed 1% (in accordance with BS 8006) at 50% of ultimate tensile strength.

- The maximum strain at nominal tensile strength as per EN ISO 10319 shall be 10%.

- The mechanical properties of the grid should be verified by both internal quality assurance and external quality control and assurance by accredited laboratories (DIN EN ISO 17025:2000).

- The production of the Geogrid shall be EN ISO 9001:2000 certified.

- Each roll should have at least one identification label with roll number and product type in accordance with DIN EN 10320.

- The product shall be marked with a CE mark according to CEN regulations.

Polyester Geogrids shall be coated with a protective PVC coating / polyethylene coating to maximize the resistance to hydrolysis and enhance durability during construction and in service.

High-density polyethylene Geogrids shall be manufactured by extruded, drawn sheets and by punched and orientation process in one direction so that the resulting ribs shall have a high degree or molecular orientation, which is continued through the integral transverse bar. It shall contain adequate stabilizers to enhance stability to environmental stress cracking (ESC) photo oxidation (UV exposure) and thermal oxidation. HDPE Geogrids must possess 100% junction efficiency of QC strength (in accordance with GRI-GGS-87 test requirements) between longitudinal ribs and transverse bars for efficient load transfer mechanism. The minimum mass per unit area (ASTM D 5261) of HDPE Geogrids shall be 500 gsm. The Geogrid roll width shall be a minimum 5 m.

4.7 Other Materials

Specification of all other materials shall be as per EIL standard specification attached with tender, CPWD specification, BIS codes or referred international codes, whichever is stringent.

4.0 CONSTRUCTION

Complete slope rectification/strengthening work shall be carried out in accordance with the specification and in conformity with the lines, grades, and dimensions shown on the drawings.

5.1 Gabion wall base preparation

Base area of the Gabion wall shall be placed on undisturbed in-situ soil or PCC. Base of the excavated pit shall be compacted well and in conformity to the limits and to the lines and grades as shown in the drawings. If loose soil is encountered at base, the same shall be well compacted as specified in drawing and as per instruction of Engineer-in-charge. The contractor shall take precautions to minimize over-excavation. Over excavation shall be filled with coarse sand at the cost of contractor.

5.2 Gabion box

Placement of Gabion box shall be done in the orientation as shown in the approved drawing. G.I. or M.S. pipe should be temporarily fixed on face of gabion while filling stones. Gabion shall be overfilled by approximately 25-50mm to allow for natural settlement. Gabion filling should be done in 3 layers in each box. The stones shall be closely packed, ensuring minimum voids between stones by skilled masons. Lacing shall be done in alternate single and double looping fashion at interval of 150mm maximum. Bracing wire should be provided to control bulging at 0.3m c/c along height and length.

The Gabion wall system supplier shall provide one qualified and experienced representative at site on a full-time basis during the entire gabion working phase to ensure that the quality of the work performed by the contractor is in accordance with the specifications & drawing and to assist the contractor during gabion wall installation.

The Contractor's construction supervisor shall have experience and should be qualified to direct all work at the site. All expenses relating to the presence of supervisor of Gabion wall system supplier on site shall be deemed to have been included in the quoted rates, and no extra claim on this account shall be admissible.

5.3 Placement of Geotextile

Geotextile Terram 1000/Equivalent shall be laid in line with the drawing for retaining the soil in MSE wall, separation and filtration purpose. Jointing or stitching/overlapping etc. shall be as per manufacturer's specification & construction drawing. Care shall be taken while laying the geotextile to avoid damage during construction.

5.4 Placement of Geogrid Reinforcement

All reinforcement shall be installed at the proper elevation and orientation as shown in the approved drawings or as directed by the Engineer-in-charge. The reinforcement strips shall be placed normal to the face of the wall unless otherwise shown on the drawings.

5.5 Reinforced Soil/Fill

Backfilling behind the MSE wall shall be done with sand (Zone-II & III) and in compliance with the compaction criteria specified in the drawing. The backfilling shall be raised simultaneously as the rise of the wall.

The compacted layer should not be more than 200 mm thick. The compaction of backfill material shall be 85% relative density as per IS 2720 (Part-XIV).

5.6 Setting out of SDA & horizontal drainage pipe

The positions and reference numbers of the anchor (SDA) should be clearly marked on the slope/pile face by the contractor for easy identification. Along with anchoring, the

position of horizontal drainage pipe shall also be marked as per drawing and instructions of Engineer-in-charge. The contractor shall make necessary arrangements, such as constructing the temporary platform to install the SDA and horizontal drainage pipes.

5.7 Drilling Equipment for Anchoring & horizontal pipe

The Contractor should ensure that the total length of drill rods available at each drilling location is sufficient for the length of the anchor & horizontal drainage pipe. Contractor should also ensure that the diameter of the drill bits is appropriate for drilling the hole of specified diameter.

5.8 Drilling and installation of drainage pipe

HDPE drainage pipe shall be installed at 5 to 10 degree inclined upwards with horizontal in locations as shown in the drawing. In case, hard rock is encountered during the drilling, then the length drill hole shall be restricted up to the surface of rock.

5.9 Shotcreting

Shotcreting shall be carried out as per specified technique of FHWA-SA-96-069R. The minimum thickness of shotcreting shall be 100mm.

5.10 Specification for other construction

Procedure for all other construction works shall be as per EIL standard specification attached with tender, CPWD specification, MoRTH, BIS codes or referred international codes and best construction practices.

For measurement of quantity for payment purposes during construction, all work below existing ground level shall be considered as sub-structure work/work below plinth level.

5.11 Inspection

The engineer-in-charge shall verify the materials supplied by the contractor to ensure that all the requirements of the specifications are satisfactorily met. This includes all submittals and proper installation of the system.

5.0 SUBMITTALS

Contractor shall provide shop drawings, test nail procedures, material and mill test certificates as applicable, mix designs (grout & concrete), qualifications, construction procedures and detailed construction sequencing plans including excavation sequence, at least one week prior to the commencement of the work. For all submittals related to SDA refer document no. C046-000-81-47-SP-0012 attached with the tender.

6.0 QUALIFICATION

Drilling operators and foremen shall have at least 5 years of experience installing nails or permanent grouted nails. A List of project personnel with appropriate qualifications shall be submitted for Engineer-in-charge's approval at least 7 (seven) working days before any physical works at the site. Inadequate proof of personnel qualifications may be a cause for withholding construction approval. Changes to previously approved personnel must be applied and approved in writing.

Shotcreting nozzle operators shall have at least 2 years of experience in applying shotcrete on projects of comparable nature or work under the immediate supervision of a foreman or instructor.

The Engineer-in-charge shall approve the Contractor's qualification and site personnel within 7 working days after the receipt of the submission. Work shall not start until the Contractor's qualifications have been approved. The Engineer in charge may suspend the work if the Contractor substitutes unqualified personnel for approved personnel during construction. If work is suspended due to the substitution of unqualified personnel, the Contractor shall be fully liable for additional costs resulting from the suspension of the work. Adjustments in contract time resulting from the suspension under such circumstances will not be allowed.

Appendix-I

Form No. F-02 Page 1/3

XPLORER

RECORD OF ROCK DRILLING

Client's Name: IJPPL
Project: Restoration of Exposed 42" Pipe line at 20 km
BH Location: Top at the slope along pipe
Surface Elev.
Coordinate N-
E-

Type of Bit Used: T.C.
BH Dia (mm): 150
Casing Depth (m): 0.0
Term. Depth (m): 25.45
Water Table (m): NIL

BH No.: 01
Start Date: 21/03/2025
Finish Date: 23/03/2025
Operator: Murgan
Supervisor: Ratan
Drilling Method: Rotary

Depth (M)	Description	Rock Recovery (%)	RQD (%)	Size of Borehole (mm)	SPT: No. of Blows	SPT: N Value	Drilling Observation: Type of Casing	Colour of Return Water	Water Loss(%)	Rate of Penetration	Remarks
0.5-0.82 SPT-1	Very Dense Brownish clay Sand with murum			150	14/33/67	>100	NX	Brownish			SPT-1
2.0-2.35 SPT-2	very Dense Redish clay Sand with Gravel.			"	15/43/57	>100	"	"			SPT-2
3.50-3.90 SPT-3	— Do —			"	19/47/53	>100	"	"			SPT-3
5.0-5.25 SPT-4	Very Dense Brownish silty sand with Gravel.			"	25/100	>100	"	"			SPT-4
6.5-6.73 SPT-5	— Do —			"	35/100	>100	"	"			SPT-5
8.0-8.24 SPT-6	Very Dense Redish Brown clay sand with Gravel.			"	40/100	>100	"	"			SPT-6
9.5-9.90 SPT-7	— Do —			"	33/50/50	>100	"	"			SPT-7

Note:

- BH ...... Borehole
- P ...... Percussion Drilling
- R ...... Rotary

Site in-Charge: [signature]
Client's Signature ....

Form No. F-02

Page 2/3

XPLORER

RECORD OF ROCK DRILLING

Client's Name: ISPRL
Project: Restoration of Exposed 42" pipe line at 20 km
BH Location: Top of the slope
Surface Elev.:
Coordinate N-:
E-:

Type of Bit Used: TC
BH Dia (mm): 150
Casing Depth (m): 5.0
Term. Depth (m): 25.45
Water Table (m): NIL

BH No.: 01
Start Date: 21/03/2025
Finish Date: 22/03/2025
Operator: [illegible]
Supervisor: Ratan
Drilling Method: Rotary

Depth (M)	Description	Rock Recovery (%)	RQD (%)	Size of Borehole (mm)	SPT: No. of Blows	SPT: N Value	Drilling Observation: Type of Casing	Drilling Observation: Colour of Return Water	Drilling Observation: Water Loss(%)	Drilling Observation: Rate of Penetration	Remarks
11.0-11.35 SPT-8	Very Dense Redish Brownish Sandy clay with Gravel.			150	32/55/45	>100	NX	Brownish			SPT-8
12.50-12.77 SPT-9	Very Dense Redish Brown silty sand with Gravel.			"	34/61/	>100	NX	"			SPT-9 (Hammer rebound)
14-14.45 SPT-10	Very Dense white pink Sandy silt				19/32/37	69	"	"			SPT-10
15.50-15.95 SPT-11	Very Dense white pink silty sand with Gravel.				10/30/39	69	"	"			SPT-11
17.0-17.45 SPT-12	Very Dense white yellow Sandy silt				12/21/32	53	"	"			SPT-12
18.5-18.95 SPT-13	Very Dense Redish Brown silty sand with Gravel				16/28/35	63	"	"			SPT-13

Note :

- BH .... Borehole
- P .... Percussion Drilling
- R .... Rotary

Site in-Charge .... [signature]
Client's Signature ....

Page 3/3

Form No. F-02

XPLORER

RECORD OF ROCK DRILLING

Client's Name ISPRL
Project Restoration of exposed 42" pipe line at 20 km
BH Location TDF at Slope
Surface Elev
Coordinate N-
E-

Type of Bit Used TC
BH Dia (mm) 150
Casing Depth (m) 0.0
Term. Depth (m) 25.45
Water Table (m) NIL

BH No. 01
Start Date 21/03/2025
Finish Date 23/03/2025
Operator Narayan
Supervisor Rajan
Drilling Method Rotary

Depth (M)	Description	Rock Recovery (%)	RQD (%)	Size of Borehole (mm)	SPT		Drilling Observation					Remarks
					No. of Blows	N Value	Type of Casing	Colour of Return Water	Water Loss(%)	Rate of Penetration		
20.0-20.45 SPT-14	Very dense white pink Sandy Silty.			150	17/24/40	64	NX	Brownish				SPT-14
21.5-21.95 SPT-15	Very Dense white Sandy silt			"	20/25/32	57	NX	"				SPT-15
23.0-23.45 SPT-16	— Do —			"	15/27/38	65	"	"				SPT-16
25.0-25.45 SPT-17	Very Dense white pink Sandy silt with gravel.			"	17/29/53	81	"	"				SPT-17

Note :

- BH.....Borehole
- P.....Percussion Drilling
- R.....Rotary

Site in-Charge
Client's Signature

Appendix-II
(Site Photographs)

SPECIFICATION FOR SELF DRILLING ANCHORS (SDA)

ISPRL

PROJECT : RESTRORATION OF EXPOSED 42" PIPELINE AT CH. 2.0KM

OWNER : M/s. ISPRL

JOB NO. : C046

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
0	27.03.2025	ISSUED FOR TENDER	AS	ROUT/RB	VKP

1.0 SCOPE

This specification provides the general requirements of materials, preconstruction testing, installation details and quality control for self drilling anchors (SDA) installed in various type of slopes.

The work covers installation of self-drilling anchor (SDA) for slope stabilization works for permanent restoration of exposed 42" pipeline by stabilizing the slope at Ch. 2.0 km, Bala.

2.0 REFERENCES

The following list of codes & standards shall be referred to during the installation of SDA.

IS: 11309	Method of conducting pull out test on anchor bars and rock
ASTM D4435-13e1	Standard Test Method for Rock Anchor Pull Test
BS EN 1997-1	Eurocode 7: Geotechnical design Part-1: General Rules
BS EN 1537	Execution of Special Geotechnical Work-Ground Anchors

Whenever any reference to Codes is made, the same shall be taken as the latest revision (with all amendments issued thereto on the date of award of the contract). In case of any variation/contradiction between the provision of codes and this specification, the provision given in this specification shall be followed.

3.0 MATERIALS

The self-drilling anchor system comprises of a hollow threaded bar with an attached drill bit that can perform drilling, anchoring and grouting in a single operation. SDA is a high-graded hollow core steel (safe load more than or equal to 230KN and ultimate load more than or equal to 280KN) bar with continuous threaded surface for mechanical coupling. In addition to hollow core steel bar, other parts of the assembly consist of hexagonal nut, bearing plate (200mmx200mmx10mm), extension couplings and sacrificial drill bit. SDA core steel bar, nuts, bearing plates and couplers should be hot dip galvanized or epoxy coated for corrosion protection. Before and during installation, thread ends shall be kept clean to enable fitting of hex nut and coupler thread. Drilling and installation of SDA shall be carried out as per manufacturer's guidelines.

3.1 Specification of Anchor Nut

Key Size (mm) : 46
Length (mm) : 45
Type of Steel (mm) : CK45

3.2 Specification of Coupler

Dia, d (mm) : 42
Length, L (mm) : 160

Type of Steel : EN 10083-1

3.3 Specification of self-drilling anchors

The core steel bar of SDA shall conform to the properties given in Table-1 below.

Table: 1

Product Name	Type	Test Method	Chemical Composition in (%)							
			C	Si	Mn	P	S	Cr	Ni	Cu
Self Drilling Anchor	R32N	ASTM E-415: 2017	0.41	0.22	0.62	0.02	0.004	0.9	-	-

Mechanical Properties	
Outer Diameter (mm)	32
Minimum Yield Load (KN)	230
Minimum Ultimate Load (KN)	280
Minimum Elongation (%)	6
Thread Type	Rope threaded
Type of Steel	EN 10083-1
Thread (Left/Right hand)	Left to right
Option for Anti-Corrosion	Epoxy Coating or Hot dip Galvanization

4.0 HOLE, ANCHOR AND GROUTING

The minimum diameter of drilled holes shall be 75 mm (drill bit size). The hollow threaded bar for SDA shall have outer diameter of minimum 32 mm and inner diameter of approximately 20mm. The length of the bar shall be decided as per good for construction (GFC) drawings or instructions of Engineer-in-charge. Drill bit to be used shall be selected according to installed length of bar and geology.

Grout to be used for SDA shall be non-shrink cement grout (Min. M30 grade). The grout mix may be prepared with OPC of grade 53 having a water cement ratio not thicker than 0.4 and shall contain suitable additives to provide required flowability. Grout should be injected at pressures suitable to site conditions and shall not contain admixtures containing chlorides and alkali. All accessories of SDA shall be suited to the main anchor rod type and shall be procured from original manufacturer of the SDA. CONTRACTOR shall seek Engineer-In-Charge's approval for couplers, nut and plate of SDA. Self-Drilling Anchor shall be grouted through the flushing hole immediately after completion of the drilling operation. The grout mix, grouting pressure and quantity shall be determined by the Contractor according to the ground conditions encountered and approved by the Engineer-in-charge.

5.0 INSTALLATION

Installation of SDA shall be done in accordance to manufacturer's specifications and relevant standards in order to develop required pull-out strength. SDA drilling, grouting, and anchoring should be carried out in one operation. The wire mesh to be used for

shotcreting shall be placed at the same time as SDA installation. The wire mesh shall be placed over the heads of SDA and shall be connected to the heads by plates & nuts before commencing shotcreting.

The contractor shall submit detailed method statement for installation of ground anchors prior to commencement of works for review/approval of Owner/Owner's representative. The method statement shall contain but not limited to the following information:

a) A detailed construction sequence including excavation sequence
b) Drilling method and details of drilling equipment
c) Installation method
d) Grouting method and equipment
e) Material and plant requirements at each construction stage
f) Shop drawings
g) Method of Testing
h) Details of assembled component samples comprising of anchor bars, coupling sleeves, connectors, centralizers, grout pipes etc.
i) Detail of working platform
j) Details of permanent casing (wherever required)
k) Method of storing materials
l) Method of assembling anchor bars
m) Method of constructing anchor heads
n) Details of testing assembly including details of datum for deformation measurement and master pressure gauge to be used. Calibration tests shall be performed by an independent testing laboratory within 90 calendar days of the date submitted.

6.0 QUALITY CONTROL AND TESTING

Both verification and proof testing of the anchors shall be required and the test shall be as per relevant codal standards. Contractor shall submit the testing arrangement for Engineer-in-charge's approval before testing arrangement is made at site. The Contractor shall supply all material, equipment, and labor to perform the tests. Owner's Engineer shall measure and record all data in an acceptable manner. Testing of anchor shall not be performed until the grout has reached sufficient strength to ensure design bond stresses mobilization (Minimum 72 hrs).

6.1 Testing Equipment

For both Verification and Proof tests CONTRACTOR shall use a specifically designed reaction frame (as shown in Figure 1 of IS: 11309).

6.2 Verification Tests

Verification load test shall be carried out with adequate safety measures as per the requirements/provisions given in IS: 11309. The number of SDA to be tested shall be as per the bill of quantities and direction of Engineer-in-charge.

The test shall be performed within 10 days after the SDAs are installed. Verification test anchors shall be incrementally loaded to twice the design load (DL) and displacements shall be recorded.

6.3 Proof Test

Proof load Test shall be performed on SDAs installed for stability enhancement of slopes. The number of proof tests shall be as per Schedule of rates. Proof test anchors shall be incrementally loaded to 1.5 times the design load (DL) and displacements recorded. The location of the proof tests shall be determined by the Contractor and approved by Engineer-in-charge.

6.4 Acceptance Criteria

A test nail shall be considered acceptable when:

i) For verification tests, the total creep movement is less than 2mm between the 6 and 60 minute readings and the creep rate is linear or decreasing throughout the creep test load hold period.

ii) For proof tests, the total creep movement is less than 1mm during the 10 minutes readings or the total creep movement is less than 2mm during the 60 minute readings and the creep rate is linear or decreasing throughout the creep test load hold period.

iii) For both verification & proof test: The maximum test load is sustained without reaching the failure point (pullout). The failure point shall be the point where the movement of the test nail continues without an increase in the load. The failure load corresponding to the failure point shall be recorded as part of the test data.

7.0 REPORTING

Contractor shall provide material and mill test certificates as applicable, mix designs (grout), qualifications of workman and construction procedures at least one week prior to the commencement of the work.

Daily report shall be generated by CONTRACTOR for installation of SDA. The report shall include the following minimum information:

a) Date and shift
b) Chainage
c) SDA number
d) Locations (Sketch)
e) Drilled lengths
f) Steel quantity
g) Grout quantity
h) Tested SDA number

8.0 QUALIFICATION

Drilling operators and foremen shall have at least 5 years of experience installing nails or permanent grouted nails. A List of project personnel with appropriate qualifications shall be submitted for Engineer-in-charge's approval at least 7 (seven) working days before any physical works at the site. Inadequate proof of personnel qualifications may be a cause for withholding construction approval. Changes to previously approved personnel must be applied and approved in writing.

Shotcreting nozzle operators shall have at least 2 years of experience in applying shotcrete on projects of comparable nature or work under the immediate supervision of a foreman or instructor.

The Engineer-in-charge shall approve the Contractor's qualification and site personnel within 7 working days after the receipt of the submission. Work shall not start until the Contractor's qualifications have been approved. The Engineer in charge may suspend the work if the Contractor substitutes unqualified personnel for approved personnel during construction. If work is suspended due to the substitution of unqualified personnel, the Contractor shall be fully liable for additional costs resulting from the suspension of the work. Adjustments in contract time resulting from the suspension under such circumstances will not be allowed.

SPECIFIC REQUIREMENTS FOR BORED CAST-IN-SITU RCC PILES

ISPRL

PROJECT : RESTRORATION OF EXPOSED 42" PIPELINE AT CH. 2.0KM

OWNER : M/s. ISPRL

JOB NO. : C046

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
0	27.03.2025	ISSUED FOR TENDER	AS	ROUT/RB	VKP

1.0 SCOPE OF WORK

1.1 The work covers installation of straight shaft Bored cast-in-situ piles for slope stabilization works for permanent restoration of exposed 42" pipeline by stabilizing the slope at Ch. 2.0 km, Bala.

1.2 The work involves but not limited to the following:

Construction of 500mm diameter straight shaft RCC bored cast-in-situ piles. The approximate length of piles below cut-off level and approximate number of piles are as follows:

Area	Diameter of Pile	Approx. no. of piles	Approx. length below cut-off level (m)
Slope at Ch.2.0 km	500mm	310	17-20

2.0 AVAILABLE INFORMATION

Proposed piling area is along the distressed slope at Ch.2.0 km, Bala. Bidder to refer document no. C046-000-81-47-SP-0011 for information about subsoil and prevailing groundwater conditions along with site photographs attached with the tender. Bidder shall visit the site to assess the extent of work for constructing temporary access road for rig movement and working platform for piling works. Quoted rates for the work shall be inclusive of all these activities and no extra claim on time and/or cost shall be entertained by owner. Scheme for access road and working platform shall be submitted to Owner/EIL for review and approval.

3.0 REQUIREMENTS

All work shall be carried out in accordance with the specifications enclosed herewith, and the applicable Codal provisions. Contractor shall ensure minimum requirements as laid down hereunder:

3.1 Termination of Piles

Piles shall be terminated in stiff clay strata with minimum pile length of 17-20 m below COL as indicated in layout drawing.

The termination layer of piles shall be decided by conducting Standard penetration test (conforming SPT N-value more than 30 for minimum five consecutive tests in 750mm interval starting 1.5m before termination depth of pile and 1.5m after termination depth of pile) in pile bore.

This shall be conducted one in ten pile locations (minimum) as per the instruction of Engineer-in-charge. Termination depth in all cases shall be certified by Engineer-in-charge.

3.2 MATERIALS

Materials shall conform to "Standard Specification for Materials for Reinforced Concrete Piles (EIL specification no.: 6-74-0006)", enclosed and forming a part of the tender.

3.2.1 **Concrete**

The concrete shall have a minimum strength of 30 N/mm^2 at 28 days. The cement for concrete shall be Ordinary Portland/Portland Pozzolana/Portland Slag cement having minimum cement content not be less than 400 kg/m^3 with maximum water-cement ratio of 0.45. The allowable slump shall be as per relevant latest revision of IS codes (IS:2911 Part I/Sec.2). The Engineer-in-charge may allow marginal adjustment in water/cement ratio to obtain concrete of good workability. The other concrete specifications shall be as per relevant clauses of "Design, Construction & Installation of Bored cast-in-situ piles (EIL Specification No. 6-74-0011) forming part of this document.

3.2.2 **Reinforcement**

Reinforcement shall be TMT high strength deformed bars of grade Fe500D conforming to IS:1786 (latest revision). The reinforcement in the pile shall consist of the following or as per the pile reinforcement drawings which shall be available to the contractor at the time of execution of work:

a) Longitudinal Reinforcement

Piles reinforcement shall be 6 nos. 25mm diameter bars up to the termination depth of pile.

b) Stirrups

Stirrups in the form of helical/circular shall be of 8mm diameter high strength deformed bars of grade Fe500D conforming to IS 1786 (latest revision) at 150mm c/c all through the length of pile.

c) Stiffeners

Stiffener bar shall be of 16 mm diameter and shall be provided all through the length of pile at spacing of about 1.5m c/c.

d) Cover

Clear cover to reinforcement shall be 50 mm.

3.3 INSTALLATION

3.3.1 Installation of piles shall be carried out in accordance with the pile lay out drawings which shall be available to the contractor at the time of execution of work.

3.3.2 Cut-off level of the piles shall correspond to those given in the working drawings.

3.3.3 To ensure dense and sound concrete upto cut-off level, concreting shall extend 750mm above cut-off level. However, no extra payment shall be made for this and quoted rates shall be inclusive of this.

3.3.4 In case the reinforcement cage is made up of more than one segment, the same shall be assembled by welding only, before lowering, as per IS:456-2000 by providing necessary laps.

3.3.5 The vertical reinforcement shall project 50 times its diameter above the cut -off level.

3.3.6 Pile shall be constructed by continuous mud circulation technique. All precautions for obtaining clean and sound pile shaft shall be strictly observed.

3.3.7 For tremie concreted piles, a sample of drilling fluid shall be taken from the base of the borehole by means of an approved sampling device in the first few piles and at suitable interval of piles thereafter. Concreting shall not proceed if density of fluid exceeds 1250 kg/m^3. The sand content in the fluid shall not exceed 7 percent.

3.4 MEASUREMENT OF PILES

3.4.1 The piles shall be measured and paid for the actual pile length executed from pile tip to the cut off level, given in the working drawings or as indicated by the Engineer-in-charge.

3.4.2 No payment shall be made for concreting above cut-off level.

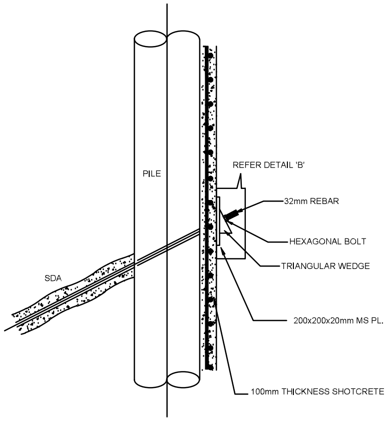
3.4.3 For fulfilling the termination criteria, SPT is to be carried out in pile bore as mentioned under clause 3.1. No extra payment shall be made for conducting SPT in pile bore. Cost shall be built-in quoted rates for pile construction.

3.5 LIST OF ATTACHMENTS

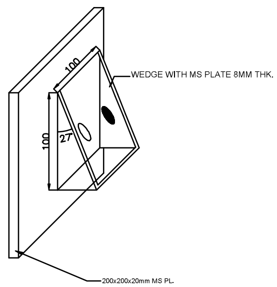
STANDARD AND SPECIFICATIONS – Geotechnical

6-74-0006	Standard Specification for Materials for Reinforcement Concrete Piles
6-74-0011	Standard Specification for Construction and installation of RCC Bored Cast-in-situ Piles

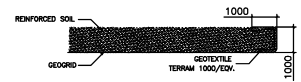
C046-000-81-47-11001



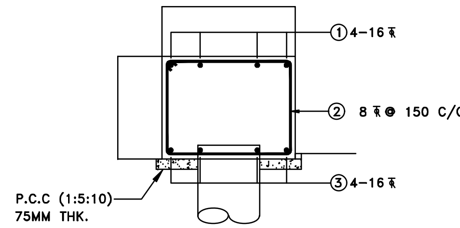
DETAIL 'A'



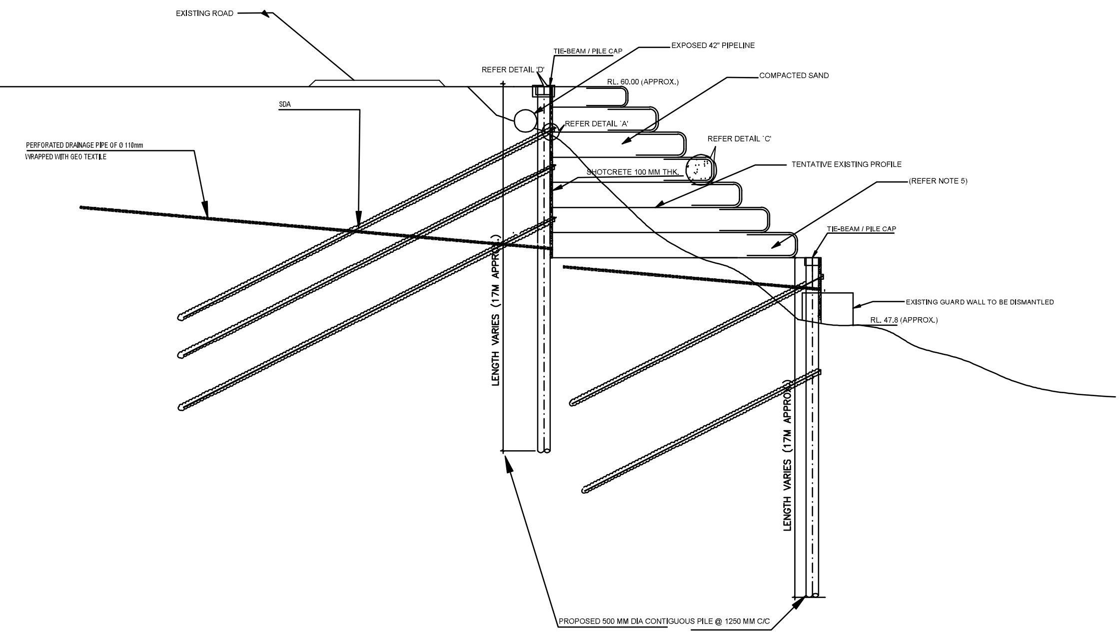
DETAIL 'B'



DETAIL 'C'



DETAIL 'D'



SECTION 1-1

REF. DWG. NO.	REFERENCE DRAWING TITLE

NOTES :-

1. ALL DIMENSIONS ARE IN mm & LEVELS ARE IN M.
2. SCHEME IS APPLICABLE THROUGHOUT THE COMPLETE STRETCH OF ISPRL EXPOSED PIPELINE SLOPE AREA (~90M).
3. GRADE OF CONCRETE SHALL BE M30.
4. REINFORCEMENT FOR BORED PILE SHALL BE HYSD BARS (GRADE Fe500D).
5. FOR DETAILS OF ALL MATERIALS AND CONSTRUCTION PROCEDURE REFER TENDER SPECIFICATION No. C046-000-81-41-SP-0011, C046-000-81-41-SP-0012, C046-000-81-47-SP-0013.
6. HDPE PIPE SHALL BE PERFORATED ON THE 2/3 OF PIPE PORTION PERFORATIONS SHALL BE 10mm @ 57mm C/C IN A TRIANGULAR GRID PATTERN.

REV.	DATE	REVISIONS	BY	CHKD	APPD	PEM/PC
A	27-03-25	ISSUED FOR TENDER	AS	ROUT/RB	VKP	-

इंजीनियर्स इंडिया लिमिटेड ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

INDIAN STRATEGIC PETROLEUM RESERVES LTD. (ISPRL)

PERMANENT RESTORATION WORKS OF EXPOSED 42" ISPRL PIPELINE

SLOPE PROTECTION SCHEME FOR ISPRL PIPELINE
(LOCATION - NEAR BALA VILLAGE AT CHAINAGE 2 K.M.)

SCALE	JOB NO.	UNIT	DIVN.	DEPT.	DWG. NO.	REV.
1:100	C046	000	81	47	11001	A

3-1641-0501 REV.2 A1-841x594

मानक विनिर्देशन
सिविल एवं संरचनात्मक कार्य

STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS

मिट्टी का कार्य

EARTHWORK

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	18.03.21	REVISED & REISSUED	TK	AJS	AS	SM
5	21.08.14	REVISED & REISSUED	AJS	AS	PKM	SC
4	19.06.09	REVISED & REISSUED	AS	SCH	VINAY KUMAR	N. DUARI
3	22.01.02	UPDATED & REISSUED	R SOOD	R SOOD	H MATHUR	GRR
2	AUG'94	UPDATED & REISSUED	-	H MATHUR	GP LAHIRI	A. SONI

Abbreviations:

CNS : Cohesive Non Swelling

Structural Standards Committee

Convenor : Mr. Anurag Sinha

Members:
Mr. C Damodaran
Mr. V.K.Panwar
Mr. Samir Das
Mr. Amitabh Kishore
Mr. Gyasuddin
Mr. Charanjit Singh (Projects)
Mr. Ravindra Kumar (Constn.)

CONTENTS

1.0 SCOPE

This specification deals with earth work in excavation and filling.

2.0 CLASSIFICATION OF SOIL

2.1 Ordinary Soil

2.1.1 Soft Soil/ Loose Soil

Generally any soil which yields to the ordinary application of pick and shovel, or to phawra, rake or other ordinary digging implements such as:

a) Sand, gravel, loam, clay, mud, black cotton soil
b) Vegetables or organic soil, turf, peats, soft shale or loose murrum
c) Mud concrete below ground level
d) Any mixture of soil mentioned above.

2.1.2 Hard/ Dense Soil

Generally any soil, which requires close application of picks or jumpers or scarifier and rippers to loosen the same, such as:

i) Stiff heavy clay, hard shale or compact murrum requiring grafting tool and/ or pick and shovel
ii) Shingle and river or nallah bed boulders
iii) Soling of roads, paths etc. and hard core
iv) Macadam surface of any description (water bound, grouted tarmac etc.)
v) Lime concrete, stone masonry in lime or cement mortar below ground level
vi) Soft conglomerate when the stone can be detached from the matrix with picks and shovels

2.2 Soft Rock

This is fissured/ disintegrated rocky strata, boulders (volume more than 0.028 m^3 and less than 0.400 m^3) and also which cannot be quarried/ excavated by using above manual tools but can be quarried/ excavated manually by using crow bars is classified as soft rock. Soft rock shall include all kinds of stiff and stratified rock, such as shales, thinly bedded philites, laterite hard conglomerate, lime stone, sand stone and unreinforced cement concrete below ground level. Soft rock may be quarried or split with crow bar or picks and can also be excavated by rippers, dozers and other mechanical equipment, but without the aid of blasting. If required and permitted, light blasting may be restored to, for loosening the materials, but this will not, in any way entitle the material to be classified as "Hard Rock".

2.3 Hard Rock

2.3.1 Hard Rock (Not Requiring Blasting)

This shall include all types of hard and compact rock, having closely spaced fissures or joints, on account of which blasting is not considered necessary and shall not be resorted unless permitted by the Engineer-in charge.

2.3.2 Hard Rock (Requiring General Blasting)

This shall include all types of hard and compact rock occurring in unfissured masses or similar foundations, boulders (volume more than 0.4 m^3) for excavation in which blasting is

considered necessary such as quartzite, granite, basalt stones, reinforced cement concrete (reinforcement to be cut through but not separated from concrete) below ground level and the like.

2.3.3 **Hard Rock (Requiring Controlled Blasting (Explosive/ Non-explosive)**

This type of excavation becomes necessary when excavation is done in formations, mentioned in Clause 2.3.2, in the vicinity of existing foundations/ structures. Mode of blasting shall be decided by Engineer-in-Charge, keeping in view the sensitivity of structures.

2.3.4 **Hard Rock (Blasting Prohibited)**

Hard rock requiring blasting as described in clause 2.3.2 above, but where blasting is prohibited for any reason and excavation has to be carried out by chiseling, wedging, pneumatic/ hydraulic/ electro-mechanical breaking by using splitter or by chemical means or any other agreed method.

The use of excavation shall not be considered as a reason for classification under hard rock requiring blasting unless clearly found necessary in the opinion of Engineer-in-Charge.

3.0 BACKFILLING MATERIAL

3.1 Suitable Materials:

3.1.1 Back filling suitable material shall be approved by the Engineer-in-charge. Additionally, they shall be free from refuse, large stones or rocks or other material which might prevent proper compaction or cause the compacted fill or embankment to perform inadequately or to have insufficient stability or bearing capacity for the superimposed loads to which it is likely to be subjected.

3.1.2 Back filling of excavation in trenches, foundations and elsewhere shall consist of one of the following materials as shown on drawing, or directed by the Engineer-in-charge.

i) Soil
ii) Selected earth from heaps or brought from borrow areas.

In case i) or ii) are not available, the Engineer-in-charge may approve use of any of the following:

iii) Stone/ Gravel
iv) Sand
v) CNS material.

3.1.3 The material shall be free from refuse, debris, roots, hard lumps and any other foreign organic material.

3.2 Unsuitable Materials

Unsuitable material shall include particles in excess of 75 mm size and that which is:

a) Organic material, logs, stumps and perishable materials.
b) Material susceptible to spontaneous combustion
c) Materials with undefined properties
d) Materials having a moisture content greater than the maximum specified
e) Building rubble and domestic and industrial wastes
f) Soils and rock susceptible to deterioration/ change of their properties.

g) Clay, silt and other loose or soft soils not in accordance with compaction criteria.
h) Dredged material
i) Material containing gypsum or other soluble salts.

4.0 SETTING OUT

4.1 The Contractor shall be responsible for the true and proper setting out of the work in relation to original points, ***lines**** and ***levels**** of reference and for the correctness of the levels, dimensions and alignment of all parts of the work. If at any time during progress of the work any error appears or arises in the position of level, dimension, or alignment of part of the work, the Contractor at his own expense shall rectify such errors to the satisfaction of the Engineer-in-Charge. The checking of any line or level by the Engineer-in-Charge shall not in any way relieve the Contractor of his responsibilities.

4.1.1 Tolerances*

The grade shall be properly shaped to the required elevations and parallel to the required surface. The elevation of any point and the line of any edge or center of the earthworks shall conform to that shown on the drawings within the tolerances stated below:

	Tolerances from True Level	Tolerances from True Line
Basic Grading	- 25 mm	- 75 mm
Embankments	+75 mm - 0	+75 mm - 75 mm

4.2 The Contractor shall lay out and construct one or more permanent bench marks in some central place before the start of the work, from which all important levels for the excavations will be set.

These permanent bench marks shall consist of masonry pillars with top neatly plastered and leveled as per the directions of the Engineer-in-Charge. Bench marks shall be well connected with triangular grid system or any other bench mark approved by the Engineer-in-Charge.

5.0 EARTHWORK IN EXCAVATION

5.1 Excavation shall be carried out in any material met on the site to the lines, levels and contours shown on the detailed drawings and the Contractor shall remove all excavated materials to spoil heaps on site or transport for use in filling on the site or stack them for reuse as directed.

5.2 Excavated material shall not be deposited within 1.5 m from the top edge of the excavation.

5.3 The sides of the excavation may be cut sloping, or shored and strutted to hold the face of earth as per site requirements and as directed by the Engineer-in- Charge.

5.4 Foundation pits/ trenches shall not be excavated to the full depth unless construction is imminent. The last 15 cm depth of the excavation shall not be done until concreting work is imminent. The full depth may at the discretion of the Engineer-in-Charge be excavated and the bed covered with a 50 mm (minimum) thick (or as indicated on drawing) layer of lean concrete 1:5:10 mix (1 cement : 5 coarse sand : 10 crushed stone aggregate) or as specified in schedule of rates/ shown on drawing, after watering if required, and consolidating the bed.

5.5 If the bottom of any excavation has been left exposed by the Contractor and in the opinion of the Engineer-in-Charge, that has become badly affected by the atmosphere or by water, then the Contractor shall remove such portions of the deteriorated material as the Engineer-

in-Charge may direct and shall make good with lean concrete 1:5:10 mix (1 cement : 5 coarse sand : 10 crushed stone aggregate). All expenses for such additional concrete and excavation shall be borne by the Contractor.

5.6 Where excavation is made in excess of the depth required, the Contractor shall, at his own expense, fill upto required level with lean concrete 1:5:10 mix (1 cement : 5 coarse Sand : 10 crushed stone aggregates) or as decided by Engineer-in-Charge.

5.7 The Contractor shall provide suitable drainage arrangement to prevent surface water from any source entering the foundation pits at his own cost.

5.8 The Contractor shall make all arrangements for dewatering during excavation and subsequent works, the accumulated water from any source (including subsoil water) in the excavated pits/trenches and keeping the excavated pits/ trenches dry for subsequent works.

5.9 The Contractor shall make necessary arrangements for lighting, fencing and other suitable measures for protection against risk of accidents due to open excavation.

5.10 Where the excavation is to be carried out below the foundation level of an adjacent structure, the precaution to be taken such as under pinning, shoring and strutting etc. shall be determined by the Engineer- in-Charge. No excavation shall be done unless such precautionary measures are carried out as per directions of the Engineer-in-Charge. The payment for such precautionary measures shall, however, be made separately.

5.11 Loose or soft bed ground encountered in excavation at the required depth shall on the Engineers-in-Charge's instructions be excavated to a firm bed and difference made up to the required level with lean concrete 1:5:10 mix (1 cement : 5 coarse Sand : 10 crushed stone aggregates).

5.12 In those cases where during excavation, side slips occur for reasons not attributable to the Contractor (e.g. side slips which take place on their own but not due to surcharge of earth kept near the edge of excavation and cracking of excavation top strata due to clay drying out leading to collapse of excavation sides), the Engineer-in-Charge shall admit payment at his discretion.

5.13 Any obstacle encountered during excavation shall be reported immediately to the Engineer-in-Charge and shall be dealt with as instructed by him. Removal of buried pipes or cables shall not be done without prior permission of the Engineer-in-Charge and the Contractor shall provide all measures to protect the same. Cost of such protective measures are deemed to be included in the rates for various items of excavation.

5.14 The Contractor shall not undertake any concreting in foundation until the excavation pit/trench is approved by the Engineer-in-Charge.

5.15 The specification for earth work shall also apply to excavation in rock in general.

5.16 In case of hard rock requiring blasting, the provisions mentioned below shall be strictly followed.

5.16.1 **General**

Where hard rock is met with and blasting operations are considered necessary, the Contractor shall intimate about the same to the Engineer-in-Charge, and obtain his approval in writing for resorting to blasting operation.

The Contractor shall obtain license from the district authorities for undertaking blasting work as well as for obtaining and storing the explosive as per the Explosive Rules 2008, corrected upto date. He shall purchase the explosives, fuses, detonators etc. only from a licensed dealer. He shall be responsible for the safe custody and proper accounting of the explosive materials. The Engineer-in-Charge or his authorised representative shall have the access to check the Contractor's store of explosive and his accounts.

In case where explosives are required to be transported and stored at site, relevant clauses of the Explosive Rules, 2008 as amended subsequently, shall apply.

The Contractor shall be responsible for any accident to workmen, public or property, due to blasting operations.

5.16.2 **Precautions**

Blasting operations shall be carried out under the careful supervision of a responsible authorised and licensed blaster of the Contractor (referred subsequently as "blaster" only) during specified hours, as approved in writing by the Engineer-in-Charge. The blaster shall be fully conversant with the rules of blasting.

Proper precautions for safety of persons shall be taken. Red flags shall be prominently displayed around the area to be blasted and all the people on the work except those who actually light the fuses, shall withdraw to a safe distance of not less than 200 m from the blast. Precautions as per Explosive Rules 2008 with amendment shall be followed.

5.16.3 **Fuses**

All fuses shall be cut to the lengths required before being inserted into the holes. Joints in fuses shall be avoided. Where these are unavoidable, a semicircular niche shall be cut in one piece of fuse about 2 cm. deep from the end and the end of other piece inserted into this niche, and the two pieces then wrapped together with a string. All joints exposed to dampness shall be wrapped with rubber tape. Fuse and detonators shall be kept separated from the explosives.

5.16.4 **Blasting with Gun Powder**

Blasting shall normally be done with gun powder. Dynamite, gelatine or any other high explosive shall only be used in special cases with the written permission of the Engineer-in-Charge.

In case of blasting with gun powder, the position of all bore holes to be drilled shall be marked out in circles with white paint. The bore holes shall be jumped or drilled in the rock face. The depth of bore hole shall be about the same as that of the line of least resistance and its size shall be such that the cartridges can easily pass down to the bottom. The bore holes must be dried before being charged and these shall be inspected by the Contractor's agent.

Gun powder may be used in the form of pellet blasting cartridges or as powder or granules. Cartridges are provided with tapered central hole. One end of fuse is passed through the narrow end of the hole and a sufficient length of the fuse is doubled back so that when the fuse is pulled, it is held tight in the tapered hole of the cartridge. Other cartridges are then inserted in the fuse to make up the required charge. The cartridge along with the fuse is lowered down in the bore hole, placed in position and gently filled and pressed home with dry hay or turf. The rest of the bore shall then be filled with dry clay, which shall be tamped with copper or brass rod until it becomes compact. Care shall be taken to avoid any possibility of an air space around the fuse. The safety fuses shall be taken to the required distance so as to allow the blasting to take place after the person lighting the fuse has withdrawn to a safe distance.

Where gun powder is used in the form of powder or granules it shall be introduced in the bore hole by means of funnel or copper tube. The bore holes shall be loaded with two thirds of the quantity of charge required, and safety fuse then directly introduced over the charge. Remaining one third charge shall then be introduced, and gently filled and pressed home with dry hay or turf. The rest of the bore hole shall be filled with dry clay in the same way as for cartridges, and the safety fuse taken to the required distance.

The charges shall be fired by igniting the fuse. The number of charges to be fired and the actual number of shots heard, shall be compared, and the Contractor's blaster shall satisfy himself by examination that all the charges have exploded, before workmen are permitted to approach the site. The charge which has not exploded, shall not be permitted to be withdrawn. The tamping and charge shall be flooded with water and the holes marked with a red cross (X) over it. Another hole shall be jumped at a distance of about 45 cm from the old hole and fired in the usual way. This operation shall be continued, till the original and any subsequent unfired charges are exploded.

5.16.5 **Blasting with Dynamite or any other High Explosive**

In case of blasting with dynamite or any other high explosive the position of all bore holes to be drilled shall be marked out in circle with white paint. These shall be inspected by the Contractor's blaster. Bore holes shall be of a size that the cartridge can easily pass down. After the drilling operation, the blaster shall re-inspect the holes to see that the holes marked out by him have been drilled. The Blaster shall then prepare all charges necessary for the bore holes. The bore holes shall be thoroughly cleaned before a cartridge is inserted. Wooden tamping rods (not pointed but cylindrical throughout) shall be used, in charging holes. Metal rods shall never be used for tamping. One cartridge shall be first placed in the bore hole, gently pressed and not rammed down. Other cartridges shall then be added as may be required to make up the necessary charge for the bore hole. The top most cartridge shall be connected to the detonator which shall in turn be connected to the safety fuse of required length.

The maximum of eight (8) bore holes shall be loaded and fired on each occasion. The charges shall be fired successively and not simultaneously.

Immediately before firing a blast, due warning shall be given and the blaster shall see that all persons have retired to a place of safety. The safety fuses of the charged holes shall be ignited in the presence of the blaster, who shall see that all the fuses are properly ignited.

Careful count shall be kept by him and others of each blast as it explodes. After the blast the blaster shall inspect the work and ascertain that all the charged holes have been exploded. In case of misfired holes, the Blaster shall inspect the same after half an hour and mark red crosses (X) over the holes. During this interval of half an hour, no body shall approach the misfired holes. None of the drillers shall work near such holes, until one of the two following operations has been done by the blaster.

a) Either the Contractor's blaster shall very carefully (when the tamping is of damp clay) extract the tamping with a wooden scraper and withdraw the fuse, primer and detonator, after which a fresh detonator, primer and fuse shall be placed in the misfired holes and fired.

OR

b) The hole shall be cleaned for 30 cm of tamping and its direction ascertained by placing a stick in the hole. Another hole shall then be drilled 15 cm away and parallel to it. This hole shall be charged and fired. The misfired hole should also explode along with the new one.

Before leaving the work, the blaster of one shift shall inform another blaster relieving him for the next shift, of any cases of misfire, and shall point out their positions denoted by red crosses and also state the action, if any, to be taken in the matter.

The Engineer-in-Charge shall also be informed by the blaster of all cases of misfire, their causes and steps taken in that connection.

5.16.6 **Controlled Blasting (Explosive/ Non-explosive)**

Whenever required by the Engineer-in-Charge, rock blasting shall be carefully controlled so that vibrations generated during the blasting do not cause damage to the buildings and installation around. Similarly, the rock pieces should not fly off and endanger the buildings and installations around. Apart from the general precautions mentioned in the preceding paragraphs, following protective measures and limits for use of explosive are suggested as guidelines. Bidders are requested to carefully check the site conditions and submit details of the scheme they propose to adopt for controlling the blast.

Following protective measures shall be adopted while carrying out blasting operations.

The hole shall be covered with mild steel plate of minimum 12 mm thickness.

Reinforcement rod mesh not less than 20 mm dia. at 150 mm centre in both directions shall be placed over the steel plates.

Steel plate and reinforcement shall be inspected after every blasting operation and all twists shall be removed before reuse to the satisfaction of the Engineer-in-Charge.

Sand filled bags of 6 to 8 layers shall be placed over the mesh suitably covering the whole region under blasting operation.

The thickness of covering plate and the kind of dead weight is to be duly approved by the Engineer-in-Charge.

5.16.7 Hard rock requiring blasting as described under Clause 2.3.2 above, but where blasting is prohibited for any reason(s), breaking up of rock can be done by using Splitter and/or chemical substances of approved manufacturer mixed in an appropriate proportion. The method involves drilling holes into rock and then inserting Splitter (hydraulic/ pneumatic/ electro-mechanical) or injecting Chemical solvents into the holes. The breaking-up of rock takes place in a controlled fashion without much noise and spark. Any other method as agreed with Engineer-in-Charge may also be used.

5.17 Excavation in areas where existing under ground cables are envisaged, to be carried out carefully by manual means taking proper safety precautions.

The earth work machinery be deployed after ensuring from the trial pits that no cable is crossing the proposed area of excavation.

5.18 Payment (applicable for item rate tenders only)

5.18.1 The payment clause shall be operated only if the earthwork is to be measured separately as per relevant tender item.

5.18.2 Payment for earth work in excavation shall be made on cubic meter (m^3) basis on the measurement of volume of pit/ trench of excavation with working space as per relevant Indian Standards (IS:1200) and slopes/ steppings as permitted by the Engineer-in-Charge. The rate shall include cost of all the operations of blasting with explosives & accessories, making of all

arrangements for dewatering the accumulated water from any source in the excavated pit or trench, removal and disposal of surplus excavated soil within a lead of 100 m from construction areas. The rate shall also include setting out and line out work required for the excavation.

5.18.3 The following works shall not be measured separately and allowance for the same shall be deemed to have been made in the description of main item:

a) Setting out works, profiles, etc.;
b) Site clearance, such as cleaning grass and vegetation;
c) Unauthorized battering or benching of excavation;
d) Forming (or leaving 'dead men' or 'tell-tales' in borrow pits and their removal after measurements;
e) Forming (or leaving) steps in sides of deep excavation and their removal after measurements;
f) Excavation for insertion of planking and strutting;
g) Unless otherwise specified, removing slips or falls in excavations;
h) Bailing out or pumping of water in excavation from rains;
i) Bailing out or pumping of water in excavation from sub-soil water, and
j) Slinging or supporting pipes, electric cables, etc, met during excavation.

5.18.4 Special pumping other than what is included in 5.18.3 (h and i) and well point dewatering where resorted to, shall each be measured separately, unless otherwise stated, in Kilo Watt Hour against separate specific provision(s) made for the purpose.

5.18.5 The Contractor shall intimate to the Engineer-in-Charge as soon as different classification of soils are met with. The measurements of various soil classifications then shall be worked out by either of the following alternatives in the order of their decreasing importance.

a) Joint levels shall be taken as to the levels of different soil classifications and volume worked out on the basis of levels only.

b) Where levels of different strata cannot be clearly marked and defined, the Contractor shall stack different soils of various classifications separately for measurement purpose and then dispose it off.

c) If the quantum of work involved in (b) above is extensively large & time consuming, then the total area may be divided into various zones and reasonably representative samples as in (b) above may be taken and quantities of soils of various classifications finalized for the entire zone based on the representative.

If soil of any classification other than that specified in the Schedule of Rates is met with during excavation, the decision of the Engineer-in-Charge as to the classification of soil, levels of the strata of different classifications and their location shall be binding.

In above case, the total quantity of excavation shall be computed from the measurement of the pit/ trench excavated. The hard rock and soft rock shall be measured separately from the relevant stacks and each shall be reduced by fifty percent for voids, and paid under the relevant items. The balance, that is the total quantity of excavation minus the reduced (for voids) quantity of excavation for rocks shall be paid as soft/ hard soil as per the direction of the Engineer-in-Charge (However, the maximum payment shall be limited to the volume of the excavated pit/ trench as approved by Engineer-in-Charge).

6.0 SHORING AND STRUTTING

6.1 The shoring and strutting of the sides to withhold the face of excavation pits/trenches shall be done when approved or directed by the Engineer-in-Charge.

6.2 The shoring shall be of close or open timbering type or by Sheet Piling, Soldier Piling, etc. depending upon the site requirements and as directed by the Engineer-in-Charge whose decision shall be final and binding as to the type of shoring to be used.

6.3 The arrangement of the shoring and strutting shall be sound and safe and shall be got approved from the Engineer-in-Charge before installation. The approval shall not absolve the Contractor of his responsibilities of safety and any other requirements of the contract.

6.4 The shoring and strutting shall be kept in position till all the relevant work in the excavated area is completed and approved. It shall be dismantled and removed only after the permission to do so is obtained from the Engineer-in-Charge.

6.5 Sheet Piling

The contractor shall design, supply and install hot rolled steel sheet piles including all associated structural steel members viz. waler & runner beams, strut, cross ties, vertical members, guide frames, suitable interlocks, suitable corner sections, splicing & cutting of sheet piling. The contractor shall also apply recommended sealant for complete water tightness (as required) and ensure pre-drilling for installation into bedrock (as necessary), etc. as per site conditions.

The contractor shall mobilize/ demobilize all necessary tools & tackles, hammer (vibratory/ impact), crane(s) etc., shifting plant/ machinery and carryout all ancillary works (as required) and ensure subsequent removal of entire arrangement after completion of works.

6.6 Payment (applicable for item rate tenders only)

Payment for shoring and strutting by close and open timbering shall be made on square meter (m^2) basis as separate items. In both the cases, the measurement shall be done on the basis of the surface area of the sides of the excavation actually shored and strutted.

The rate shall include all labour, materials, erection of the poling boards, wales, struts, ballies etc., fixing and keeping the same in position as required, dismantling and removing the same after the work is over as directed.

Payment for shoring and strutting by sheet piling shall be made on the basis of shoring area of sheet pile exposed after complete excavation.

The rate shall include all labour, design, supply and installation of hot rolled steel sheet piles including all associated structural steel members, application of recommended sealant, pre-drilling for installation into bedrock etc., mobilization/ demobilization of all necessary tools & tackles, hammer, crane(s) etc., shifting plant/ machinery & all ancillary works, fixing and keeping the sheet piling in position, dismantling and removing the same after the work is over, etc. all complete as directed by the Engineer-in-Charge.

No extra payment shall be made for cost of extraction and replacement for installing of sheet pile deviating the specification or rejected by Engineer-in-charge. Extracted sheet piles shall be contractor's property and contractor shall remove the same from site without any extra cost to client.

7.0 BACK FILLING AROUND FOUNDATIONS AND IN PLINTH

7.1 Back filling around completed foundations, structures, trenches and in plinth shall be done to the lines and levels shown on the drawings including any trimming of the surfaces, as may be necessary. This shall be done with selected and approved earth from excavation or otherwise with suitable materials described under Clause 3.1 as directed by the Engineer-in-Charge. Where sufficient suitable material is not available from the excavation, the Engineer-in-Charge may direct to import suitable earth from other sources. The filling shall be done in layers of thickness not exceeding 15 cm with watering, rolling and ramming by manual methods/ mechanical compactors to grade and level as shown on drawings to obtain 90% laboratory maximum dry density.

7.2 The Contractor shall not commence filling in and around any work until it has been permitted by the Engineer-in-Charge.

7.3 Backfilling around liquid retaining structures and pipes shall be done only after approval of the Engineer-in-Charge is obtained.

7.4 **Payment (applicable for item rate tenders only)**

Payment for backfilling with earth shall be based on volume in cubic meters (m^3) of consolidated fill. This volume shall be derived from the difference between the volume of excavation and the structure or trenches as the case may be. The rate shall include cost of extracting suitable approved earth from available excavated soil from spoil heaps within a lead of 100 m, placing, watering, rolling, ramming compacting in layers, trimming and dressing finished surface and disposal of surplus material upto a lead of 100 m.

However, backfilling done with materials other than earth shall be paid separately under relevant items.

8.0 TRANSPORTATION OF SURPLUS EARTH

8.1 Surplus earth and soil from excavation shall be removed from construction area to the area demarcated by the Engineer-in-Charge.

8.2 **Payment (applicable for item rate tenders only)**

8.2.1 Payment shall be made only for the lead beyond initial 100 m from construction area. Rate shall include re-excavation, loading, transportation, dumping, stacking or spreading (as per directions of the Engineer-in-Charge) the surplus earth and the soil in the area demarcated by the Engineer-in-Charge. Payment shall be made on cubic metre (m^3) basis on the difference of measurements of the volume of the excavated pits and the measurement of the back filling. Quantity generated due to voids in back filled volume of earth shall also be removed by the Contractor at no extra cost and this disposal of earth shall not be measured and paid under any item.

8.2.2 In exceptional circumstances the Engineer-in-Charge may direct the Contractor to remove surplus earth, concrete debris or any other waste material from site to the areas of disposal on the basis of truck measurement. In such cases volume of material shall be calculated on the basis of truck volume reduced by 30% for voids in case of soft/hard soils and 50% for soft/ hard rock. All other provisions of disposal such as spreading, levelling, grading shall apply in this case also.

9.0 PROTECTION OF PROPERTY AND PERSONNEL

9.1 The Contractor shall protect all active utility lines shown on the drawings or encountered during the excavation. If he damages those lines, the Contractor shall repair or replace them. If existing utilities interfere with his work, the Contractor shall inform to the Engineer-in-charge and secure written instructions for further action.

9.2 The Contractor shall barricade open holes and depressions which he creates or exposes as part of this, and he shall post warning signs and lights on property adjacent to or with public access. He shall operate warning lights during hours from dusk to dawn each day and as otherwise required for safety.

9.3 The Contractor shall protect structures, utilities, pavements, and other facilities from damage caused by settlement, lateral movement, washout, and other hazards created by his operations.

9.4 The Contractor shall plan and execute all aspects of the earthwork so that the safety of personnel, the work and adjacent property is guaranteed and such that a minimum of inconvenience is caused.

10.0 CLEAN UP

Upon completion of work, the Contractor shall leave the project site clear of debris and surplus materials off plant limits in a manner meeting all location authority requirements.

मानक विनिर्देशन
सिविल एवं संरचनात्मक कार्य

STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS

सादा एवं प्रबलित सीमेंट कंक्रीट
PLAIN AND REINFORCED CEMENT CONCRETE

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
8	07 DEC 22	UPDATED & REVISED	DK	DA	AS	SM
7	29th JAN 16	UPDATED & REISSUED	AJS	AS	RS	SC
6	15th DEC 14	UPDATED & REISSUED	SP	AS	PKM	SC
5	28th DEC 12	UPDATED & REISSUED	CDS	AJS	PKM SC	DM
4	23rd NOV 07	UPDATED & REISSUED	YPC	PKM	VK	VC
3	APR 01	UPDATED & REISSUED	RPM7097	SCS	SCJ1151	MI

Abbreviations:

ACI	:	American Concrete Institute
ASTM	:	American Society for Testing and Materials
BS	:	British Standards
GI	:	Galvanized Iron
IS	:	Indian Standard
ISO	:	International Organization for Standardization
PVC	:	PolyVinyl Chloride
RCC	:	Reinforced Cement Concrete
SCC	:	Self Compacting Concrete
SWG	:	Standard Wire Gauge

Structural Standards Committee

Convenor: Mr. Anurag Sinha

Members : Mr. V. Goel
Mr. S. C. Maity
Mr. Deepak Agrawal
Ms. Alpana Srivastava
Dr. Sudip Paul
Mr. Prasenjit Saha (SMMS)*
Mr. Charanjeet Singh (Projects)
Mr. Ravindra Kumar (Construction)

*For Fireproofing Specifications

CONTENTS

1.0 SCOPE

This specification is applicable for Concrete Grade up to M60 and establishes the requirements of materials, mix proportioning, placing, curing, etc. of all types of cast-in-situ and precast concrete (ref. section 1.6) used in foundations, underground and above ground structures, floors, pavements etc. Any special requirements as shown or noted on the drawings shall supersede the provisions of this specification.

1.1 Reference Codes and Specifications

Apart from this specification, construction of plain and reinforced concrete works shall be in accordance with the Indian Standard Code of Practice for "Plain and Reinforced Concrete" IS 456 along with all amendments till date and other relevant codes mentioned therein.

1.2 For Liquid Retaining Structures, EIL Specification No. 6-68-0005 shall be applicable.

1.3 For Structural Steel works, EIL Specification No. 6-68-0006 & 0008 shall be applicable.

1.4 For Bipolar Concrete Penetrating Corrosion Inhibiting Admixture, EIL Specification No. 6-68-0017 shall be applicable.

1.5 For Self Compacting Concrete, EIL Specification No. 6-68-0019 shall be applicable.

1.6 For precast concrete manufacturing refer EIL Specification No. 6-68-0014.

1.7 In case of conflict between the clauses mentioned in this specification and those in the Bureau of Indian Standards (BIS), this specification shall govern.

2.0 MATERIALS

2.1 Materials for concrete viz cement, Pozzolanas, Fly Ash, Ground Granulated Blast Furnace Slag, Sand, Coarse aggregate, Water, etc. shall be as described in EIL Specification No.6-68-0002.

2.2 Materials for all reinforcements, embedment, inserts, water bars etc. shall conform to EIL Specification 6-68-0002.

2.3 Materials to be used as Additive to concrete shall conform to EIL specification 6-68-0002 & 6-68-0017

3.0 GRADES OF CONCRETE

Characteristic Compressive strength for different grades of concrete shall be as per Table-1.

TABLE – 1
GRADES OF CONCRETE

Group	Grade Designation	Specified Characteristic Compressive Strength of 150 mm cube at 28 days (N/mm^2)
Ordinary Concrete	M10	10
	M 15	15
	M 20	20

TABLE - 1 (CONT.)
GRADES OF CONCRETE

Group	Grade Designation	Specified Characteristic Compressive Strength of 150 mm cube at 28 days (N/mm^2)
Standard Concrete	M 25	25
	M 30	30
	M 35	35
	M 40	40
	M 45	45
	M 50	50
	M 55	55
High Strength Concrete	M 60	60

Note: The characteristic strength is defined as the strength of material below which not more than five (5) percent of the test results are expected to fall.

4.0 TYPE OF CONCRETE MIX

4.1 Unless otherwise noted on drawings, all lean/plain concrete shall be of Nominal Mix type and reinforced concrete shall be of Design Mix type.

4.2 Nominal Mix Concrete

This concrete shall be made (without preliminary tests) by adopting nominal concrete mix with proportions of materials as specified in Table 9 of IS 456.

4.3 Design Mix Concrete

The mix shall be designed as per IS: 10262 in an approved laboratory to produce the grade of concrete having the required workability and characteristic strength not less than appropriate values given in Table-1. The target mean strength of concrete mix shall be equal to the characteristic strength plus 1.65 times the standard deviation.

As long as the quality of materials does not change, a mix design done earlier but not prior to one year may be considered adequate for later work. However, in case the source & quality of materials changes or there is a break in the continuity of construction, the Engineer-in-Charge shall ask for a new design mix.

Irrespective of the grade of concrete required to be produced as per characteristic strength criteria, the minimum cement content and maximum water cement ratio of the design concrete shall be strictly maintained as stipulated in Table 5 of IS 456.

5.0 CONCRETE MIX PROPORTIONING

Proportioning, as used in this specification, shall mean the process of determining the proportions of the various ingredients to be used to produce concrete of the required workability when fresh/green and strength, durability & surface finish when hardened. The following information shall be collected prior to design of the concrete mix:

a) Grade designation.
b) Type of cement.
c) Maximum nominal size of aggregate.
d) Minimum cement content
e) Maximum water cement ratio
f) Workability requirements.

g) Exposure condition as per Table 3 & Table 4 of IS 456
h) Maximum temperature of concrete at the time of placing.
i) Method of Placing

The Engineer-in-Charge shall verify the strength of the concrete mix, before giving his sanction of its use. However, this does not absolve the Contractor of his responsibility as regards achieving the prescribed strength of the mix. If during the execution of the work, cube tests show lower strengths than required, the Engineer-in-Charge shall order fresh trial mixes to be made by the Contractor. No claim to alter the rates of concrete work shall be entertained due to such changes in mix variations. Any variation in cement consumption shall be taken into consideration for material reconciliation. Preliminary mix designs shall be established well ahead of start of work.

5.1 Maximum Density

Suitable proportions of sand and the different sizes of coarse aggregates for each grade of concrete shall be selected to give as nearly as practicable the maximum density as per clause 10.1.3 of IS 456. This shall be determined by mathematical means, laboratory tests, field trials and suitable changes in aggregate gradation. The contractor shall ensure the same to the satisfaction of Engineer-in-Charge.

5.2 Consistency

The concrete shall have a consistency such that it shall be workable in the required position and when properly vibrated it flows around reinforcing steel, all embedded fixtures, etc.

5.3 Workability

"Workability of Concrete" shall be as per clause 7 of IS 456.

5.4 Durability

For achieving sufficiently durable concrete, strong, dense aggregates, low water-cement ratio and adequate cement content shall always be used. Workability of concrete shall be such that concrete can be completely compacted with the means available. Leak-proof formwork shall be used so as to ensure no loss of cement slurry during pouring and compaction. Cover to reinforcement shall be uniform. Concrete mix design shall always take into account the type of cement, minimum cement content irrespective to the type of cement and maximum water cement ratio and minimum grade of concrete conforming to environmental exposure conditions (refer Table 3 of IS 456) as given in Table 5 of IS 456.

Generally, following types of cement shall be used for Plain and Reinforced concrete works:

a) 43/ 53 Grade Ordinary Portland Cement conforming to IS 269.
b) Rapid hardening Portland Cement conforming to IS 8041.
c) Portland Slag Cement conforming to IS 455.
d) Portland Pozzolana Cement(fly ash based) conforming to IS 1489(Part 1)
e) Portland Pozzolana Cement (calcined clay based) conforming to IS 1489(Part-2).
f) Sulphate Resisting Portland Cement conforming to IS 12330

Sulphate Resisting Portland Cement shall be used only for specific requirements depending on environmental and process exposure conditions to which the structures may be subjected to like high Sulphate concentrations, processes involving Sulphur handling etc.

5.4.1 Water Cement Ratio

Once a mix, including its water cement ratio, has been determined and approved for use by the Engineer-in-Charge, that water cement ratio shall be maintained. The Contractor shall determine the water content of the aggregates frequently as the work progresses, and the amount of mixing water shall be adjusted so as to maintain the approved water cement ratio. Maximum water-cement ratio shall be as per Table 5 of IS 456 for different exposure condition.

The minimum cement content as mentioned in Table 5 of IS 456 shall be adjusted for aggregates other than 20 mm nominal maximum size as defined in Table 6 of IS 456.

For maximum cement content refer Cl.8.2.4.2 of IS 456.

5.4.2 Where specified, Bipolar concrete penetrating corrosion inhibiting Admixture in reinforced concrete as per EIL specification No. 6-68-0017 shall be used for protecting the reinforcement from corrosion.

5.5 Limits to Deleterious Constituents

Careful selection of the mix and the constituent materials shall be made to limit the presence of deleterious constituents in concrete. The total acid soluble chloride content calculated from the mix proportion and the measured chloride content of each of the constituents shall not exceed 0.6 kg/m³ at the time of placing of concrete. The total water soluble Sulphate content of the concrete mix shall not exceed 4 percent by mass of the cement in the mix.

6.0 BATCHING

Refer clause 10.2 of IS 456.

7.0 CONCRETE MIXING

7.1 Ready Mixed Concrete supplied by Ready Mixed Concrete Plants or from on/off-site batching plants (IS 4926) shall be used for structural concrete.

All records and charts for the batching and mixing operations shall be prepared and maintained by the contractor in accordance with IS 4926 or as per the instructions of Engineer-in-Charge.

In case Ready Mixed Concrete is not available, the mixing of concrete shall be strictly carried out in an approved type of mechanical concrete mixer. The mixer shall be fitted with water measuring devices. The mixing shall be continued until there is a uniform distribution of the material and the mass is uniform in colour and consistency. If there is segregation after unloading from the mixer, the concrete shall be remixed.

7.2 Mixer

7.2.1 Mechanical Mixers shall comply with IS 1791 and 12119 and shall be maintained in satisfactory operating condition. These shall be used only for producing lean/ plain concrete and/ or nominal mix concrete wherever permitted.

7.2.2 Mixing Time

Mixing time shall be as indicated in the following Table-2. Excessive mixing requiring additions of water shall not be permitted. Time shall start when all solid materials are poured in the revolving mixer drum, provided that all of the mixing water shall be introduced before one-fourth of the mixing time has elapsed. The Engineer-in-Charge may, however, direct a change in the mixing time, if he considers such a change necessary.

TABLE-2

MINIMUM MIXING TIME FOR MIXERS

Capacity of mixer	Minimum mixing time
2 m^3 or less	2 minutes
Above 2 m^3	3 minutes or as recommended by the mixer manufacturer.

7.3 Hand Mixing

Hand mixing of concrete shall not be permitted. However, for non-critical applications namely foundations for crossovers, isolated operating platforms etc., using concrete upto grade M20 and located at far away isolated places, this may be permitted by the Engineer-in-charge as a special case. Mixing shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. No extra payment shall be made to the Contractor for mixing by hand or for using extra cement due to hand mixing.

7.4 Additives

Additive in concrete shall be used only with the prior approval of the Engineer-in-Charge and shall comply with Cl. 5.5 of IS 456. Any additive used for obtaining proper workability or leak proofness of concrete or repair/rendering works of concrete due to non-conformance to the specifications, shall not be measured and paid for. All costs relating to such usage shall be borne by the Contractor.

8.0 TRANSPORTATION, PLACING AND COMPACTION

8.1 General

The entire concrete placing programme including transportation arrangements, deployment of equipment, layout, proposed procedures and methods shall be submitted to the Engineer-in-Charge 24 hours prior to concreting for approval. No concreting shall be placed until his approval has been received. Approval of the Engineer-in-Charge for pouring concrete shall be taken as 'conveyed', when the concrete pour card is signed by him.

8.1.1 Chutes

The use of long troughs, chutes and pipes for conveying concrete from the mixer to the forms shall be permitted only on written authorization from the Engineer-in-Charge. In case an inferior quality of concrete is produced by the use of such conveyors, the Engineer-in-Charge may order discontinuance of their use and the substitution of a satisfactory method of placing the concrete. Open troughs and chutes shall be equipped with baffles and be in short lengths to avoid segregation. Chutes shall be designed so that the concrete is, to some extent, remixed at the lower end by passing down through a funnel shaped pipe or drop chute. Alternatively, they shall discharge into a storage hopper from which the concrete shall be transported to the point of placing by wheel barrows or other means. Where drop chutes are used, a sufficient number of these must be provided so that the concrete discharged from the chute is not required to flow laterally more than 1.0 metre. Where a drop chute is swung from the vertical, the bottom two sections must be maintained in a vertical position to avoid segregation. The addition of water at any point in the system of transportation, to facilitate the movement of concrete shall not be permitted. All chutes, troughs and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing them with water after each run; water used for flushing shall be discharged clear of the structure.

8.1.2 Vibrators

8.1.2.1 Concrete shall be compacted with mechanical vibrating equipment supplemented, if necessary to obtain consolidation, by hand spreading, rodding and tamping. The vibrators shall be of immersion type with operational frequency ranging between 8,000 to 12,000 vibrations per minute. All vibrators shall comply with IS 2505. Screed board concrete vibrators or concreting vibrating tables or form vibrators conforming to IS 2506, 2514 and 4656 respectively shall be used where specifically required and directed by Engineer-in-Charge.

8.1.2.2 Immersion type vibrators shall be inserted in a vertical position at intervals of about 600 mm, depending upon the mix, the equipment used, and experience on work. The vibrators shall be withdrawn slowly. The spacing shall provide some overlapping of the area vibrated at each insertion. In no case shall vibrators be used to transport concrete inside the forms. Over vibration or under vibration shall not be permitted as both are harmful. Hand tamping in some cases may be allowed subject to the approval of the Engineer-in-Charge.

8.1.2.3 In placing concrete in layers which are advancing horizontally as the work progresses, great care shall be exercised to ensure adequate vibration, bonding and moulding of the concrete between the succeeding batches.

8.1.2.4 The vibrator shall penetrate the layer being placed and also penetrate the layer below while the under layer is still plastic to ensure good bond and homogeneity between the two layers and prevent the formation of cold joints.

8.1.2.5 Care shall be taken to prevent contact of vibrators against all embedded reinforcing steel or inserts. Vibrators shall not be allowed to come in contact with forms.

8.1.2.6 The use of form vibrators shall not be permitted for compaction of in-situ concrete without specific authorisation of the Engineer-in-Charge.

8.1.2.7 The use of surface vibrators of screed board type shall not be permitted for consolidation of concrete under ordinary conditions. However, for thin slabs (of thickness less than 200 mm) surface vibration by such vibrators may be permitted, upon approval of the Engineer-in-Charge.

8.1.2.8 Whenever vibration has to be applied externally, the design of formwork and the disposition of vibrators shall be carefully planned to ensure efficient compaction and to avoid surface blemishes.

8.2 Transportation

8.2.1 All concrete shall be conveyed from the mixer to the place of final deposit such as formwork as rapidly as possible using suitable buckets, dumpers, pumps, transit mixers containers or conveyors which shall be mortar tight. Care shall be taken to prevent the segregation or loss of the ingredients and maintaining the required workability. For structural concrete produced from Ready Mixed Concrete/ Batching Plants, concrete shall be transported from the plants to the site only by transit mixers and Delivery Ticket for each delivery of concrete shall be maintained by the contractor.

8.2.2 During hot or cold weather, concrete shall be transported in deep containers. Other suitable methods to reduce the loss of water by evaporation in hot weather and heat loss in cold weather may also be adopted. All equipment used for transporting and placing of concrete shall be maintained in clean condition. All buckets, hoppers, chutes, dumpers and other equipment shall be thoroughly cleaned after each use.

8.3 Placing and Compaction

8.3.1 Before placing concrete, all soil surfaces upon which or against which concrete is to be placed shall be well compacted and free from standing water, mud or debris. Soft or yielding soil shall be removed and replaced with lean concrete or with selected soil/sand and compacted to the density as directed by Engineer-in-Charge. The surface of absorptive soil (against which concrete is to be placed) shall be moistened thoroughly so that moisture is not drawn from the freshly placed concrete. Similarly, for concrete to be placed on formworks, all chippings, shavings and sawdust etc. shall be removed from the interior of the forms before the concrete is placed.

8.3.2 Concrete shall not be placed until the formwork, the placement of reinforcing steel, embedded parts, pockets etc. have been inspected and approved by the Engineer- in-Charge. Any accumulated water on the surface of the bedding layer shall be removed by suitable means before start of placement. No concrete shall be placed on a water covered surface.

8.3.3 Concrete shall be discharged by vertical drop only and the drop height shall not normally exceed 1.5 metre throughout all stages of delivery until the concrete comes to rest in forms. However, drop height can be relaxed by the Engineer-in-Charge as per the provisions given under Cl. 8.1.1. For continuous concreting operation windows of suitable size shall be kept in the formwork or chutes shall be used to avoid segregation of concrete.

8.3.4 Concrete shall be deposited as near as practicable in its final position to avoid rehandling. Concrete shall be placed in successive horizontal layers. The bucket loads, or other units of deposit, shall be placed progressively along the face of the layer with such over-lap as will facilitate spreading the layer of uniform depth and texture with a minimum of hand shovelling. Any tendency to segregation shall be corrected by shovelling coarse aggregates into mortar rather than mortar on the coarse aggregates. Such a tendency for segregation shall be corrected by redesign of mix, change in process or other means as directed by the Engineer-in-Charge.

8.3.5 All struts, slays and braces (serving temporarily to hold the forms in correct shape and alignment pending the placing of concrete at their locations) shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. These shall not be buried in the concrete. Concrete shall be thoroughly compacted with vibrators and fully worked around the reinforcement, embedded fixtures and into corners of formwork before setting commences and shall not be subsequently disturbed. Methods of placing shall be such as to preclude segregation and avoid displacement of reinforcement or formwork. The formation of stone-packers or mortar bondage in corners and against face forms shall not be permitted. Should these occur, they shall be dug out, reformed and refilled to sufficient depth and shape for thorough bonding as directed by the Engineer-in-Charge. Care shall be taken to avoid displacement of reinforcement and embedded inserts or movement of formwork.

8.3.6 Unless otherwise approved, concrete shall be placed in single operation to the full thickness of foundation rafts, slabs, beams and similar members. Concrete shall be placed continuously until completion of the part of the work, between approved construction joints or as directed by the Engineer-in-Charge.

8.3.7 The method of placing and compaction employed in any particular section of the work shall be to the entire satisfaction of the Engineer-in-Charge.

8.3.8 During hot weather (atmospheric temperature above 40 degree Celsius) or cold weather (atmospheric temperature below 5 degree Celsius, the concreting shall be done as per the procedure set out in IS 7861).

8.3.9 Concrete that has set standing and becomes stiffened shall not be used in the work.

8.5.10 Continuous Concreting

Where called out on the drawings, continuous concreting shall be done in a single operation as per the requirements of IS 456 and IS 2974. Sufficient "Windows" shall be left in the formwork for pouring & compaction of concrete and inspection. These windows shall be fixed tightly once the level of concrete reaches their levels.

8.5.11 Concreting under special conditions

a) Work in extreme weather conditions during hot or cold weather, the concreting shall be done as per procedure set out in IS 7861(Part I) or IS 7861 (Part2).

b) Under water concreting shall be as per clause 14.2 of IS 456.

8.6 Items Embedded in Concrete

8.6.1 Concreting shall not be started unless the electrical conduits, pipes, fixtures etc., wherever required, are laid by the concerned agency. The Contractor shall afford all the facilities and maintain co-ordination of work with other agencies engaged in electrical and such other works as directed by the Engineer-in-Charge.

8.6.2 Before concreting, the Contractor shall provide, fabricate and lay in proper position all metal inserts, anchor bolts, pipes etc. (which are required to be embedded in concrete members) as per relevant drawings and directions of Engineer-in-Charge.

8.6.3 All embedment, inserts etc. shall be fully held and secured in their respective positions by the concerned agencies to the entire satisfaction of Engineer-in-Charge so as to avoid any dislocation or displacement during the concreting operations. The Contractor shall take all possible care during concreting to maintain these embedment/inserts in their exact locations.

9.0 CONSTRUCTION JOINTS

9.1 Construction joints shall be provided in position as shown or described on the drawings or as directed by the Engineer-in-Charge. Such joints shall be kept to the minimum. These shall be straight and at right angles to the direction of main reinforcement and shall be placed at accessible locations to permit cleaning out of laitance, cement slurry and unsound concrete.

9.2 In a column, the joint shall be formed about 100 mm to 150 mm below the lowest soffit of the beams framing into it. Concrete in a beam and slab shall be placed throughout without a joint but if the provision of a joint is unavoidable, the joint shall be vertical and located within 1/3 to 1/4 of the span, unless otherwise shown on the drawings.

9.3 When stopping the concrete on a vertical plane in slabs and beams, an approved stop board shall be placed with necessary slots for reinforcement bars. The construction joints shall be keyed by providing a triangular or trapezoidal fillet nailed on the stop board. Inclined joints shall not be permitted. Any concrete flowing through the joints of stop board shall be removed soon after the initial set. When concrete is stopped on a horizontal plane, the surface shall be roughened and cleaned after the initial set and a triangular or trapezoidal groove shall be provided for keying with the new concrete later.

9.4 When the work has to be resumed on a surface which has hardened, such surface shall be cleared of any foreign materials and roughened to expose the tips of the coarse aggregate. This may be done by manual chipping of concrete, with a high pressure water jet or by any other appropriate means as per Engineer-in-Charge's directions. It shall then be swept clean and thoroughly washed and wetted before any new concrete is poured. Any set mortar or concrete sticking to the exposed reinforcing rods in and around such joints shall be thoroughly removed. The reinforcements shall be wire brushed and washed just before re

pouring any cement slurry or mortar. For vertical joints neat cement slurry shall be applied on the surface before it is dry. For horizontal joints the surface shall be covered with a layer of mortar about 10 to 15 mm thick composed of cement and sand in the same ratio as the cement and sand in concrete mix. This layer of cement slurry or mortar shall be freshly mixed and applied immediately before placing new concrete.

9.5 When the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgement of particles of aggregate. The surface shall be thoroughly wetted and all free water removed. The surface shall then be coated with neat cement slurry. On this surface layer of concrete not exceeding 150 mm in thickness shall first be placed and shall be well rammed against old work, particular attention being paid to corners and close spots; work thereafter shall proceed in normal way.

10.0 SEPARATION JOINT

10.1 Separation joint shall be obtained by using an approved Alkathene sheet stuck on the surface against which concrete shall be placed. Adequate care shall be taken to cause no damage to the sheet.

11.0 EXPANSION JOINTS/ISOLATION JOINT

11.1 Expansion/ Isolation joints in structures shall be formed in the positions and to the shapes shown in the relevant drawings. Joints shall be filled with joint filling material as stipulated in the drawings/schedule of rates. Isolation joints shall be provided around all equipment foundations, columns, pedestals, trenches etc. on grade.

12.0 WATER STOPS

PVC water stops as per EIL Specification No. 6-68-0002 for materials shall be accurately cut, fitted and integrally joined as per manufacturer's specifications to provide a continuous watertight diaphragm at all points.

The water stops shall be located and embedded at expansion/contraction/ construction joints as indicated in the drawings or directed by the Engineer-in-Charge.

Adequate provision shall be made for the support and protection of water stops during the progress of the work. Damaged water stops shall be replaced and/or repaired as directed.

13.0 PROTECTION OF FRESHLY LAID CONCRETE

13.1 Newly placed concrete shall be protected by approved means, from rain, sun and wind. Concrete placed below the ground level shall be protected from falling earth during and after placing. Surface shall be kept free from contact with such ground or with water draining from such ground during placing of concrete for a period of at least 3 days unless otherwise directed by the Engineer-in-Charge. The ground water around newly poured concrete shall be kept to an approved level by pumping or other approved means of drainage and adequate steps shall be taken to prevent floatation and flooding. Steps shall be taken to protect immature concrete from damage by debris, loading, vibration, abrasion, mixing with deleterious materials that may, in the opinion of the Engineer-in-Charge, impair the strength and/or durability of the concrete.

14.0 CURING

14.1 Concrete shall be cured by keeping it continuously moist wet for the specified period of time to ensure complete hydration of cement and its hardening. Curing shall be started after 8 hours of placement of concrete in normal weather, and in hot weather after 4 hours. The water used for curing shall be of the same quality as that used for making of concrete.

Curing shall be assured by use of an ample water supply under pressure in pipes, with all necessary appliances such as hose, sprinklers etc. A layer of sacking, canvas, hessian, or other approved material which will hold moisture for long periods and prevent loss of moisture from the concrete, shall be used as covering. Type of covering which would stain, discolour or damage the concrete during and after the curing period, shall not be used. Only approved covering shall be used for curing.

Exposed surfaces of concrete shall be maintained continuously in a damp or wet condition for at least the first 7 days after placing of concrete.

The Contractor shall have all equipment and materials required for curing on hand and ready to use before concrete is placed.

For curing the concrete in pavements, floors, flat roofs or other level surfaces, the ponding method of curing shall be used. For the first 24 hours after concreting, the concrete shall be cured by use of wet sacking, canvas, hessian etc. The minimum water depth of 25 mm for ponding shall be maintained. The method of containing the ponded water shall be approved by the Engineer-in-Charge. The ponded areas shall be kept continuously filled with water, and leaks, if any, shall be promptly repaired. Areas cured by ponding method shall be cleared of all debris and foreign materials after curing period is over.

Alternatively, membrane curing may be used in lieu of moist curing with the permission of the Engineer-in-Charge. Such compounds shall be applied to all exposed surfaces of the concrete by spraying or brushing as soon as possible after the concrete has set. Minimum film thickness of such curing compounds shall be as per the recommendation of the manufacturer so as to obtain an efficiency of 90% as specified by BS-8110. This film of curing compound shall be fully removed from the concrete surface after the curing period specified earlier. Engineer-in-Charge may not allow curing by curing compounds for those surfaces where use of curing compound may be detrimental to application of future finishes over the concrete. Impermeable membranes such as polyethylene sheeting closely covering the concrete surface may also be used.

14.2 For concretes containing Portland pozzolana cement or Portland slag cement, the curing period as given in Cl. 14.1 shall be doubled. Curing by ponding shall, however, commence after the first 24 hours of concreting.

15.0 FIELD TESTS

15.1 Materials Testing

15.1.1 Aggregates

Grading test on fine and coarse aggregates shall be carried out as per IS 2386 at intervals specified by the Engineer-in-Charge.

The mandatory tests and their frequencies shall be done as given in Table-3A & 3B below:

TABLE - 3A

(For Concrete prepared at site by using Mechanical mixers)

MANDATORY TESTS ON SAND & STONE AGGREGATES

S. No	MATERIAL	TEST	FIELD / LAB TEST	MIN. QTY OF MATERIAL/ WORK FOR CARRYING OUT TEST	FREQUENCY OF TESTING*
1.	Sand	(a) Bulking of sand	Field Test	20 m^3	Every 20 m^3 or part thereof or more frequently as decided by the Engineer-in-Charge
		(b) Silt content	Field Test	20 m^3	
		(c) Particle size distribution	Field or Lab as decided by the Engineer-in-Charge	40 m^3	1) Every 40 m^3 of fine aggregate/sand required in RCC works only 2) Every 80 m^3 of fine aggregate/ sand required for other items
2.	Stone aggregate	a) Percentage of soft or deleterious materials	General visual inspection, laboratory test where required by Engineer -in-Charge or as specified	As required by Engineer-in-Charge	For all quantities
		b) Particle size distribution	Field or lab as required by Engineer-in-Charge	45 m^3	For every 45 m^3 or part thereof as decided by Engineer-in-Charge
		c)Ten percent Fine value	Laboratory	45 m^3	Initial test and subsequent test as & when required by Engineer-in-Charge

* Fresh testing is mandatory whenever there is change in Source of materials

TABLE – 3B

(Refer Cl. 4.4 & 4.6.1 of IS 4926)

(For Ready Mixed Concrete supplied by Ready Mixed Concrete Plants or from on/off-site Batching Plants)

MATERIALS TESTING REQUIREMENTS

S. No	AGGREGATE PROPERTY/ PARAMETER	TYPE OF AGGREGATE	ASSESSMENT OF TYPICAL PROPERTIES AND HIGH TEST RATE*	NORMAL MONITORING AND LOW TEST RATE*	REQUIREMENT FOR NORMAL MONITORING AND LOW TEST RATE
1	Grading	Sand/Fine	Weekly	Monthly	Last 8 results conform to IS 383 or representative values
		Coarse-Single sized/ Graded	Weekly	Monthly	
2	Particle density -Oven Dry -Saturated Surface Dry -Apparent	All Types	Weekly	3 Monthly	Last 4 results ±0.04 percent
3	Absorption	All Types	Weekly	3 Monthly	Last 4 results ±0.04 percent

S. No	AGGREGATE PROPERTY/ PARAMETER	TYPE OF AGGREGATE	ASSESSMENT OF TYPICAL PROPERTIES AND HIGH TEST RATE*	NORMAL MONITORING AND LOW TEST RATE*	REQUIREMENT FOR NORMAL MONITORING AND LOW TEST RATE
4.	**Bulk Density** - Loose - Compacted	All Types	Monthly	6 Monthly	Last 4 results $\geq 75 kg/m^3$
5	**Fines(Silt) Content**	Sand	Weekly	Monthly	Last 10 results <7.5 percent maximum allowed
		Coarse	Monthly	3 Monthly	
6	**Aggregate Impact Value**	Coarse	As specified	As specified	-
7	**10 % Fines**	Coarse	Yearly	Yearly	
8	**Flakiness**	Coarse	2 Weekly	6 Monthly	Last 3 results conform to standard
9	**Chloride Content**	All Types	Weekly	6 Monthly	Last 3 results <0.01 percent
10.	**Aggregate Abrasion Value** (Los Angeles Method)	Coarse	-	Yearly/ Source Change	-
11	**Soundness**	Fine and Coarse	-	Yearly/ Source Change	-
12.	**Potential Alkali Aggregate Reactivity Including Petrography**	Fine and Coarse	-	5 Yearly/ Source Change	-
13.	**Petrographic Description** (General)	All Types	-	5 Yearly	-

***Note** The high or low test rates apply in accordance with the following conditions:

a) High test rate
   i) To establish the typical characteristics of an aggregate, and
   ii) When significant changes in properties occur outside the tolerances for low test rates given.

b) Low test rate
   i) When the typical characteristics of the aggregate have been established, and
   ii) When subsequent tests lie within the tolerances for low test rates given

15.1.2 Water

The minimum testing frequencies shall be as follows:

SOURCE	PARAMETERS	FREQUENCY	REQUIEMENT
Non mains water (Untreated water extracted from wells, ponds, lakes, rivers, underground, etc.)	p^H value, Chloride ion content, Sulphate content and any other parameter in accordance with IS 456	Initially every week for first 6 weeks (average of test results to be taken) and then at 3-monthly interval	Need further investigation in case significant deviation observed in test results of 3-monthly interval samples from the original 6 weeks average
Mains water (Treated water supplied through piped network)	Same as above	Annual basis once all tests for source are satisfactory	In case Chloride content > 0.01%, testing frequency shall be reduced to 3 months

15.2 Compaction Factor Test /Slump Test of Concrete

15.2.1 For structural quality concrete (excluding pavements, flooring etc.) at least one Slump Test shall be made for every compressive strength test carried out. More frequent tests shall be made if there is a distinct change in working conditions or if required by the Engineer-in-Charge.

In case of Ready Mixed Concrete, provisions of IS 4926 shall be followed.

15.2.2 For structural quality concrete for pavements & floorings, measurement of workability shall be by determination of compacting factor. Value of compacting factor of 0.75 to 0.8 shall generally be acceptable.

15.3 Strength Test of Concrete

15.3.1 Samples from fresh concrete shall be taken as per IS 1199 and cubes shall be made, cured and tested at 28 days in accordance with IS 516.

15.3.2 In order to get a relatively quicker idea of the quality of concrete, optional tests on beams for modulus of rupture at 72±2 hours or at 7 days, or compressive strength tests at 7 days may be carried out in addition to 28 days compressive strength tests. For this purpose, the values shall be arrived at based on actual testing. In all cases, the 28 days compressive strength specified in Table-1 shall alone be the criterion for acceptance or rejection of the concrete in accordance with clause 15.3.9.

15.3.3 Sampling Procedure

A random sampling procedure shall be adopted to ensure that each concrete batch shall have a reasonable chance of being tested that is, the sampling should be spread over the entire period of concreting and cover all mixing units.

15.3.4 Frequency of Sampling

The minimum frequency of sampling of concrete for each grade shall be in accordance with Table-4.

TABLE – 4
(Refer Cl. 15.2.2 of IS 456)

FREQUENCY OF CONCRETE SAMPLING

Quantity of concrete in the work (m^3)	Number of samples
1-5	1
6-15	2
16-30	3
31-50	4
51 & above	4 plus one additional sample for each additional $50m^3$ or part thereof

At least one sample shall be taken from each shift.

When concrete is produced at continuous production units such as ready mixed concrete/ batching plants, atleast one sample shall be taken for every $50m^3$ of concrete or after every 50 batches, whichever occurs at a greater frequency or as decided by the Engineer-in-Charge. Samples shall be avoided from the first and the last cubic metre of concrete mix in a lot.

15.3.5 Test Specimen

Three test specimens shall be made for each sample for testing at 28 days. Additional cubes may be required for various purposes such as to determine the strength of concrete at 7 days or at the time of striking the formwork or to check the testing error. Additional samples may also be required for testing samples cured by accelerated methods as described in IS 9013. The specimen shall be tested as described in IS 516.

15.3.6 Identification mark on concrete test cubes:

The following numbering system shall be adopted on each 150 mm cube:

First line: ZZ	(Alpha code assigned by the Engineer-in-Charge to the Contractor for a particular contract starting with AA and progressing to AB, AC and so on).
Second line: XXXX	(Unique integer in ascending order starting from 1).
Third line: DD-MM-YY	(Date of casting of cube)

15.3.7 Test Results of Sample

The test results of the sample shall be the average of the strength of three specimens. The individual variation should not be more than ± 15 percent of the average. If more, the test results of the sample shall be considered invalid.

15.3.8 Standard Deviation

Standard deviation for each grade of concrete shall be calculated separately.

Standard deviation based on test results of samples:

a) The total number of test samples required to constitute an acceptable record for calculation of standard deviation shall be not less than 30. Attempts shall be made to obtain the 30 samples, as early as possible, when a mix is used for the first time.

b) For design of mix in the first instance, the value of standard deviation given in Table 8 of IS 456, Amendment No. 4 may be assumed.

c) As soon as sufficient results of samples are available, actual calculated standard deviation shall be used and the mix design shall be revised/ updated. However, when adequate past records for a similar grade exist and justify to the designer a value of standard deviation different from that shown in Table 8 of IS 456, Amendment No. 4, it shall be permissible to use that value.

d) For additional requirement on standard deviation refer clause 9.2.4 of IS 456.

15.3.9 Acceptance Criteria

15.3.9.1 Compressive Strength

The concrete shall be deemed to comply with the strength requirement when both the conditions as given in col. 2 & col.3 of Table-5 for that particular grade of concrete are simultaneously met. For working out standard deviation compressive test result of date wise serially logged 30 sample test result shall be used

15.3.9.2 Flexural Strength

The concrete shall be deemed to comply with flexural strength requirements when both the following conditions are simultaneously met:

a) The mean strength determined from any group of four non-overlapping consecutive test results exceeds the specified characteristic strength by at least 0.3 N/mm^2.

(For non overlapping consecutive compressive test result any one alternate set of four samples shall be used for verification of compliance to clause no. 16.1.a of IS 456)

b) The strength determined from any test result is not less than the specified characteristic strength less 0.3 N/mm^2

Table-5
(Refer Cl. 16.1 & 16.3 of IS 456)

Characteristic Compressive Strength Compliance Requirement

Specified Grade	Mean of the Group of 4 Non-Overlapping Consecutive Test Results in N/mm^2	Individual Test Results in N/mm^2
M15 or above	$\geq f_{ck}$ + 0.825 x established standard deviation (rounded off to nearest 0.5N/mm^2) or $\geq f_{ck}$ – 3 N/mm^2. Whichever is greater	$\geq f_{ck}$ – 3 N/mm^2

NOTE : 1) In the absence of established value of standard deviation, the values given in Table 8 of IS 456, Amendment No. 4, may be assumed, and attempt should be made to obtain results of 30 samples as early as possible to establish the value of standard deviation.

2) For concrete in quantity less than 15 m^3 where the number of samples to be taken is less than four as per the frequency of sampling given in Cl. 15.3.1 (Table-4), the mean of test results of such samples shall be f_{ck} + 4 N/mm^2 minimum and the requirement of individual test results shall be f_{ck} – 2 N/mm^2 minimum. However, when the number of sample is only one as per Table-4, the requirement shall be f_{ck} + 4 N/mm^2.

15.3.9.3 Quantity of Concrete Represented by Strength Test Results

The quantity of concrete represented by group of four consecutive test results shall include the batches from which first and last samples were taken together with all intervening batches. Acceptance of concrete shall be applicable for serially logged 30 samples. In case serially logged samples are less than 30 then standard deviation of adjoining previous sample set(s) will be used for establishing acceptance criteria as per clause 16.1.a of IS 456.

For the individual test result requirements given in col. 3 of Table-5 or in item (b) of 15.3.9.2, only the particular batch from which the sample was taken shall be at risk.

Where the mean rate of sampling is not specified, the maximum quantity of concrete that four consecutive test results represent shall be limited to 60m^3.

15.3.9.4 If the concrete is deemed not to comply pursuant to Cl. 15.3.9.1 or 15.3.9.2, the structural adequacy of the parts affected shall be investigated and any consequential action as needed shall be taken (Refer Cl. 16.0).

15.3.9.5 Concrete of each grade shall be assessed separately.

15.3.9.6 Concrete is liable to be rejected if it is porous or honey-combed, its placing has been interrupted without providing a proper construction joint, the reinforcement has been displaced beyond the tolerances specified, or construction tolerances have not been met. However, the hardened concrete may be accepted after carrying out suitable remedial measures and tests to the fullest satisfaction of the Engineer-in-Charge.

15.3.9.7 Tolerance in leveling of concrete surface at foundation/ pedestal top level where grouting is to be done:

Maximum Plan Dimension	≤ 2m	>2m but ≤4m	> 4m
Tolerance in leveling	+ 10 mm	+ 10 mm	+ 10 mm
	- 10 mm	- 20 mm	- 25 mm

15.3.9.8 Tolerance in dimensions of pocket:

20 mm overall maximum tolerance on the size of pocket.

For pockets, chemically dissolvable moulds shall be preferred. Smooth removal of moulds without affecting the pocket size shall be ensured.

16.0 INSPECTION AND TESTING OF STRUCTURES

16.1 Inspection

To ensure that the construction complies with the design, an inspection procedure shall be set up by the contractor and duly approved by the Engineer-in-Charge covering materials used, receipt of materials, their test results, records, workmanship and construction etc.

Contractor shall ensure that the surface which is to receive the grout is at proper level and so are the openings for pockets as per Cl. 15.3.9.7 & 15.3.9.8.

16.2 Immediately after stripping the formwork, all concrete shall be carefully inspected and any defective work or small defects either removed or made good before concrete has thoroughly hardened.

16.3 Testing

In case of doubt regarding the grade or soundness of concrete used, either due to poor workmanship or based on results of cube strength, compressive strength tests of concrete on the basis of clause 17.4 of IS 456 and/or load test as per clause 17.6 of IS 456 shall be carried out.

The Engineer in Charge shall be the final authority for interpreting the results of all tests and shall decide upon the acceptance or otherwise. The decision of the Engineer-in-Charge shall be final and binding on the contractor. In case the results of the tests are unsatisfactory, the Engineer-in-Charge may instruct the contractor to demolish and reconstruct the structure or part thereof without any extra cost to the Owner.

16.4 Members other than Flexural Members

Members other than flexural members like columns etc. shall be referred to the designer to investigate the structural adequacy. The decision of the designer shall be final and binding on the contractor.

16.5 Non-destructive Tests

Non-destructive tests using Ultrasonic Pulse Velocity and Rebound Hammer methods shall be resorted to for checking the soundness of concrete placed and shall be as per the directions of Engineer-in-Charge. The testing shall be based on IS 13311, Part-1. However, the Rebound Hammer test (IS 13311, Part 2) shall only be used in combination with other tests (Destructive or Non Destructive) for checking the concrete quality.

17.0 FINISHING OF CONCRETE

17.1 On striking the formwork, all surface defects such as bulges, ridges and honey-combing etc. observed shall be brought to the notice of the Engineer-in-Charge. The Engineer-in-Charge may, at his discretion allow rectification by necessary chipping and packing or grouting with concrete or cement mortar. However, if honey-combing or sagging is of such extent as being undesirable, the Engineer-in-Charge may reject the work totally and his decision shall be binding. No extra payment shall be made for rectifying these defects, demolishing and reconstructing the structure. However, quantity of cement actually used for this purpose may

be considered for reconciliation of materials. All burrs and uneven faces shall be rubbed smooth with the help of carborundum stone.

The surface of non-shuttered faces shall be smoothened with a wooden float to give a finish similar to that of the rubbed down shuttered faces. Concealed concrete faces shall be left as from the formwork except that honey-combed surface shall be made good as specified above. The top faces of slabs not intended to be covered shall be levelled and floated to a smooth finish to the rises or falls shown on the drawings or as directed. The floating shall not be executed to the extent of bringing excess fine materials to the surface. The top faces of slabs intended to be covered with screed, granolithic or similar finishes, shall be left with a rough finish.

17.2 Repair and Replacement of Unsatisfactory Concrete

17.2.1 Repair shall be made as soon as possible after the forms are removed and before the concrete becomes too hard with prior permission from the Engineer-in-Charge, in writing. Stone pockets, segregation patches and damaged areas shall be chipped out and the edges undercut slightly to form a key. All loose material shall be washed our before patching. No excess water shall be left in the cavity, but the concrete shall be damp. A good bond between the patch and parent concrete shall be obtained by sprinkling dry cement on the wet surface or by throwing mortar with force on to the wetted concrete, or by brush in a coat of thick cement grout of about 1:1 (1 cement:1 sand) just before applying the patching material. Before this has dried, the remainder of the patch shall be filled with mortar or concrete, depending on the extent of the repair.

17.2.2 Cement concrete/mortar used in repair of exposed surfaces shall be made with cement from the same source as that used in concrete and blended with sufficient amount of white Portland cement to produce the same colour as in the adjoining concrete. The proportions of ingredients shall be same as those used in parent concrete. The mortar shall be as dry as possible and well compacted into the cavity. All filling shall be tightly bonded to the concrete and shall be sound, free from shrinkage cracks after the filling has been cured and dried.

17.2.3 For larger repairs to hardened concrete, necessary formwork bearing tightly at the edges of the cavity shall be provided. Concrete shall be chipped out to a depth of at least 100 mm and preferably 150 mm. Mortar shall be scrubbed into all surfaces with a wire brush before placing the concrete. Damaged reinforcement shall be adequately spliced with new steel so as to maintain the original strength. Additional reinforcement, if required in the patch, shall be provided as per the instructions of Engineer-in-Charge.

17.2.4 In case in the opinion of the Engineer-in-Charge, defects in the concrete is excessive or beyond repair, the contractor shall either redo the structure or take other remedial measures as instructed by the Engineer-in-Charge. The decision of the Engineer-in-Charge shall be final and binding to all in this respect.

17.2.5 Approved epoxy formulation for bonding fresh concrete used for repairs with already hardened concrete shall be used by the Contractor if asked by the Engineer-in-Charge. Epoxy shall be applied in strict accordance with EIL Specification 6-68-0056 and the instructions of the manufacturer.

17.2.6 All repair works due to non-conformance or non-adherence to specification, if allowed by the Engineer-in-Charge, shall be carried out free of cost to the owner.

17.3 Curing of Patched Work

Immediately after patching is completed, the patched area shall be covered with an approved non-staining water saturated material which shall be kept wet and protected against sun and wind for a period of 12 hours. Thereafter, the patched area shall be kept continuously wet by a fine spray or sprinkling for not less than 10 days.

18.0 WATERPROOF CEMENT PAINT

Wherever specified, concrete elements (whether cast-in-situ or precast) exposed to atmosphere shall be provided with three coats of cement based waterproof paint as per IS 5410 provided these surfaces shall not contain any protective coating. Prior to application of the paint, the surface shall be prepared to remove all foreign particles, loose materials, extra deposited concrete lumps, etc. using appropriate mechanical/ manual means.

19.0 FORM WORK

19.1 General

19.1.1 Forms for concrete shall be of plywood conforming to IS 6461 (Part-5) or steel or as directed by the Engineer-in-Charge and shall give smooth and even surface after removal thereof.

19.1.2 If it is desired by Engineer-In-Charge, the Contractor shall prepare, before commencement of actual work, design and drawings for formwork and get them approved by the Engineer-in-Charge. For details regarding design, detailing etc., reference may be made to IS 14687.

19.1.3 Form work and its supports shall maintain their correct position and be to correct shape and profile so that the final concrete structure is within the limits of dimensional tolerances specified below, unless required otherwise, for functional/aesthetic reasons. The decision of the Engineer-in-Charge shall be final and binding in this regard.

(a) Deviation from specified dimensions of cross section of columns and beams. — -5 mm to +10 mm

(b) Deviation from dimensions of footings (see Note below)

i) Dimensions in plan	-10 mm to +50 mm
ii) Eccentricity	0.02 times the width of the footing in the direction of deviation but not more than 50 mm.
iii) Thickness	-10 mm to +50 mm or ±0.05 times the specified thickness, whichever is less

Note: These tolerances apply to Cast-in-situ concrete dimensions only, not to positioning of vertical reinforcing steel or dowels.

(c) Deviation in length (major dimension of single unit)

upto 3m	±6 mm
3m to 4.5m	±9 mm
4.5m to 6m	±12 mm
Additional deviation for every subsequent 6m.	±6 mm

(d) Deviation in straightness or bow (deviation from specified line) for a single or continuous member) e.g. beam, column or slab edge.

upto 3m	6 mm
3m to 6m	9 mm
6m to 12m	12 mm
additional for every subsequent 6m.	6 mm

(e) Deviation in squareness shall be measured taking the longer of two adjacent sides as the base line.

The shorter side shall not vary in its distance from a perpendicular so that the difference between the greatest and shortest dimensions exceeds 6 mm. For this purpose, any error due to lack of straightness shall be ignored. Squareness shall be checked with respect to the straight lines that are most nearly parallel with the features being checked. When the nominal angle is other than 90 degree, the included angle between check lines shall be varied accordingly.

(f) Deviation in twist shall be within a limit such that any corner shall not be more than the limit given below from the plane containing other three corners.

upto 600 mm wide and upto 6m in length	:	6 mm
over 600 mm wide and for any length	:	12 mm

(g) Maximum deviation in flatness from a 1.5m straight edge placed in any position on a nominally plain surface shall not exceed 6 mm.

(h) Tolerance in leveling of concrete surface at foundation/ pedestal top level where grouting is to be done — As per Cl. 15.3.9.7

19.2 Form Requirement

19.2.1 The formwork shall be true, rigid and adequately braced both horizontally as well as diagonally. The forms shall have smooth and even surface and be sufficiently strong to carry, without deformation, the dead weight of the green concrete, working load, wind load and also the side pressure exerted by the green concrete. As far as practical, clamps shall be used to hold the forms together. Where use of nails is unavoidable minimum number of nails shall be used. Projected part of nail shall not be bent or twisted for easy withdrawal.

19.2.2 Where through tie rods are required to be put to hold the formwork and maintain accurate dimension, they shall always be inserted through a precast concrete block (of same mix proportion as is to be used for concreting) with a through hole of bigger diameter. The Precast block shall tightly fit against in inner faces of formwork. The holes left after the withdrawal of tie rods shall be fully grouted with cement sand mortar of same proportion as that used for concrete. However, use of such precast block shall in no case impair the desired appearance or durability of the structure. No such tie rods shall be used in any liquid retaining or basement structure.

19.2.3 Tie wires shall be permitted only upon approval of the Engineer-in-Charge and shall be cut off flush with the face of the concrete to counter sunk, filled and finished in the manner specified in clause 17.

19.2.4 Form joints shall not permit any leakage. The formwork shall be strong enough to withstand the effect of vibrations practically without any deflection, bulging, distortion or loosening of its components.

19.2.5 Forms for beams and slabs (span more than 6.0m) shall have camber of 1 in 500 so as to offset the deflection and assume correct shape and line after deposition of concrete. For cantilevers, the camber at free end shall be 1/100th of the projected length. Where architectural considerations and adjunctive work are critical, smaller form cambers shall be adopted as decided by the Engineer-in-Charge.

19.2.6 All vertical wall forms may be designed and constructed for the following minimum pressure. The pressures listed in Table-6 are intended as guide only and the Contractor shall ensure that the formwork is adequately strong and sturdy.

TABLE - 6
MINIMUM DESIGN PRESSURE FOR WALL FORMWORK

Rate of pour in meter/hour	Pressure in KN/m^2	
	at 10^0 (in Celsius)	at 24^0 (in Celsius)
0.6	36.0	29.0
0.9	40.0	32.0
1.2	44.0	35.0
1.5	46.0	37.0

All horizontal forms shall be designed and constructed to withstand the dead load of the green concrete, reinforcement, equipment, material, embedment and a minimum live load of $2.0\ kN/m^2$.

19.3 Inspection of Forms

Temporary openings shall be provided at the base of column and wall forms and other places necessary to facilitate cleaning and inspection. Before concrete is placed, all forms shall be carefully inspected to ensure that they are properly placed, sufficiently rigid and tight; thoroughly cleaned, properly treated and free from foreign material. The complete form work shall be inspected and approved by the Engineer-in-Charge before the reinforcement bars are placed in position. When forms appear to be unsatisfactory in any way, either before or during the placing of concrete, the work shall be stopped until the defects have been rectified as per the instructions of the Engineer-in-Charge.

19.4 Cleaning and Treatment of Formwork

The surfaces of forms that would come in contact with concrete shall be well treated with approved non-staining form release agents such as soft soap, oil, emulsions etc. Release agents shall be applied so as to provide a thin uniform coating to the forms without coating the reinforcement.

19.5 Chamfers and Fillets

All corners and angles shall be formed with 45 degree mouldings to form chamfers or fillets on the finished concrete. The standard dimensions of chamfers and fillets, unless otherwise detailed or specified shall be 25x25 mm. For heavier work chamfers or fillets shall be 50x50 mm. Care shall be exercised to ensure accurate mouldings. The diagonal face of the moulding shall be planed or surfaced to the same texture as the forms to which it is attached.

19.6 Reuse of forms

Before reuse, all forms shall be thoroughly scrapped, cleaned, examined and when necessary, repaired and retreated, before reusing. Formwork shall not be reused, if declared unfit or un-serviceable by the Engineer-in-Charge.

19.7 Removal of Forms/Stripping Time

In the determination of time for removal of forms, consideration shall be given to the location and character of the structures, the weather and other conditions including the setting and curing of the concrete and material used in the mix.

Forms and their supports shall not be removed without the approval of the Engineer-in-Charge. Forms shall not be released until the concrete has achieved a strength of at least twice the stress to which the concrete may be subjected at the time of removal. The formwork shall be removed without shock and methods of form removal likely to cause over stressing or damage to the concrete shall not be adopted. Supports shall be removed in such a manner as to permit the concrete to uniformly and gradually take the stresses due to its own weight.

In normal circumstances when average air temperature exceeds 15 degree Celsius during the period under consideration after pouring of concrete and where ordinary Portland cement is used, forms may generally be removed after expiry of following periods.

(a) Walls, columns and vertical faces of all structural members	16 to 24 hours as may be decided by the Engineer-in-Charge.
(b) Slabs (props left under)	3 days.
(c) Beam Soffits (props left under)	7 days.
(d) Removal of props under slabs:	
Spanning upto 4.5m.	7 days.
Spanning over 4.5m.	14 days.
(e) Removal of props under beams and arches:	
Spanning upto 6m	14 days.
Spanning over 6m	21 days

(f) Cantilever Construction Formwork shall remain till structures for counter acting or bearing down have been erected and have attained sufficient strength (minimum 14 days).

Notes:

i) For other concrete, the stripping time recommended for ordinary Portland cement shall be suitably modified as per the instructions of the Engineer-in-Charge.

ii) The number of props left under, their sizes, supporting arrangement, and disposition shall be such as to be able to safely carry the full dead load of the slab, beam or arch as the case may be together with any live load likely to occur during curing or further construction.

iii) Where the shape of the element is such that the formwork has re-entrant angles, the form work shall be removed as soon as possible after the concrete has set, to avoid shrinkage cracking occurring due to the restraint imposed.

iv) For rapid hardening cement, 3/7 of the above mentioned periods shall be considered subject to a minimum of 16 hours.

v) For Portland pozzolana or low heat cement, 10/7 of the above mentioned periods shall be considered.

19.8 Staging/Scaffolding

19.8.1 Staging/Scaffolding shall be properly planned and designed by the Contractor. Use of only steel tubes is permitted for staging/scaffolding. The Contractor shall get it reviewed by Engineer-in-Charge before commencement of work. While designing and during erection of scaffolding/staging, the following measures shall be considered:

(a) Sufficient sills or underpinnings in addition to base plates shall be provided particularly where scaffolding is erected on soft grounds.

(b) Adjustable bases to compensate for uneven ground shall be used.

(c) Proper anchoring of the scaffolding/staging at reasonable intervals shall be provided in each direction with the main structure wherever available.

(d) Horizontal braces shall be provided to prevent the scaffolding/staging from rocking.

(e) Diagonal braces shall be provided continuously from bottom to top between two adjacent rows of uprights.

(f) The scaffolding/staging shall be checked at every stage for plumb line.

(g) Wherever the scaffolding/staging is found to be out of plumb line it shall be dismantled and re-erected afresh and effort shall not be made to bring it in line with a physical force.

(h) All nuts and bolts shall be properly tightened and care shall be taken that all clamps/couplings are firmly tightened to avoid slippage.

(i) Erection work of a scaffolding/staging under no circumstances shall be left totally to semi-skilled or skilled workmen and shall be carried out under the supervision of a technically qualified civil engineer of the Contractor.

19.8.2 For smaller works or works in remote areas, wooden ballies may be permitted for scaffolding/staging by the Engineer-in-Charge at his sole discretion. The contractor must ensure the safety and suitability of such works as described under clause 19.8.1 above.

20.0 EXPOSED/ARCHITECTURAL CONCRETE WORK

20.1 Form Work

Other things remaining same as per clause 19.0, formwork shall be of high quality. Care shall be taken to arrange the forms so that the joints between forms correspond with the pattern indicated in the drawings. The forms shall be butting with each other in straight lines, the corners of the boards being truly at right angles. The joints between the forms shall cross in the two directions at right angles. The size of forms shall be so selected as to exactly match with the pattern of forms impression on the concrete face indicated in the drawings. Maximum care shall be taken to make the form work watertight. Burnt oil shall not be used for treatment of forms. The Contractor shall be permitted reuse of forms brought new on the work place only if forms are properly cared for, stored and treated after each use.

The Engineer-In-Charge may, at his absolute discretion, order removal of any forms considered unsuitable for use in the work.

20.2 Finishing

Repairing to exposed concrete work shall be avoided. Rendering and plastering shall not be done. Minor repairing, if unavoidable shall be done as specified in clause 17.0 with the written permission of the Engineer-in-Charge.

21.0 REINFORCEMENT

21.1 The Contractor shall develop the bar bending schedule for all RCC structures/ structural parts at no extra cost to the Owner and shall get it reviewed by the Engineer-in-charge. Reinforcement shall be cut and bent to shape as per dimensions shown in the bar bending schedule/ drawings.

If protective fusion bonded epoxy coating is required to be applied on reinforcement bars, the same shall be done as per IS 13620. All repairs to applied protective coating required due to mishandling and/ or bending of reinforcement bars shall also be done as per relevant clauses of IS 13620.

21.2 Straightening, Cutting and Bending

Procedure for cutting and bending shall be as given in IS 2502. Bars shall be bent in a slow and regular movement to avoid fractures by mechanical means only. In case bars are supplied in coils, they shall be smoothly straightened without any kinks.

Cold twisted deformed bars shall be bent cold. Bars larger than 25 mm in size (except cold twisted deformed bars) may be bent hot at cherry red heat to a temperature not exceeding 850° Celsius as per the instructions of the Engineer-in-Charge. The bars shall be allowed to cool gradually without quenching.

Bars shall be cut & bend in a Bar Bending Machine. Bars which develops cracks or splits after bending shall be rejected. A second bending of reinforcement bars shall be avoided but when reinforcement bars are bent aside at construction joints and afterwards bent back into their original position, care should be taken to ensure that at no time is radius of the bend less than 6 times bar diameter for high strength deformed bars. Care shall also be taken when bending back the dowel bars to ensure that concrete around the bars is not damaged. All bars shall be properly tagged for easy identification.

21.3 Placing and Fixing

All reinforcement shall be cleaned to ensure freedom from loose mill scale, loose rust, oil, form releasing agents, grease or any other harmful material before placing them in position. Reinforcement shall not be surrounded by concrete unless it is free from all such materials. Rough handling and dropping of reinforcement from a height shall be avoided.

All reinforcement shall be fixed in the correct position and shall be properly supported to ensure that displacement will not occur when the concrete is placed and compacted.
The uncoated reinforcement bars shall be tied at every intersection by two strands of 16 SWG black soft annealed binding wire. The Epoxy coated reinforcement bars shall be tied with 2 strands of PVC coated GI 18 SWG wire at every intersection. Crossing bars shall not be tack welded for assembly of reinforcement. The reinforcement bars shall be kept in position by using the following methods:

a). In case of beam and slab construction, precast cover blocks (having the same sand contents as the concrete which shall be placed) of size 40 x 40 mm and thickness equal to the specified covers shall be placed firmly in between the bars and forms so as to secure and maintain the specified covers over the reinforcement.

When reinforcement bars are placed in two or more layers in beams, the vertical distance between the horizontal bars shall be maintained by introducing spacer bars at 1 to 1.2m centre to centre.

b) In case of thick rafts & pile caps having two or multi layers of reinforcement, the vertical distance between the horizontal bars shall be maintained by introducing suitable chairs, spacers, etc.

c) In case of columns and walls, the vertical bars shall be kept in position by means of timber templates with slots accurately cut in them. The templates shall be removed after the concreting has been done below it.

d) Exposed portions of reinforcement bars shall not be subjected to impact or rough handling and workmen will not be permitted to climb on extending bars until the concrete has attained sufficient strength so that no movement of the bars in the concrete is possible.

21.4 Special requirements for Handling, Stacking, Placing of Epoxy coated Reinforcing bars.

Epoxy coated reinforcing bars shall be carefully handled and it shall be ensured that these do not rub on any hard surface or against another epoxy coated/uncoated reinforcing bar whether during conveying/transportation, stacking or placing.

During transportation and while stacking the epoxy coated reinforcing bars shall be placed on wooden planks not spaced further than 600 mm. When placed in stacks the epoxy coated reinforcing bars shall be neatly tied in bundles using PVC binding material.

The cut-ends of bars shall be touched up with special touch up material of specifications as provided by the coating agency. After cutting of the bar the application of touch up material shall be completed within four hours.

While bending the bars the pins of work bench(s) shall be provided with a PVC or plastic sleeve. Each bending operation on epoxy coated reinforcing bar shall be completed in time not less than 90 seconds.

Epoxy coated reinforcing steel bar shall not be directly exposed to sun rays or rain, and shall be protected with opaque polyethylene sheets or similar means as approved by the Engineer in Charge.

While doing concreting the workmen or machinery shall not rest or move on the epoxy coated reinforcing bars. Wooden planks shall suitably be placed to create proper gang-way.

21.5 Splicing/Overlapping

Only bars of full length shall be used as shown in the drawings. But where this cannot be done, overlapping of bars shall be done as directed by the Engineer-in-Charge. The overlapping bars shall be tied with two strands of 16 SWG black soft annealed binding wire. The overlaps shall be staggered for different bars and located at points along the span where neither shear nor bending moment is maximum.

21.6 Welded Joints

Welding of reinforcing bars shall not be permitted without the written permission of the Engineer-in- Charge. Where welding of reinforcing bars is permitted, it shall be in accordance with the recommendations of IS 2751 and IS 9417. Welded joints shall be located at suitable staggered positions. Tests shall be made as directed by the Engineer-in-Charge to prove that the joints are of the full strength of the bars. Maximum one welded joint shall be allowed per bar.

21.7 Mechanical Connections

The mechanical splices to reinforcement by means of couplers, clamps etc shall be used (as per manufacturer's specifications) with the written approval of the Engineer-in-Charge. Following tests, at the minimum, shall be conducted in advance to prove efficiency of the coupled joint before putting them to actual use. This covers requirements of couplers to be used with bars conforming to grades less than & equal to Fe550D of IS 1786.

Name of the Test	Testing Requirement	Code of conformance
Static Tensile test: 1. Tensile strength	Each connection shall develop at least 125% of the specified yield strength of the reinforcing bar & 100% of the specified tensile strength. Bar break requirement shall be satisfied to avoid splice failure & to develop full tensile strength of the bar.	ASTM A370/ ACI 318/ **AC 133**/ ISO 15835/ IS 16172
Static Tensile test: 2. Percentage elongation (Ductility)	The minimum percentage elongation (at maximum forces), in the reinforcing bar outside the length of the mechanical splice shall be minimum 3% before the failure of the test piece.	ISO 15835 IS 16172
Static compression test	Each connection shall develop atleast 125% of the specified yield strength of the reinforcing bar.	ASTM A370/ ACI 318/ AC 133
Permanent Elongation (Slip)	Permanent elongation across the coupled joint shall be less than 0.1 mm after loading at 60% of the yield strength of the reinforcing bar	BS 8110/ ISO 15835 IS 16172
Cyclic tensile test	Mechanical splice shall withstand 100 cycles of stress variation from 5% to 90% of the yield strength of reinforcing bar & without loss of static tensile strength capacity when compared with like specimen.	IS 16172
Moderate Oligocyclic (Seismic) Test (Cyclic Tension & Compression Test) **(Refer note- 1)**	Deformation across the coupled joint shall be less than 0.3 mm after subjecting the joint to a series of 20 cycles with 95% tension as well as 50% compression of the yield strength of the reinforcing bar & without loss of static tensile strength capacity when compared with like specimen.	ISO 15835/ ASTM A370/ ACI 318/ AC 133
Violent Oligocyclic (Seismic) Test (Cyclic Tension & Compression Test) **(Refer note- 2)**	The joint shall be subjected from zero strain upto twice the yield strain in tension followed by compression stress of 50% of yield strength of reinforcing bar for 4 cycles. Thereafter, from zero strain upto five times the yield strain in tension followed by compression stress of 50% of yield strength of reinforcing bar for 4 cycles. Deformation across the coupled	ISO 15835/ ASTM A370/ ACI 318/ AC 133

Name of the Test	Testing Requirement	Code of conformance
	joint shall be less than 0.3 mm after 4 cycles & less than 0.6 mm after 8 cycles & without loss of static tensile strength capacity when compared with like specimen.	
Low cycle fatigue test **(Refer note- 3)**	Mechanical splice shall withstand 10,000 cycles of alternating tension & compression load from +173Mpa to -173Mpa & without loss of static tensile strength capacity when compared with like specimen.	IS 16172

Notes:

1) Moderate Oligocyclic (Seismic) test shall be performed for structures in seismic zone II.

2) Violent Oligocyclic (Seismic) test shall be performed for structures in seismic zone III, IV & V.

3) Low cycle fatigue test shall be performed for all structures except for concrete structures which are subjected to high cycle of fatigue like machine foundations etc. For concrete structures which are subjected to high cycle of fatigue, High cycle fatigue test shall be performed as per IS 16172.

All operations relating to reinforcement coupling shall be done by using manufacturer's patented machine/ equipment in the presence of Engineer-in-Charge. Mechanical connections shall be placed away from points of high stress and shall be staggered.

21.8 Tolerances on Placing of Reinforcement

Unless otherwise directed by the Engineer-in-Charge, reinforcement shall be placed within the following tolerances:

a) For effective depth 200 mm or less ± 10 mm

b) For effective depth more than 200 mm ± 15 mm

21.9 Substitution

When indicated diameter of reinforcement bar is not available, the Contractor shall use other diameter of reinforcement bars on written approval of the Engineer-in-Charge.

21.10 Tolerance to Cover

The actual concrete cover shall not deviate from the required nominal cover by + 10 mm measured over the steel reinforcement including links.

22.0 PAYMENT

22.1 Plain and Reinforced Concrete

22.1.1 Payment for plain and reinforced cement concrete shall be made on cubic metre basis of the volume of the actual finished work done or as per approved construction drawings, whichever is less and shall be inclusive of providing pockets, openings, recesses of all sizes, chamfers, fillets, grooves, separation/ expansion/ isolation/ construction/ movement joints, curing by normal moist curing or using curing compound etc. as directed by Engineer-in-Charge etc. The rates shall be deemed to include complete cost of getting the

respective mix designs approved, making and testing concrete cubes and carrying out other tests including tests of various ingredients, as per specifications and as directed by Engineer in Charge. Payment shall, however, be separately made for tests on concrete cubes done by accelerated methods of curing as defined in IS 9013.

22.1.2 No separate payment shall be made for any additive/ admixture/ Plasticizer/ Fibres used by the contractor for accelerating or retarding the strength of concrete or for achieving specified workability. The rate quoted shall be deemed to be inclusive of all costs related to any such additive/admixture/ Plasticizer/ Fibres.

22.1.3 The rate shall however be exclusive of reinforcement, metal inserts, pipe sleeves, formwork, water stops and any filler material in expansion/isolation joints.

22.1.4 Where the strength of concrete mix as indicated by tests, lies in between the strengths of any two grades given in Table-1, and it is accepted by the Owner/Engineer-in-Charge, such concrete shall be classified as a grade belonging to the lower of the two grades between which it lies. In case the cube strength shows higher results than those specified for the particular grade of the concrete, it shall not be placed in the higher grade nor shall the Contractor be entitled for any extra payment on such account. The concrete giving lower strength than specified may be accepted at reduced rates after satisfying the safety of the structure by checking it with tests as specified or rejected entirely at the discretion of the Engineer-in-Charge. The rejected concrete shall be dismantled at no extra cost to the owner and no payment or extension of time shall be granted for the concrete so rejected and the formwork and reinforcement used for the same. Cost of any material supplied by the Owner free of cost shall be recovered from the Contractor at double the prevailing market rate. In case the concrete of lower strength can be improved by carrying out some strengthening measures entirely at the discretion of the Engineer in Charge, then the said measures including all related tests shall be carried out by Contractor at his own cost. If the Contractor is able to make up the strength to the required grade by such improvement measures to the entire satisfaction of Engineer-in-Charge, payment shall be made for the grade achieved. However, if the strength of concrete is not made up to the strength of required grade, payment shall be made only for the lower strength of such concrete as accepted by the Engineer-in-Charge.

22.1.5 Deductions for openings, pockets etc. shall be as specified in relevant parts of IS 1200.

22.1.6 The rate quoted for reinforced cement concrete, also includes single pour concreting wherever specified. The rate shall be inclusive of all extra cost related to labour, shuttering, staging and making all other arrangements for such continuous casting e.g. provisions for adequate movement and storage spaces, special gangways, scaffolding, additional construction equipments, adequate lighting and supervision while the work continues round the clock etc. The rate shall also be inclusive of all costs related to concreting in any thickness, shape and position and at any height or depth so as to avoid any cold joint between specified construction joints.

22.1.7 Form Work

Unless otherwise specified, payment for form work shall be on square metre basis of the actual area in contact with the concrete cast. The rates shall be inclusive of keeping the formwork for the full period as specified in the above clauses and removing the same after the period is over. No extra payment shall be made for providing scaffolding/ staging/ access/ stairways/ ladders etc.

The rates shall be inclusive of any provision to be made or kept in the formwork for providing dowels, inserts etc.

Superior quality formwork for exposed/architectural concrete work shall be measured and paid separately under the relevant item in the schedule of rates.

22.2 Reinforcement

22.2.1 Payment for plain round mild steel reinforcement bars, high strength deformed steel bars and epoxy coated reinforcing steel bar shall be on the basis of weight of bare steel irrespective of any coating applied in metric tons. The weight of the bar shall be derived from the sizes and corresponding nominal unit weight given in Table-1 of IS 1786. In case actual unit weight of the bars is less than nominal unit weight, but within permissible tolerances, the weight of reinforcement shall be calculated on the basis of actual unit weight. In case actual unit weight of the bars is more than nominal unit weight, the payment shall be made on the basis of nominal unit weight. Standard hook lengths, chairs, spacer bars and authorized laps only shall be included in the weight calculated. Binding wire shall not be weighed nor otherwise measured. Measurements for weight shall not include cutting allowance etc.

22.2.2 Rate quoted for reinforcement shall include cost of supplying, decoiling, straightening, cleaning, cutting, bending, placing, binding, welding (if required) and providing necessary cover blocks of concrete.

22.2.3 Payment for a mechanical threaded coupler/ clamp shall be made by measuring the lap length of the respective rebar on which coupler/ clamp is used. The rate shall include supply of complete assembly, fixing, testing etc. all complete.

22.3 Water Stops/Water Bars & Expansion/Isolation Joints

22.3.1 Payment for water bars shall be made on running metre (RM) basis of the water stops provided in position. Rate shall include supplying, cutting, fixing, jointing by vulcanising or any other approved method, wastage, etc. complete.

22.3.2 Payment for filler materials in Expansion/Isolation joints shall be made on running metre basis of the joint provided. For boards provided at expansion/isolation joints, the measurement shall be made on square metre basis. Rate shall be inclusive of supply, cutting, fixing, jointing, wastage etc. complete.

22.4 Waterproof Cement Paint

22.4.1 Payment for waterproof cement paint as per Cl. 18.0 shall be made separately on Sqm basis.

मानक विनिर्देश
सिविल एवं संरचनात्मक कार्य

STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS

संरचनात्मक इस्पात कार्य

STRUCTURAL STEEL WORKS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
7	13.01 20	UPDATED & REISSUED	TK	AJS	RS	RK TRIVEDI
6	26.08.14	UPDATED & REISSUED	SP	AS	PKM	S CHANDA
5	18.06 09	REAFFIRMED & REISSUED	AS	PKM	VINAY KUMAR	N DUARI
4	18 04.00	UPDATED & REISSUED	DPN	RS	SCJ	MI
3	MAY'94	UPDATED & REISSUED	DPN	RS	GPL	A SONI

Abbreviations:

AFC	:	Approved For Construction
AWS	:	American Welding Society
BIS	:	Bureau of Indian Standards
IS	:	Indian Standards

Structural Standards Committee

Convenor: Mr. Rajanji Srivastava

Members:
Mr. Anurag Sinha
Mr. VK Panwar
Mr. Samir Das
Mr. Amitabh Kishore
Mr. Gyasuddin
Mr. Charanjit Singh (Proj.)
Mr. Ravindra Kumar (Constn)

CONTENTS

1.0 SCOPE

This specification describes the information to be included in a Project Specification and also covers the requirements for material, storage, preparation of fabrication drawings, fabrication, assembly, tests/examinations, transportation, erection and painting of all types of bolted and/or welded structural steel works for general construction work. Fabrication of structures shall also include fabricating:

(a) Built up sections/plate girders made out of rolled section and/or plates.

(b) Compound sections made out of rolled sections.

2.0 REFERENCES

2.1.1 BIS Codes

IS: 800, 808, 816, 819, 822, 919, 1024, 1261, 1323, 1477, 1852, 2074, 7205, 7215, 7307, 7310, 7318, 9595, 12778 and other relevant BIS Codes.

SP: 6(1)

2.1.2 International Standard

AWS D1.1

2.2 EIL Specifications

6-68-0002- Materials
6-79-0020 (or relevant Job Specification) – Surface preparation & protective coating (New construction)

2.3 In case of conflict between the clauses mentioned in this specification and those in the Indian Standards, this specification shall govern. Any special provision as shown or noted on the design drawings or any project specific specification specified elsewhere shall govern over the provisions of this specification.

3.0 MATERIALS

3.1 General

All materials shall conform to their respective specifications given in EIL Specification no. 6-68-0002. The use of equivalent or alternative materials shall be permitted only in very special cases and for all such cases prior written approval of the Engineer-in-Charge shall be obtained.

3.2 Receipt & Storing of Materials

3.2.1 Each section shall be marked for identification and each lot shall be accompanied by manufacturer's quality certificate, chemical analysis and mechanical characteristics.

3.2.2 All sections shall be checked, sorted out and arranged by grade and quality in the store. Any instruction given by the Engineer-in-Charge in this respect shall be strictly followed.

3.2.3 All material shall be free from surface defects such as pitting, cracks, laminations, twists etc. Defective material shall not be used and all such rejected material shall be immediately removed from the store/site. The decision of the Engineer-in- Charge in this regard shall be final and binding.

3.2.4 Welding wires and electrodes (packed in their original cartons) shall be stored separately by quality and lots inside a dry and enclosed room in compliance with IS:9595 and as per the instructions given by the Engineer-in-Charge. Electrodes shall be kept perfectly dry to ensure satisfactory operation and weld metal soundness.

3.2.5 Each lot of electrodes, bolts, nuts etc. shall be accompanied by manufacturer's quality/test certificates.

3.2.6 All bolts (including nuts & washers) shall be checked, sorted out and arranged diameter-wise by grade and quality in the store.

3.3 Material Tests

3.3.1 The Contractor shall submit manufacturers' quality certificates for all the materials supplied by him. In case, quality certificates are not available or are incomplete or when material quality differs from standard specifications, such materials shall not be used in the construction. However, the Contractor shall get all appropriate tests conducted in approved test houses for such materials as directed by the Engineer-in-Charge, at no extra cost, and submit the same to Engineer-in-Charge for his approval. The Engineer-in-Charge may approve the use of such materials entirely at his discretion.

3.3.2 The Contractor shall ensure that all materials brought to site are duly approved by the Engineer-in-Charge. Rejected materials shall not be used and shall be removed from site forthwith. Any material of doubtful quality for which specific tests are to be carried out as per the instruction of the Engineer-in-Charge shall be separately stacked and properly identified and shall not be used. These shall be removed from site forthwith.

4.0 FABRICATION DRAWINGS

4.1 Fabrication and erection drawings shall be prepared by the Contractor on the basis of "Approved for Construction" (AFC) design drawings, EIL Standards issued to the Contractor. These drawings shall be prepared by Contractor or by an agency engaged by the contractor using TEKLA or AUTODESK Advance Steel or equivalent 3D Modeling software and approved by the Engineer-in-Charge.

4.2 Fabrication and erection drawings shall be thoroughly checked, stamped "Approved for Construction" and signed by the Contractor's own responsible Engineer irrespective of the fact that such drawings are prepared by the Contractor or his approved agency, to ensure accuracy and correctness of the drawings. Unchecked and unsigned drawings shall not be used for the purpose of proceeding with the work. The Contractor shall proceed with the fabrication and erection work only after thoroughly satisfying himself in this regard.

4.3 All fabrication and erection drawings shall be issued for construction by the Contractor directly to his work- site. Six copies of such drawings shall simultaneously be submitted to the Engineer-in-Charge who may check/ review some or all such drawings at his sole discretion and offer his comments for incorporation in these drawings by the Contractor.

However, the Contractor shall not proceed with the fabrication of such structures whose fabrication drawings are required to be reviewed before taking up the fabrication work as noted on "Approved for Construction (AFC)" design drawings issued to the Contractor or as

conveyed by the Engineer-in-Charge. The fabrication of such structures shall be done only as per the reviewed fabrication drawings.

The review of such drawings by EIL shall be restricted to the checking of the following only:

i) Structural layout, orientation and elevation of structures/members.

ii) Sizes of members.

iii) Critical joint details.

4.4 Fabrication drawings shall be drawn to scale and shall convey the information clearly and adequately. Following information shall be furnished on such drawings:

i) Reference to design drawing number (along with revision number) based on which fabrication drawing has been prepared.

ii) Structural layout, elevations & sections (with distinct erection marking of all members).

iii) Framing plans, member sizes, orientation and elevations.

iv) Layout and detailing of rain water pipes and gutters showing all necessary levels, connections and provisions wherever required.

v) Detailing of shop/field joints, connections, splices, for required strength and erection.

vi) Location, type, size and dimensions of welds and bolts.

vii) Shapes and sizes of edge preparation for welding.

viii) Details of shop and field joints/welds.

ix) Bill of materials/D.O.D. Lists.

x) Quality of structural steel, plates etc., welding electrodes, bolts, nuts and washers to be used.

xi) Erection assemblies identifying all transportable parts and sub-assemblies with special erection instructions, if required.

xii) Method of erection and special precautions to be taken during erection as required.

xiii) Details of holes and fittings in components necessary for safe lifting and erection purpose.

4.5 The Contractor shall additionally ensure accuracy of the following and shall be solely responsible for the same:

i) Provision for erection and erection clearances.

ii) Marking of members

iii) Cut length of members

iv) Matching of joints and holes.

v) Provision kept in the members for other interconnected members.

vi) Bill of materials/D.O.D. Lists.

4.6 Connections, splices and other details where not shown on the design drawings shall be suitably designed and shown on the fabrication drawings based on good engineering practice developing full member strength. **Design calculations for such connections/ splices shall be submitted to the Engineer-in-Charge alongwith the fabrication drawings.**

4.7 Any substitution or change in section shall be allowed only when prior written approval of the Engineer-in-Charge has been obtained. Fabrication drawings shall be updated incorporating all such substitutions/changes by the Contractor at no extra cost to the Owner.

4.8 In case during execution of the work, the Engineer-in-Charge on review of drawings considers any modifications/ substitutions necessary to meet the design parameters/ good engineering practice, these shall be brought to the notice of the Contractor who shall incorporate the same in the drawings and works without any extra cost to the owner. The Contactor will be totally responsible for the correctness of the detailed fabrication drawings and execution of the work.

4.9 Contractor shall incorporate all the revisions made in the design drawings during the course of execution of work in his fabrication drawings, and resubmit the drawings at no extra cost to the Owner. All fabrication shall be carried out only as per the latest AFC design drawings and corresponding fabrication drawings.

4.10 The Contractor shall supply two prints each of the final/as built drawings alongwith their native soft file to Engineer-in-Charge for reference and record. The rates quoted shall include for the same.

5.0 FABRICATION

5.1 General

5.1.1 Fabrication of structures shall be done strictly as per "Approved for Construction" fabrication drawings (prepared by the Contractor based on the latest design drawings) and in accordance with IS:800, 9595 & other relevant BIS Codes and BIS Hand Book SP:6(1).

5.1.2 Prior to commencement of structural fabrication, undulations in the fabrication yard, if any, shall be removed and area levelled and paved by the Contractor.

5.1.3 Any defective material used in the work shall be replaced by the Contractor at his own expense. Necessary care and precautions shall be taken so as not to cause any damage to the structure during any such removal and replacement.

5.1.4 Any faulty fabrication pointed out at any stage of work by the Engineer-in- Charge, shall be made good or replaced by the Contractor at his own cost.

5.1.5 Tolerances for fabrication of steel structures shall be as per IS:7215.

5.2 Fabrication Procedure

5.2.1 **Straightening & Bending**

5.2.1.1 All materials shall be straight and, if necessary, before being worked shall be straightened and/or flattened (unless required to be of curvilinear form) and shall be free from twists.

5.2.1.2 Bending of rolled sections and plates shall be done by cold process to shape/s as shown on drawings.

5.2.1.3 After completion of bending or straightening, welds within the area of bending or straightening shall be thoroughly visually inspected. Nondestructive tests required to be carried out for such locations shall be done only after straightening or bending activity.

5.2.2 **Clearances**

The erection clearance for cleated ends of members shall be not greater than 2mm at each end. The erection clearance at ends of beams without web cleats and end plates shall be not more than 3mm at each end but where for practical reasons, greater clearance is necessary, suitably designed seatings approved by the Engineer-in-Charge shall be provided.

5.2.3 **Cutting**

5.2.3.1 Prior to cutting, all members shall be properly marked showing the requisite cut length/width, connection provisions e.g. location and dimensions of holes, welds, cleats etc. Marking for cutting shall be done judiciously so as to avoid wastages or unnecessary joints as far as practicable. Marking shall be done by placing the members on horizontal supports/pads in order to ensure accuracy. Marking accuracy shall be limited to + 1mm.

5.2.3.2 Cutting may be affected by shearing, cropping or sawing. Gas cutting by mechanically controlled torch shall be permitted for mild steel. Hand flame cutting may be permitted subject to the approval of the Engineer-in-Charge.

5.2.3.3 Except where the material is subsequently joined by welding, no loads shall be transmitted into metal through a gas cut surface.

5.2.3.4 Shearing, cropping and gas cutting shall be clean, square, free from any distortion & burrs, and should the Engineer-in-Charge find it necessary, the edges shall be ground afterwards, to make the same straight and uniform at no extra cost to the Owner.

5.2.4 **Holing**

5.2.4.1 Holes for bolts shall not be formed by gas cutting process.

5.2.4.2 Holes through more than one thickness of material of members such as compound stanchions and girder flanges shall, where possible, be drilled after the members are assembled and tightly clamped/bolted together. Punching may be permitted before assembly, provided the thickness of metal is less than 16mm and the holes are punched 3mm less in diameter than the required size and reamed, after assembly, to the full diameter. Punching shall not be adopted for dynamically loaded structures.

5.2.4.3 Holes may be drilled in one operation through two or more separable parts and burrs removed from each part after drilling.

5.2.4.4 Holes in connecting angles and plates, other than splices, also in roof members and light framing, may be punched full size through material not over 12mm thick, except where required for close tolerance bolts or barrel bolts.

5.2.4.5 All matching holes for black bolts shall register with each other so that a gauge of 2mm less in diameter than the diameter of hole shall pass freely through the assembled members in the direction at right angle to such members. Finished holes shall be not more than 2mm in diameter larger than the diameter of the black bolt passing through them, unless otherwise specified by the Engineer- in-Charge.

5.2.4.6 Holes for turned and fitted bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to H8 tolerance specified in IS:919. Parts to be connected with close tolerance or barrel bolts shall be firmly held together by tacking bolts or clamps and the holes drilled through all the thicknesses in one operation and subsequently reamed to size. Holes not drilled through all the thicknesses in one operation shall be drilled to a smaller size and reamed out after assembly. Where this is not possible, the parts shall be drilled and reamed separately.

5.2.4.7 To facilitate grouting, holes shall be provided in column bases or seating plates exceeding 300mm in width for the escape of air.

5.2.4.8 To avoid accumulation of water in gussetted column bases of laced, battened or box type stanchions, suitable reverse U-type holes shall be provided at the junction of base plate and column section in the vertical gussets for draining out of any water.

5.2.4.9 Slotted holes shall be punched or formed by drilling two holes and completed by cutting.

5.2.5 **Assembly**

The component parts shall be assembled and aligned in such a manner that they are neither twisted nor otherwise damaged, and shall be so prepared that the required camber, if any, is provided. Proper clamps, clips, jigs and other fasteners (bolts and welds) shall be placed in a balanced pattern to avoid any distortion in the members and to ensure their correct positioning (i.e. angles, axes, nodes etc.). Any force fitting, pulling/stretching of members to join them shall be avoided. Proper care shall be taken for welding shrinkage & distortion so as to attain the finished dimensions of the structure shown on the drawings.

5.2.6 **Welding**

5.2.6.1 **General**

a) All joints shall be welded unless noted otherwise on the design drawings.

b) Welding shall be in accordance with IS:816, IS:819, IS:1024, IS:1261, IS:1323 and IS:9595 as appropriate.

c) The Contractor shall make necessary arrangement for providing sufficient number of welding sets of the required capacity, all consumables, cutting and grinding equipment with requisite accessories/ auxiliaries, equipment & materials required for carrying out various tests such as dye penetration, magnetic particle, ultrasonic etc.

d) Adequate protection against rain, dust, snow & strong winds shall be provided to the welding personnel and the structural members during welding operation. In the absence of such a protection no welding shall be carried out.

e) It shall be the responsibility of the Contractor to ensure that all welding is carried out in accordance with the terms of this specification and relevant BIS codes. The Contractor shall provide all the supervision to fulfil this requirement.

5.2.6.2 **Preparation of Member for Welding**

a) **Edge Preparation**
Edge preparation/bevelling of fusion faces for welding shall be done strictly as per the dimensions shown in the drawings. In case, the same are not indicated, edges shall be prepared (depending on the type of weld indicated in the drawing) as per the details given in IS:9595. Bevelling of fusion faces shall be got checked and approved by the Engineer- in-Charge. The tolerances on limits of gap, root face & included angle shall be as stipulated in IS:9595.

b) **Cleaning**

Welding edges and the adjacent areas of the members (extending upto 20mm) shall be thoroughly cleaned of all oil, grease, scale and rust and made completely dry. Gaps between the members to be welded shall be kept free from all foreign matter.

c) **Preheating**

Preheating of members, shall be carried out as per IS:9595 when the base metal temperature is below the requisite temperature for the welding process being used. Preheating shall be done in such a manner that the parts, on which the weld metal is being deposited, are above the specified minimum temperature for a distance of not less than 75mm on each side of the weld line. The temperature shall be measured on the face opposite to that being heated. However, when there is access to only one face, the heat source shall be removed to allow for temperature equalization (1 minute for each 25mm of plate thickness) before measuring the temperature.

d) **Grinding**

i) Column splices & butt joints of struts and compression members (depending on contact for load transmission) shall be accurately ground and close-butted over the whole section with a tolerance not exceeding 0.2mm locally at any place. In column caps & bases, the ends of shafts together with the attached gussets, angles, channels etc., shall be accurately ground so that the parts connected butt over minimum 90% surface of contact. In case of connecting angles or channels, care shall be taken so that these are fixed with such accuracy that they are not reduced in thickness by grinding by more than 2mm.

ii) Ends of all bearing stiffeners shall be ground to fit tightly at both top and bottom. Similarly bottom of the knife edge supports along with the top surface of column brackets shall be accurately ground to provide effective bearing with a tolerance not exceeding 0.2mm locally at any place.

iii) Slab bases and caps shall be accurately ground over the bearing surfaces and shall have effective contact with the ends of stanchions. Bearing faces which are to be grouted direct to foundations need not be ground if such faces are true & parallel to the upper faces.

iv) Tack welding shall be thoroughly removed by grinding or gouging such that subsequent welding shall be done properly.

5.2.6.3 **Welding Processes**

Welding of various materials under this specification shall be carried out using one or more of the following processes.

- Manual Metal Arc Welding Process (MMAW)
- Submerge Arc Welding Process (SAW)
- Gas Metal Arc Welding Process (GMAW)
- Flux Cored Arc Welding Process (FCAW)

The welding procedure adopted and consumables used shall be specifically approved by the Engineer-in-Charge. A combination of different welding processes or a combination of electrodes of different classes/makes may be employed for a particular joint only after qualifying the welding procedures to be adopted and obtaining the written approval of the Engineer-in-Charge.

5.2.6.4 **Approval & Testing of Welders**

The Contractor shall satisfy the Engineer-in-Charge that the welders are suitable for the work upon which they will be employed. For this purpose the welders shall have satisfied the relevant requirements of IS:7318 or AWS D1.1. If the welders will be working to approved welding procedures, they shall have satisfied the relevant requirements of IS:7310 or AWS D1.1.

Adequate means of identification shall be provided to enable each weld to be traced to the welder by whom it was made. The Contractor shall intimate the Engineer-in-Charge sufficiently in advance, the commencement of tests, to enable him to be present to witness the same.

5.2.6.5 **Approval & Testing of Welding Procedures**

The Contractor shall carry out procedure tests in accordance with IS:7307 or AWS D1.1 to demonstrate by means of a specimen weld of adequate length on steel representative of that to be used, that he can make welds with the welding procedure to be used for the work to the complete satisfaction of the Engineer- in-Charge. The test weld shall include weld details from the actual construction and it shall be welded in a manner simulating the most unfavourable instances of fit-up, electrode condition etc., which are anticipated to occur on the particular fabrication. Where material analysis is available, the welding procedure shall be carried out on material with the highest carbon equivalent value.

After welding, but before the relevant tests given in IS:7307 or AWS D1.1 are carried out, the test weld shall be held as long as possible at room temperature, but in any case not less than 72 hours, and shall then be examined for cracking. The examination procedure shall be sufficiently rigorous to be capable of revealing significant defects in both parent metal and weld metal.

After establishing the welding method, the Contractor shall finally submit to the Engineer-in-Charge for his approval the welding procedure specification in standard format given in IS:9595 before starting the fabrication.

5.2.6.6 **Sequence of Welding**

a) As far as practicable, all welds shall be made in a sequence that will balance the applied heat of welding while the welding progresses.

b) The direction of the general progression in welding on a member shall be from points where the parts are relatively fixed in position with respect to each other towards points where they have a greater relative freedom of movement.

c) All splices in each component part of a cover-plated beam or built up member shall be made before the component part is welded to other component parts of the member.

d) Joints expected to have significant shrinkage shall be welded before joints expected to have lesser shrinkage.

e) Welding shall be carried continuously to completion with correct number of runs.

f) The Contractor shall choose the welding sequence after carefully studying each case such as to minimize distortion and shrinkage & submit the same to the Engineer-in-Charge for comments and approval.

5.2.6.7 **Welding Technique**

a) After the fusion faces are carefully aligned and set with proper gaps, the root pass of butt joints shall be executed properly so as to achieve full penetration with complete fusion of the root edges.

b) On completion of each run, all slag and spatters shall be removed and the weld and the adjacent base metal shall be cleaned by wire brushing and light chipping. Visible defects such are cracks, cavities and other deposition faults, if any, shall be removed to sound metal before depositing subsequent run of weld.

c) All full penetration butt welds shall be completed by chipping/gouging to sound metal and then depositing a sealing run of weld metal on the back of the joints. Where butt welding is practicable from one side only, suitable backing steel strip shall be used and joint shall be arranged in such a way as to ensure that complete fusion of all the parts is readily obtained.

d) While welding is in progress care shall be taken to avoid any kind of movement of the components, shocks, vibrations to prevent occurrences of weld cracks.

e) Any deviation desired from the recommended welding technique and electrodes shall be adopted only after obtaining written approval of the Engineer-in-Charge.

5.2.6.8 **Inspection & Testing of Welds**

The method of inspection shall be according to IS:822 and extent of inspection and testing shall be in accordance with the relevant applicable standard or, in the absence of such a standard, as specified by the Engineer-in-Charge. Welds shall not be painted or otherwise obscured until they have been inspected, approved and accepted.

The Engineer-in-Charge or his representative shall have access to the Contractor's work at all reasonable times and the Contractor shall provide him with all facilities necessary for inspection during all stages of fabrication and erection with, but not limited to, the following objectives.

i) To check the conformity with the relevant standards and suitability of various welding equipments and their performance.

ii) To witness/approve the welding procedure qualification.

iii) To witness/approve the welders performance qualification.

iv) To check whether shop/field welding being executed is in conformity with the relevant specifications and codes of practice.

Inspection and testing of all fabricated structures shall be carried out by the Contractor by any, or, a combination of all the following methods as directed by the Engineer-in-Charge and no separate payment shall be made, unless otherwise mentioned, for inspection and testing of welds/fabricated structures:

A. Visual Inspection

All finished welds (i.e. 100 percent) shall be visually inspected for identification of the following types of weld defects & faults.

a) Weld defects occurring at the surface such as blow holes, exposed porosity, unfused welds etc.

b) Surface cracks in the weld metal or in the parent metal adjacent to it.

c) Damages to the parent metal such as undercuts, burning, overheating etc.

d) Profile defects such as excessive convexity or concavity, overlapping, unequal leg lengths, excessive reinforcement, incompletely filled grooves, excessive penetration beads, root grooves etc.

e) Distortion due to welding i.e., local shrinkage, camber, bowing, twisting, rotation, wariness etc.

f) Linear eccentric, angular and rotational misalignment of parts.

g) Dimensional errors.

B. Mechanical Tests

The mechanical testing (such as tensile load tests, bend tests, impact tests etc.) shall be done in accordance with the relevant standards and as per the instructions of the Engineer-in-Charge.

C. Magnetic Particle/Dye Penetration/Ultrasonic Examination

The examination shall be done at random as directed by the Engineer-in-Charge. Whenever such tests are directed, the tests shall be carried out on joints chosen by him. The tests shall be carried out by employing approved testing procedure in accordance with IS:822.

D. Radiographic Examination

Radiographic examination shall be carried out only in special cases for random joints as

directed by the Engineer-in-Charge. The Contractor shall be paid extra for such examination except for penalty radiographic tests for which the cost shall be borne by him. The Contractor shall make necessary arrangement at his own expense for providing the radiographic equipment, films and all other necessary materials required for carrying out the examination. The tests shall be carried in the presence of the Engineer-in-Charge by employing approved testing procedure in accordance with IS:822. The Contractor shall fulfill all the statutory safety requirements while handling X-ray and Gamma-ray equipment and provide the Engineer- in-Charge all the necessary facilities at site such as dark room, film viewer etc., to enable him to examine the radiographs.

5.2.6.9 **Repair of Faulty Welds**

No repair of defective welds shall be carried out without proper permission of the Engineer-in-Charge and his approval for the corrective procedure.

Welds not complying with the acceptance requirements (as specified by BIS Codes & the Engineer-in-Charge), as revealed during inspection & testing of welds or erection or in-situ condition, shall be corrected either by removing & replacing or as follows:

a) Excessive convexity	- Reduced to size by removal of excess weld metal.
b) Shrinkage cracks, cracks in in parent plates and craters	- Defective portions removed down to sound metal and re-welded.
c) Under cutting.	- Additional weld metal deposited.
d) Improperly fitted/ misaligned parts.	- Welding cut & edges suitably prepared and parts.
e) Members distorted by the heat of welding	- Member straightened by mechanical means or careful application of limited amount of heat, temperature of such area not to exceed 650 degree Centigrade (dull red heat).

In removing defective parts of a weld, gouging, chipping, oxygen cutting or grinding shall not extend into the parent metal to any substantial amount beyond the depth of weld penetration, unless cracks or other defects exist in the parent metal. The weld or parent metal shall not be undercut in chipping, grinding, gouging or oxygen cutting.

Any fabricated structure or its component which, in the opinion of Engineer- in-Charge, is defective and/or beyond any corrective action shall be removed forthwith from the site as instructed by the Engineer-in-Charge without any extra claim. The owner reserves the right to recover any compensation due to any loss arising out of such rejections.

5.2.7 **Bolting**

5.2.7.1 All bolts shall be provided such that no part of the threaded portion of the bolts is within the thickness of the parts bolted together. Washers of suitable thickness shall be used under the nuts to avoid any threaded portion of the bolt being within the thickness of parts bolted together.

5.2.7.2 The threaded portion of each bolt shall project through the nut at least one thread.

5.2.7.3 Flat washers shall be circular and of suitable thickness. However, where bolt heads/nuts bear upon the bevelled surfaces, they shall be provided with square tapered washers of suitable thickness to afford a seating square with the axis of the bolt.

5.2.7.4 Different bolt grades of the same diameter shall not be used in the same structure, except if agreed otherwise by the Engineer-in-Charge.

5.2.7.5 Bearing type bolts shall be used (unless noted otherwise) and tightened firmly by available means.

5.2.8 **Splicing**

5.2.8.1 Splicing of built up/compound/latticed sections shall be done in such a fashion that each component of the section is joined in a staggered manner.

5.2.8.2 Where no butt weld is used for splicing, the meeting ends of two pieces of joist/channel/built up section shall be ground flush for bearing on each other and suitable flange and web splice plates shall be designed and provided for the full strength of the flange/ web of the section and welds designed accordingly.

5.2.8.3 Where full strength butt weld is used for splicing (after proper edge preparation of the web and flange plates) of members fabricated out of joist/ channel/ angles/ built up section, additional flange and web plates shall be provided, over and above the full strength butt welds, to have 40% strength of the flange and web.

5.2.8.4 Where a cover plate is used over a joist/channel section the splicing of the cover plate and channel/joist sections shall be staggered by minimum 500mm. Extra splice plate shall be used for the cover plate and joist/channel section as per clause 5.2.8.2 or 5.2.8.3.

5.2.8.5 Prior approval shall be obtained by the Contractor for locations of splices where not shown on design drawings. For members upto a length of 7m, generally no splice shall be allowed but in exceptional cases one splice shall be allowed at approved location. Maximum two numbers of splices shall be allowed for members exceeding this length.

5.2.9 **Machining & Grinding**

5.2.9.1 All slab bases and slab caps shall be accurately machined over the bearing surfaces and shall be in effective contact with the ends of column sections (shafts).

5.2.9.2 For slab bases and slab caps, ends of column shafts shall be accurately machined. However, for gussetted bases and caps, the column shafts shall be ground flush for effective contact with parts connected together.

5.2.9.3 Gussetted bases and caps shall be ground flush for effective contact with ends of column sections.

5.2.9.4 End of all bearing stiffeners shall be machined or ground to fit tightly at top and bottom without any air gap.

5.2.9.5 While machining or grinding care shall be taken so that the length or thickness of any part does not get reduced by more than 2.0mm.

5.2.9.6 For all machining or grinding works for gassetted base and cap plates, the clearance between the parts joined shall not exceed 0.2mm at any location.

6.0 MARKING FOR IDENTIFICATION

6.1 Each component shall be distinctly marked (with paint) before delivery in accordance with the marking diagrams and shall bear such other marks as will facilitate erection. Components which are identical in all respects may have the same erection mark.

6.2 For small members which are delivered in bundles or crates, the required marking shall be done on small metal tags securely tied to the bundle.

7.0 SHOP ERECTION

The steel work shall be temporarily shop erected complete or as directed by the Engineer-in-Charge, so that the accuracy of fit may be checked before despatch.

8.0 INSPECTION & TESTING OF STRUCTURES

8.1 The Engineer-in-Charge (or his authorised representative) shall have free access at all times to those parts of the Contractor's works which are concerned with the fabrication of the steel work and shall be provided with all reasonable facilities for satisfying himself that the fabrication is being undertaken in accordance with the provisions of these specifications & other relevant BIS Codes.

8.2 Should any structure or part of a structure be found not to comply with any of the provisions of this specification (or relevant BIS Codes as referred to), it shall be liable to rejection. No structure or part of the structure, once rejected shall be resubmitted for inspection, exception cases where the Engineer-in-Charge or his authorised representative considers the defect as rectifiable.

8.3 Defects which may appear during/after fabrication/ erection shall be made good only with the consent of the Engineer-in-Charge and procedure laid down by him.

8.4 All necessary gauges and templates shall be supplied free to the Engineer-in-Charge by the Contractor whenever asked for during inspection. The Engineer-in- Charge, may at his discretion, check the test results obtained at the Contractor's works by independent tests at a test house, and the cost of such tests shall be borne by the Contractor.

9.0 SHOP PAINTING

9.1 All components and members of steel work shall be given one shop coat of primer, as specified in the tender, immediately after the surfaces have been properly prepared (i.e. degreased, derusted, descaled & cleaned) in accordance with the job specification or 6-79-0020, as applicable.

The primer coat shall be applied over completely dry surfaces (using brushes of good quality) in a manner so as to ensure a continuous and uniform film without "holidaying". Special care shall be taken to cover all the crevices, corners, edges etc. However, in areas which are difficult to reach by brushing, daubers/mops shall be used by dipping the same in paint and then pulling/ pushing them through the narrow spaces. The primer coat shall be air dried and shall have the thickness as per EIL Specification no. 6-79-0020 or the relevant job specification.

9.2 Surfaces which are inaccessible after shop assembly, shall receive the full specified protective treatment before assembly (this shall not apply to the interior of sealed hollow sections).

9.3 Steel surfaces shall not be painted within a suitable distance of any edges to be welded if the paint specified would be harmful to welders or impair the quality of the welds.

9.4 Welds and adjacent parent metal shall not be painted prior to deslagging, inspection and approval by the Engineer-in-Charge.

9.5 Parts to be encased in concrete shall have only one coat of primer and shall not be painted after erection.

10.0 PACKING

10.1 All items shall be suitably packed in case these are to be despatched from the fabrication shop to the actual site of erection so as to protect them from any damage/distortion or falling during transit. Where necessary, slender projecting parts shall be temporarily braced to avoid warping during transportation.

10.2 Small parts such as gussets, cleats etc., shall be securely wired on to their respective main members.

10.3 Bolts, nuts washers etc. shall be packed in crates.

11.0 TRANSPORTATION

Loading and transportation shall be done in compliance with transportation rules. In case, certain parts can not be transported in the lengths stipulated on the drawings, the position details of such additional splice joints shall be got approved by the Engineer-in- Charge.

12.0 SITE (FIELD) ERECTION

12.1 Plant & Equipment

The suitability and capacity of all plant and equipment used shall be to the complete satisfaction of the Engineer-in-Charge.

12.2 Storing & Handling

All steel work shall be so stored and handled at site so that the members are not subjected to surface abrasion, excessive stresses and any damage.

12.3 Setting Out

Prior to setting out of the steel work, the Contractor shall get himself satisfied about the correctness of levels, alignment, location of existing concrete pedestals/columns/brackets and holding down bolts/pockets provided therein. Any minor modification in the same including chipping, cutting and making good, adjusting the anchor bolts etc., if necessary, shall be carried out by the Contractor at his own expense. The positioning and levelling of all steel work including plumbing of columns and placing of every part of the structure with

accuracy shall be in accordance with the drawings and to the complete satisfaction of the Engineer-in-Charge.

12.4 Tolerances

Tolerances for erection of steel structures shall be as per Annexure 'A'

13.0 SAFETY & SECURITY DURING ERECTION

13.1 The contractor shall comply with IS:7205 for necessary safety and adhere to safe erection practices and guard against hazardous as well as unsafe working conditions during all stages of erection.

13.2 During erection, the steel work shall be securely bolted or otherwise fastened and when necessary, temporarily braced/guyed to provide for all loads to be carried by the structure during erection till the completion, including those due to the wind, erection equipment & its operation etc. at no extra cost to the owner. For the purpose of guying, the Contractor shall not use other structure in the vicinity without prior written permission of the Engineer-in-Charge.

13.3 No permanent bolting or welding shall be done until proper alignment has been achieved.

13.4 Proper access, platform and safety arrangement shall be provided for working and inspection, (at no extra cost to the owner) whenever required.

14.0 FIELD CONNECTIONS

14.1 Field Bolting

Field bolting shall be carried out with the same care as required for shop bolting.

14.2 Field Welding

All field assembly and welding shall be executed in accordance with the requirements for shop assembly and welding. Holes for all erection bolts - where removed after final erection shall be plugged by welding. Alternatively erection bolts may be left and secured.

15.0 GROUTING

15.1 Prior to positioning of structural columns/girders/ trusses over the concrete pedestals/columns/brackets, all laitance & loose material shall be removed by wire brushing & chipping. The bearing concrete surfaces shall be sufficiently levelled, hacked with flat chisels to make them rough, cleaned (using compressed air) and made thoroughly wet. All pockets for anchor bolts shall also be similarly cleaned and any excess water removed. Thereafter, the structural member shall be erected, aligned & plumbed maintaining the base plates/shoe plates at the levels shown in the drawings, with necessary shims/pack plates/wedges.

15.2 After final alignment and plumbing of the structure, the forms shall be constructed allround and joints made tight to prevent leakage. Grouting (under the base plates/shoe plates including grouting of sleeves & pockets) shall be done with non-shrink grout having compressive strength (28 days) not less than 40N/sq.mm Non shrink grout shall be of free

flow premix type and of approved quality and make. It shall be mixed with water in proportion as specified by the manufacturer. Ordinary 1:2 cement/sand mortar grout shall be used only for small, isolated structures e.g. operating platforms not supporting any equipment, pipe supports, crossovers, stairs & ladders. The thickness of grout shall be as shown on the drawings but not less than 25 mm nor more than 40mm in any case.

15.3 The grout mixture shall be poured continuously (without any interruption till completion) by grouting pumps from one side of the base plate and spread uniformly with flexible steel strips and rammed with rods, till the space is filled solidly and the grout mixture carried to the other side of the base plate.

15.4 The grout mixture shall be allowed to harden for a period as decided by the Engineer-in-Charge. At the end of this period, the shims/wedges/pack plates may be removed and anchor bolts tightened uniformly. The alignment of the structure shall now be rechecked and if found correct, the voids left by the removal of shims/wedges/pack plates (if removed) must be filled up with a similar mixture of grout. In case after checking, serious misalignment is indicated, the grout shall be removed completely and fresh grouting done after making appropriate correction of alignment.

16.0 SCHEME AND SEQUENCE OF ERECTION

The Contractor shall furnish the detailed scheme and sequence of erection to match with the project schedule and get the same approved by the Engineer-in- Charge. All necessary co-ordination and synchronization shall be done with the Civil contractor where Civil works are not included in the scope of structural contractor at no extra cost so as to match with the project schedule.

17.0 PAYMENT

This clause shall apply to Item Rate tender only.

17.1 Payment for structural steel works shall be made on the basis of admissible weight in metric tons (determined as described in clause 17.2 and 17.3) of the structure accepted by the Engineer-in-Charge. The rate shall include supplying (as per supply conditions given in the Tender) fabricating, erecting in position (at all levels & locations), testing/examining (excluding radiography only) of bolted and/or welded structural steel works of all types (including all built up/compound sections made out of rolled sections and/or plates) including all handling, transporting, storing, straightening if required, cutting, edge preparation, preheating, bolting and welding of joints (including sealing the joints of box sections with continuous welding), finishing edges by grinding/machining as shown, fixing in line & level with temporary staging & bracing and removal of the same after erection, grouting with non-shrink/ordinary grout as specified, preparation of fabrication & erection drawings, & erection schedule and getting them reviewed, preparation and submission of as built drawings, preparing the surfaces for painting, and applying the primer as specified after fabrication, return of surplus materials to owner's stores and material reconciliation in the case of materials supplied by the owner as per relevant contract conditions etc. all complete for all the operations mentioned in the foregoing clauses.

17.2 The weight for payment shall be determined from the fabrication drawings and respective bill of materials prepared by the Contractor. The bill of materials shall be checked and approved by the Engineer-in-Charge before making the payment. The Contractor shall prepare full scale template in order to supplement/verify the actual cutting dimensions where so directed by the Engineer-in-Charge. The weight shall be calculated on the basis of

BIS Hand Book wherever applicable. In case sections used are different from BIS sections, then Manufacturers' Hand Book shall be adopted. No allowance in weight shall be made for rolling tolerances.

17.3 Welds, bolts, nuts, washers, shims, pack plates, wedges, grout and shop painting shall not be separately measured. The quoted rate shall be deemed to include the same.

17.4 The rate shall include all expenses related to safety & security arrangements during erection and all plants & tools required for fabrication, transportation & erection.

18.0 PAINTING AFTER ERECTION

18.1 General

18.1.1 The scope of painting after erection shall be at the sole discretion of the Engineer-in-Charge and the Contractor shall obtain written instruction in this regard sufficiently prior to taking up any procurement of paint and execution of painting work after erection of steel structures.

18.1.2 The Contractor shall carry out the painting work in all respects with the best quality of approved materials (conforming to relevant EIL Specification no. 6-79-0020 or the job specification, as applicable) and workmanship in accordance with the best engineering practice. The Contractor shall furnish characteristics of paints (to be used) indicating the suitability for the required service conditions. The paint manufacturer's instructions supplemented by Engineer-in-Charge's direction, if any, shall be followed at all times. Particular attention shall be paid to the following:

- Proper storage to avoid exposure & extremes of temperature.
- surface preparation prior to painting.
- Mixing & thinning.
- Application of paint and the recommended limit on time intervals between consecutive coats.

18.1.3 Painting shall not be done in frost or foggy weather, or when humidity is such as to cause condensation on the surfaces to be painted.

18.1.4 Surface which shall be inaccessible after site assembly shall receive the full specified protective treatment before assembly.

18.1.5 Primers & finish coat paints shall be from the same manufacturer in order to ensure compatibility. Painting colour code shall be as per Annexure-'B' or the job specification.

18.2 Rub Down & Primer Application

The shop coated surfaces shall be rubbed down thoroughly with emery/abrasive paper to remove dust, rust, other foreign matters and degreased, if required, in accordance with EIL specification no. 6-79-0020 or the job specification, as applicable, cleaned with warm fresh water and air dried. The portions, from where the shop coat has peeled off, shall be touched up and allowed to dry.

Primer coat as per EIL specification no. 6-79-0029 or the job specification, as applicable, shall be applied by brushing/ spraying over the shop coat in a manner so as to ensure a continuous and uniform film throughout. Special care shall be taken to cover all the crevices, corners, edges etc. The final primer coat shall be air dried and shall have a

minimum film thickness as per EIL Specification no. 6-79-0029 or job specification after drying, as applicable.

In case a different cleaning procedure & primer specifications are specified in the drawing/Tender, the same shall be adopted.

18.3 Final Paint Application

After the primer is hard dry, the surfaces shall be dusted off and the paint as per EIL specification no. 6-79-0029 or the job specification, as specified, shall be applied by brushing/spraying so that a film free from "holidaying" is obtained. The colour & shade of first coat of paint shall be slightly lighter than the second coat in order to identify the application of each coat. The second coat of paint shall be applied after the first coat is hard dry. The minimum thickness of each film shall be 20 microns (± 10% tolerance) after drying.

In case a different type of paint & painting procedure are specified in the drawing/tender, the same shall be adopted.

18.4 Inspection & Testing of Painting Works

18.4.1 All painting materials including primers & thinners brought to site by the Contractor for application shall be procured directly from reputed and approved manufacturers and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates shall not be accepted.

18.4.2 The Engineer-in-Charge at his discretion may call for additional tests for paint formulations. The Contractor shall arrange to have such tests performance including batch wise test of wet paints for physical & chemical analysis. All costs shall be borne by the Contractor.

18.4.3 The painting work shall be subject to inspection by the Engineer-in-Charge at all times. In particular, the stage inspection will be performed and Contractor shall offer the work for inspection and approval at every stage before proceeding with the next stage. The record of inspection shall be maintained. Stages of inspection are as follows:

(a) Surface preparation
(b) Primer application
(c) Each coat of paint

18.4.4 Any defect noticed during the various stages of inspection shall be rectified by the Contractor to the entire satisfaction of the Engineer-in-Charge before proceeding further. Irrespective of the inspection, repair and approval at intermediate stages of work the Contractor shall be responsible for making good any defects found during final inspection/guarantee period/defect liability period, as defined in General Conditions of Contract. Dry film thickness (DFT) shall be checked and recorded after application of each coat. The thickness shall be measured at as many locations as decided by the Engineer-in-Charge. The Contractor shall provide standard thickness measuring instrument such as elkometer (with appropriate range for measuring dry film thickness of each coat) free of cost to the Engineer-in-Charge whenever asked for.

18.5 Payment

Payment for painting of structural steel works shall be made on the basis of admissible weight in metric tons of the painted structures accepted by the Engineer-in-Charge.

The rate shall include supplying & applying the paint, specified in the tender, of approved quality and shade over the primer, specified in the tender, over the shop primer already applied to structural steel works of all types/shapes at all levels, locations & positions including storage, surface preparation, degreasing, cleaning, drying, touching up of shop primer coat, providing temporary staging, testing etc. all complete to the entire satisfaction of the Engineer-in-Charge.

ANNEXURE-'A'
(Clause 12.4)

Maximum Permissible Erection Tolerances

A.	**Columns**	
1.	Deviation of column axes at foundation top level with respect to true axes.	
	i) In longitudinal direction	± 5 mm
	ii) In lateral direction	± 5 mm
2.	Deviation in the level of bearing surface of columns at foundation top with respect to true level	± 5 mm
3.	Out of plumb (Verticality) of column axis from true vertical axis, as measured at top:	
	i) Upto and including 30m height whichever is less.	± H/1000 or ± 25 mm
	ii) Over 30m height	± H/1200 or ± 35 mm whichever is less.
4.	Deviation in straightness in longitudinal & transverse planes of column at any point along the height.	± H/1000 or ± 10 mm whichever is less.
5.	Difference in the erected positions of adjacent pairs of columns along length or across width of building prior to connecting trusses/beams with respect to true distance.	± 5 mm
6.	Deviation in any bearing or seating level with respect to true level.	± 5 mm
7.	Deviation in difference in bearing levels of a member on adjacent pair of columns both across & along the building.	± 5 mm

Note: 1. Tolerance specified under 3 should be read in conjunction with 4 & 5.
Note: 2. 'H' is the column height in mm.

B.	**Trusses**	
1.	Shift at the centre of span of top chord member with respect to the vertical plane passing through the centre of bottom chord.	± 1/250 of height of truss in mm at centre of span or ± 15mm whichever is less.
2.	Lateral shift of top chord of truss at the centre of span from the vertical plane passing through the centre of supports of the truss.	± 1/1500 of span of truss in mm or ± 10mm Whichever is less.
3.	Lateral shift in location of truss from its true position.	± 10mm

4.	Lateral shift in location of purlin from true position.	± 5mm
5.	Deviation in difference of bearing levels of truss from the true level.	± 1/1200 of span of truss in mm or 20mm whichever is less.

C. Gantry Girders & Rails

1.	Shift in the centre line of crane rail with respect to centre line of web of gantry girder.	$\pm \left[\frac{\{\text{web thickness (mm)}\}}{2} + 2 \text{ mm}\right]$
2.	Shift of alignment of crane rail (in plan) with respect to true axis of crane rail at any point.	± 5 mm
3.	Deviation in crane track gauge with respect to true gauge.	
	i) For track gauge upto and including 15 m.	± 5 mm.
	ii) For track gauge more than 15m. Subject to maximum ± 10mm, where S in metres is true gauge.	± [5 + 0.25 (S-15)]
4.	Deviation in the crane rail level at any point from true level.	± 10 mm.
5.	Difference in level between crane track rails (across the bay) at	
	i) Supports of gantry girders	15 mm.
	ii) Mid span of gantry girders	20 mm.
6.	Relative shift of crane rail surfaces (at a joining) in plan and elevation.	2 mm.

ANNEXURE-'B'
(Clause 18.1)

PAINTING COLOUR CODE FOR STRUCTURAL STEEL

1.	GANTRY GIRDER & MONORAIL	DARK GREEN
2.	GANTRY GIRDER & MONORAIL STOPPER SIGNAL	RED
3.	BUILDING STRUCTURAL STEEL COLUMNS, BRACKETS, BEAMS, BRACINGS, ROOF TRUSS, PURLINS, SIDEGIRTS, LOUVERS, STRINGERS	DARK ADMIRALITY GREY
4.	PIPE RACK STRUCTURE & TRESTLE	DARK ADMIRALITY GREY
5.	CHEQUERED PLATE (BOTH FACES)	BLACK
6.	GRATING	BLACK
7.	LADDER RUNGS	BLACK VERTICALS & CAGE RED
8.	HAND RAILING	
	- HANDRAIL, MIDDLE RAIL, TOE PLATE	SIGNAL RED
	- VERTICAL POST	BLACK

मानक विनिर्देशन
सिविल एवं संरचनात्मक कार्य

STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS

गिराने एवं तोडने सम्बंधी कार्य
DEMOLITION AND DISMANTLING

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor		Standards Bureau Chairman
					Approved by		
5	13 05 19	REAFFIRMED & REISSUED	TK	AS	RS		RKT
4	18 11 13	REVISED & ISSUED AS STANDARD SPECIFICATION	AJS	RS	PKM	SC	SC
3	10 06 08	REAFFIRMED & REISSUED	PKB	PKM	VK		VC
2	25 04 01	REVISED & ISSUED AS STANDARD SPECIFICATION	SKP	RS	SCJ		MI
1	16 03 98	REVISED & ISSUED AS STANDARD SPECIFICATION	SARITA	SKP	SCJ		AS
0	AUG'89	ISSUED AS STANDARD SPECIFICATION		AKV	GPL		RCPC

Abbreviations:

C&D	:	Construction & Demolition
GI	:	Galvanized Iron
RA	:	Recycled Aggregates
RCC	:	Reinforced Cement Concrete

Structural Standards Committee

Convenor : Mr. Rajanji Srivastava

Members : Mr. Anurag Sinha
Mr. VK Panwar
Mr. Samir Das
Mr, Amitabh Kishore
Mr. Gyasuddin
Mr. Ravindra Kumar (Const.)
Mr. Charanjit Singh (Proj.)

CONTENTS

1.0 SCOPE

This specification covers the procedure and safety requirements for demolition and dismantling of masonry (Brick & Stone), concrete (Plain /Reinforced), structural steel (sheeted/ unsheeted) works.

2.0 GENERAL

2.1 Apart from this specification, the demolition and dismantling of structures (part or whole) shall be in compliance with all statutory safety regulations and any other special requirement as shown/ noted on the drawings and General Conditions of Contract. Prior consent and approval of the Engineer-in-Charge shall be obtained in writing before starting any dismantling works. Any restrictions imposed regarding working hours shall also be strictly followed by the Contractor.

2.2 All materials obtained from dismantling/demolition operations shall be the property of the Owner unless otherwise specified and shall be segregated as serviceable or unserviceable materials and kept in safe custody until handed over to the Engineer-in-Charge.

2.3 Contractor shall follow the principle of selective demolition by sequencing the demolition activities in such a way that the non-structural materials like window/ door frames, pipes, tiles, bricks, asphalt, ceramics, etc. shall be removed first before starting the main demolition activities.

2.4 Where it becomes necessary to disconnect any existing service line(s) (such as electrical, piping etc.) during dismantling/demolishing operation and where so required by the Engineer-in-Charge, suitable alternate arrangement shall be made by the Contractor to maintain the continuity and proper functioning of the affected service line(s) with the approval of the Engineer-in-Charge at no extra cost to the Owner.

2.5 Specification No. 6-68-0003 (Earthwork) shall be referred to the extent applicable.

3.0 SAFETY PRECAUTIONS

3.1 The Contractor shall adhere to safe demolishing/ dismantling practice at all stages of work to guard against accidents, hazardous and unsafe working procedures.

3.2 Necessary propping, shoring, strutting and/or underpinning shall be done for the safety of all surrounding structures (whose safety is likely to be endangered) before taking up the demolishing and dismantling works.

3.3 Temporary enclosures/ barricading made out of GI sheets, fencings, danger lights, warning tapes, etc. shall be provided by the Contractor and got approved by the Engineer-in-Charge before start of work to prevent accidents.

3.4 Contractor must ensure the availability of adequate fire fighting equipments/ arrangements before starting actual demolishing/ dismantling works. These facilities shall be made available throughout the entire operation of demolition and dismantling of structures.

3.5 All equipments, pipes, fittings and instruments, underground utilities etc. located in the vicinity shall be protected by suitable means, as decided by the Engineer-in-Charge, during demolishing/ dismantling operations.

3.6 Roads and working spaces shall be kept free of any debris/dismantled materials at the end of day's work.

3.7 Necessary measures shall be taken to keep the dust and noise nuisance to minimum levels.

3.8 Dismantled elements/components shall not be dropped from a height or thrown from a distance. Dismantling of elements fixed by screws/bolts/hooks etc. shall be done by taking out the fixtures with proper tools only. Such fixtures may be allowed to be cut by sawing or flame cutting, in the event of their being stuck up due to corrosion etc. However, the decision of Engineer-in-Charge in this regard shall be final and binding. Welds shall be removed by flame cutting. Tearing or ripping of elements shall not be resorted to under any condition.

3.9 Dismantling of equipments/ instruments and such other fixtures shall be done with utmost care with proper tools & tackles and shall be stacked separately. Their disposal or retainment shall be as per the directions of Engineer-in-Charge.

4.0 PROCEDURE

4.1 Entire work of demolishing & dismantling shall be meticulously planned. Prior to start of work, the Contractor shall thoroughly understand the scope and nature of the work, and then prepare and submit the proposed work execution plan of demolishing & dismantling to the Engineer-in-Charge for his review. Comments if any, shall be taken care by the contractor and execution of the work shall be done based on the revised execution plan.

4.2 Demolition and dismantling shall be restricted to the extent shown on drawings or as directed by the Engineer-in-Charge.

4.3 Necessary work permits (as applicable) shall be obtained prior to start of demolishing/ dismantling activities.

4.4 Demolition of any structure shall be carried out in the sequence reverse to that followed at the time of its construction.

4.5 Dismantling shall be done in a systematic manner. All elements including equipments/ instruments shall be carefully removed without causing any damage.

4.6 Blasting in any form shall not be permitted. However, techniques like pneumatic/ hydraulic breakers, diamond cutting, etc. shall be utilized to the maximum possible extent.

4.7 Chipping of concrete/grout shall be done with precision by chiseling. The finished surfaces shall be made true to the requisite size and shape.

4.8 Pockets/holes of specified size shall be made/ cut by drilling/ chiseling/ core cutting/ diamond cutting, etc.

4.9 Cut-outs in RCC Slab/ wall shall be made by vibration-less spark-free mechanical means like core-cutting, wet cutting by diamond wall saw system, etc.

5.0 CLEANING & STACKING

All demolished/dismantled serviceable materials such as bricks, stones, reinforcement bars, structural steel, sheeting etc. shall be separated out, cleaned and stacked in separate lots within the plant boundary as directed by the Engineer-in-Charge.

6.0 DISPOSAL

All unserviceable materials shall be disposed off in spoil heaps within or outside the plant boundary as per the directions of the Engineer-in-Charge. Areas required outside the plant

boundary for dumping of disposed material shall be arranged by the contractor and got approved by the Engineer-in-Charge.

7.0 C&D WASTE MANAGEMENT

Contractor shall make all possible efforts to reduce, reuse and recycle Construction & Demolition (C&D) waste. A comprehensive Waste Management Plan shall be submitted to the Engineer-in-Charge for review. As a social responsibility, contractor shall promote and spread awareness about recycling of C&D waste that can act as a perfect substitute for depleting natural aggregate resources, shortage of dumping sites, increasing transportation & disposal cost, stringent regulations for extracting new materials and environmental pollution as a whole. Recycling equipments like jaw/ cone crushers, shaft impactors, magnetic separators, vibrating screens, washing equipments, etc. are now easily available in the market. Recycled Aggregates (RA) both coarse & fine can be used in PCC, pavements, drains, plastering, making bricks, kerb stones, pavement blocks and for soil stabilization. Residual concrete can be recycled in Ready Mixed Concrete Plants by installing Recycling Drum and rebars extracted from C&D waste can be used in drains, pavements, chairs, spacers, stirrups, etc.

8.0 PAYMENT

8.1 General

Measurement of all works shall be taken prior to start of demolishing/ chipping/ dismantling works.

8.2 Masonry/Concrete Works (Demolition)

8.2.1 Payment shall be made on the basis of actual volume in cubic metres (cu.m.) of masonry/ concrete works demolished. The thickness of plaster/ bitumen felt shall be included in measurements.

8.2.2 The rate for demolishing shall include supply of all labour, tools & tackles, necessary safety measures, propping, underpinning, scaffolding, handling, cutting, straightening, scraping & cleaning of reinforcement bars and other embedments (in case of reinforced concrete works), sorting out and stacking of all serviceable materials, disposal of all unserviceable material, clearing the site, etc. all complete as specified and directed by the Engineer-in-Charge.

8.3 Excavation & Backfilling

8.3.1 Excavation and backfilling shall be paid separately as per relevant clauses of Specification No. 6-68-0003 for Earth Work.

8.4 Chipping of Concrete Works

8.4.1 Payment shall be made on the basis of admissible area in square metres (sq.m.) of concrete surfaces chipped, pertaining to the different categories of thicknesses specified in the schedule of items.

8.4.2 The rate for chipping shall include supply of all labour, tools and tackles, necessary safety measures, scaffolding, chiseling, handling, exposing, cutting, straightening, scraping, clearing the reinforcement bars (in case of reinforced concrete works), wire brushing and washing the exposed surfaces, disposal of all unserviceable material etc. all complete as directed.

8.5 Making Pockets/Holes in Concrete Works and Cut-outs in RCC Slab/ Wall

8.5.1 Payment for Pockets/ holes shall be made on the basis of number (Each) of pockets/ holes of sizes upto & inclusive of 200x200x500mm deep, made or cut in the concrete works at all depths & heights.

8.5.2 Payment for cut-outs in RCC slab/ wall shall be made in CuM on the basis of plan/ elevation area for a thickness upto & inclusive of 400mm at all depths & heights.

8.5.3 The rate for making pockets/holes and cut-outs shall include supply of all labour, tools & tackles, necessary safety measures, scaffolding, chiseling, drilling, core/ diamond cutting, diamond wall saw system, handling, cutting or relocating reinforcement bars, cleaning, disposal of all unserviceable material etc. all complete as directed.

8.6 Dismantling of Structural Steel Works

8.6.1 Payment shall be made on the basis of weight (MT) of the structure/components being dismantled. Assessment of weight shall be done as per the specifications or as per the direction of Engineer-in-Charge.

8.6.2 The rate for dismantling shall include supply of all labour, tools and tackles, equipment, consumables, necessary safety measures, scaffolding, propping, handling, unbolting, cutting (by sawing or flame cutting) of gussets/ plates/ bolts/ hooks/ welds, cleaning, sorting out and stacking of all serviceable materials, disposal of all unserviceable material, etc. all complete as specified and directed.

8.7 Dismantling of Roof & Wall Sheeting

8.7.1 Payment shall be made on the basis of dismantled sheeted area in square metres (sq.m.) of plan area in case of roof sheeting and area in elevation in case of side and louver sheeting.

8.7.2 The rate for dismantling shall include supply of all labour, tools and tackles, equipments, consumables, necessary safety measures, handling, scaffolding, unbolting, cutting (by saw or flame cutting) of hook bolts, removal of ridges, gutters, flashings, transporting, stacking of all serviceable materials, disposal of all unserviceable material, etc. all complete as directed.

मानक विनिर्देश
सिविल एवं संरचनात्मक कार्य
विविध मदें

STANDARD SPECIFICATIONS
CIVIL AND STRUCTURAL WORKS
MISCELLANEOUS ITEMS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
5	14.02.22	REVISED & REISSUED	TARUN KAPOOR	AMARJEET SINGH	AMURAG SINHA	S MAZUMDAR
4	22.03.16	REVISED & REISSUED	MODITA	ALPANA	R. SRIVASTAVA	S.CHANDA
3	29.06.10	REISSUED	AS	PKM	SCH	N DUARI
2	26.04.01	UPDATED & REISSUED	SBJ	R SOOD	SC JAIN	MI
1	AUG 94	UPDATED & REISSUED	SBJ	R SOOD	GPL	A SONI
0	AUG 89	ISSUED AS STANDARD SPECIFICATION	-	AKV	GPL2	RCPC

Abbreviations:

BIS	:	Bureau of Indian Standards
DPC	:	Damp Proof Course
FGL	:	Finished Ground Level
IS	:	Indian Standard
RCC	:	Reinforced Cement Concrete

Structural Standards Committee

Convenor: Mr. Anurag Sinha

Members:
Mr. V. Goel
Mr. S. C. Maity
Mr. Deepak Agrawal
Ms. Alpana Srivastava
Dr. Sudip Paul
Mr. Prasenjit Saha (SMMS)*
Mr. Charanjeet Singh (Projects)
Mr. Ravindra Kumar (Construction)

*For Fireproofing Specifications

CONTENTS

1.0 SCOPE

The scope shall be as specified separately for different items below.

2.0 REFERENCES

2.1 BIS Codes

IS:73 : Paving bitumen - specification

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

IS:6313 : Code of practice for Anti-termite measures in buildings

2.2 EIL specifications

6-68-0002: Materials
6-68-0004: Plain and Reinforced Cement Concrete

3.0 MATERIALS

The materials shall be as specified separately for different items below.

4.0 GENERAL REQUIREMENTS

The Contractor shall test the materials, wherever applicable, in approved laboratory as required by the Engineer-in-Charge and furnish test certificates for materials and obtain the approval of the Engineer-in-Charge prior to the use of such materials in the works. All tests shall be in accordance with relevant Indian Standards.

5.0 PRE-CONSTRUCTIONAL ANTI-TERMITE TREATMENT

5.1 Scope

This specification establishes the materials and method of accomplishing pre-constructional anti-termite treatment of soil for protection of buildings against attack by subterranean termites with the usage of chemical emulsions in accordance with the procedure laid down.

5.2 Materials

Refer EIL Specification No. 6-68-0002.

5.3 Procedure for Treatment

5.3.1 The treatment shall be carried out by an approved agency specialized in the field. Apart from this specification, the work shall be carried out in compliance with IS:6313. In case of any contradiction, this specification shall govern.

5.3.2 **Site Preparation**

Prior to start of Anti Termite treatment, area(s) shall be made free from logs, stumps, timber offcuts, leveling pegs, roots of plants/ trees etc. Soil treatment shall start when foundation trenches/ pits are ready to take concrete/ masonry in foundations and plinth area ready for laying the subgrade. Treatment shall not be carried out when it is raining or the subsoil water level is at the same or higher than the level of treatment. In the event of water-logging

of foundations, the water shall be pumped out and the chemical emulsion applied when the soil is absorbent.

5.3.3 **Treatment of the excavated pits/ trenches and backfill for Foundations**

a) The bottom surface and the lower 300 mm side surfaces of the excavated pits/ trenches for foundations of masonry works and RCC plinth beams supporting such masonry works, shall be treated with specified chemical emulsion @ 5 litres/m^2 of the surface area. However, no such treatment shall be required in case of pits/ trenches made for RCC foundations supporting RCC walls and/ or columns.

b) On completion of construction of masonry foundations, the backfill in immediate contact with the substructure shall be treated in layers, of 300 mm, with emulsion @ 7.5 litres/m^2 of the vertical surface of the substructure (i.e. 7.5 x 0.3 = 2.25 litres/meter of perimeter) for each side. The treatment shall be given after ramming of each layer of soil, by rodding the earth at 150 mm centres close to the wall surface and working the rod backward and forward (parallel to the wall surface) and then spraying the specified dosage of emulsion. The emulsion shall be directed towards the masonry surfaces so that the soil in contact with these surfaces is well treated with the chemical. After the treatment, the soil shall be tamped back into place. This shall be done for full depth of the fill.

c) For RCC walls and columns, the treatment as specified in (b) shall start from a depth 500 mm below the finished ground level, and shall be done upto the FGL.

5.3.4 **Treatment of Plinth/ Basement and Apron**

a) The top surface of the consolidated earth below the non-suspended floor slabs and the peripheral aprons of widths upto 750 mm, the bottom surface and side surfaces of the excavated pits for the basements shall be treated with chemical emulsion @ 5 litres/m^2 of the surface area. Holes 50 mm to 75 mm deep at 150 mm centre, both ways, shall be made on the surface with 12 mm diameter mild steel rod and then emulsion shall be sprayed uniformly over the area. At expansion joint locations, anti-termite treatment shall be supplemented by treating through the expansion joint @ 2.0 litres per linear metre of joint after the sub-grade has been laid.

b) Treatment of Junctions of plinth filling and wall/column faces shall be done after making a small channel 30 mm x 30 mm, by making rod holes 150 mm apart (upto the ground level) in the channel and then by moving the rod backward and forward to break up the earth. The chemical emulsion shall be poured along the channel @ 7.5 litres/m^2 of the vertical wall/column surface so as to soak the soil right to the bottom. The soil shall be tamped back into place after the treatment.

5.3.5 **Treatment of Soil along External Perimeter of Building**

After the building is complete, the earth along the external perimeter shall be rodded at intervals of 150 mm and to depth of 300 mm. The rod shall be moved backward and forward parallel to the wall to break up the earth and chemical emulsion poured along the wall @ 7.5 litres/m^2 of vertical surface (i.e. 7.5 x 0.3 = 2.25 litres/metre of perimeter). After the treatment, the earth shall be tamped back into place.

5.4 Guarantee

A Guarantee of minimum 5 years shall be provided by the contractor against the performance of the Anti-termite treatment.

5.5 Payment

This clause shall apply to Item Rate tender only.

Payment for pre-constructional anti-termite treatment shall be made on square metre (sq.m.) basis of plinth area of the building at ground floor only.

The rate shall include supplying all materials, spray pumps, tools, tackles & other accessories, labour, site preparation, rodding, tamping, mixing, spraying the specified chemical emulsion at prescribed dosage, storage facilities, handling, transporting etc. all complete as directed & specified.

6.0 ANTI-CORROSIVE LAYER

6.1 Scope

This specification covers the requirement of materials, method of preparation and procedure for laying an anticorrosive layer over top surface of tank foundations for protection of bottom plates of steel tanks against corrosion attack.

6.2 Materials

6.2.1 Sand shall be clean, dry, coarse, hard, angular, free from coatings of clay, dust and mix of vegetable and organic matter and shall conform to IS:383 - Grade III.

6.2.2 Bitumen shall be of grade VG10 conforming to IS:73.

6.3 Mixing and Laying

The bitumen shall be heated till it melts. 3% kerosene may be added if required. Sand shall be thoroughly mixed with bitumen (8% to 10% by volume) in a mixing drum to give a uniform mixture and shall be laid over clean and dry surface of tank foundation to line, grade and levels as shown on the drawings and directed by the Engineer-in-Charge. Bitumen shall not be heated beyond the specified temperature limits. The layer shall be tamped to form hard mass of specified compacted thickness.

6.4 Payment

This clause shall apply to Item Rate tender only.

The payment shall be made on square metre (sq.m.) basis of the area covered with the anticorrosive layer.

The rate shall include supplying all materials, tools, plants, labour, transportation, handling, heating, mixing, laying, tamping etc. all complete as specified.

7.0 DRESSING & TRIMMING

7.1 Scope

This specification covers the procedure for dressing, trimming and paving with earth the peripheral area around the completed building/ structure.

7.2 Procedure

The ground all around the completed building/structure for 3 metres width or as specified by the Engineer-in-Charge, shall be cleaned and dressed to suitable slope. Over the prepared ground a layer of approved earth shall be spread, watered and well consolidated so as to achieve an average thickness of 75 mm.

7.3 Payment

This clause shall apply to Item Rate tender only.

Payment shall be made on square metre (sq.m.) basis of the actual area dressed and paved with earth.

The rate shall include supplying all materials, labour including cleaning, dressing the ground to required slope, spreading of earth, watering, ramming, consolidating etc. all complete as directed.

8.0 BREAKING PILE HEADS

8.1 Scope

This specification covers procedure for breaking pile heads of RCC piles.

8.2 Procedure

8.2.1 Head of already cast/ driven RCC piles shall be broken after 28 days of casting up to a length and elevation as shown on the drawing by chiseling or by approved mechanical means taking all necessary safety precautions. Care shall be taken that pile reinforcement is not cut or damaged during chiseling operation. All debris and loose or cracked concrete in the pile shall be removed and disposed off within the plant boundary as per the directions of the Engineer-in-Charge and site shall be left clean for casting of pile caps. The surface of reinforcement bars shall be cleaned, if required by wire brushing, so that no old concrete sticks to them.

8.3 Payment

This clause shall apply to Item Rate tender only.

Payment shall be made per pile basis for the actual number of pile heads broken.

The rate shall include supplying all tools and tackles, labour including disposal of debris, bending the pile reinforcements for proper anchorage within the pile cap etc. all complete as directed.

9.0 BUILDING-UP PILE HEADS

9.1 Scope

This specification covers requirements of materials and procedure for building-up of RCC Pile Heads.

9.2 Materials

9.2.1 Concrete shall be of the same grade & EIL specification shall be same as that for the pile.

9.2.2 Reinforcement shall be of the same grade as that for the pile.

9.2.3 Type of cement shall be same as that used for the pile.

9.3 Procedure

Concrete in existing piles shall be chiseled off minimum upto the lap-length of the reinforcements in the pile. In cases where reinforcements are longer than the concreted piles, the top concrete of the existing piles shall be chiseled or by approved mechanical means upto a length of 800 mm.

Concrete surface and reinforcement of pile shall be cleaned of any dirt, grease, debris etc. and concrete surface shall be made rough by hacking. Reinforcement shall be lapped/ welded as per the direction of the Engineer-in-Charge. Neat cement slurry shall be applied on top surface of concrete and using approved formwork, concreting shall be done upto the level shown on the drawing and as directed by the Engineer-in-Charge.

9.4 Payment

This clause shall apply to Item Rate tender only.

Payment shall be made on cubic metre basis for the total quantity of concrete actually poured for achieving the level as shown on drawings.

The rate shall include supply of all materials (except reinforcement which shall be paid separately as per respective item) labour, cleaning, welding, shuttering, vibrating, finishing, curing etc. all complete. Cutting of pile heads and excavation including backfilling shall be paid separately as per respective item.

10.0 HARD CORE

10.1 Scope

This specification covers the requirements of materials and procedure for laying of hard core.

10.2 Materials

Hard core shall consist of broken/ crushed stones of 150 mm and down size. Stones shall be sound, angular, hard and free from flakes, dust and other impurities.

10.3 Procedure

Hard core shall be laid to the grade, level and thickness as shown on the drawing. Broken stones of required height shall be vertically placed and blinded with approved murrum/ sand and consolidated with roller including watering, dressing etc. However, areas inaccessible by roller may be compacted by hand rammer.

10.4 Payment

This clause shall apply to Item Rate tender only.

The hard core shall be measured on the basis of volume in cubic metres (cu.m.) of the compacted hard core laid. The rate shall include all labour, materials, consolidation by rammer/ roller, watering, dressing etc. all complete.

11.0 SAND FILLING IN PLINTH/FOUNDATIONS

11.1 For specification of sand to be used for filling, reference shall be made to EIL Specification No. 6-68-0002.

11.2 Filling shall be carried out in layers not exceeding 150 mm and shall be compacted mechanically or by saturation to specified grade and level and to obtain 90% laboratory maximum dry density or as specified in schedule of rates.

11.3 Compaction by flooding may be accepted at the discretion of the Engineer-in-Charge, provided the required compaction is achieved.

11.4 The Contractor shall not commence filling in and around any work until it has been permitted by the Engineer-in-Charge.

11.5 Payment

This clause shall apply to Item Rate tender only.

Payment shall be made on cubic metre (cu.m.) basis of the finished compact volume. The rate shall include cost of sand for any compacted thickness, wastage if any, all handling, transport for all leads, tamping, watering, flooding, dressing etc. Any brick work required for ponding shall be paid separately under relevant item.

12.0 DAMP PROOF COURSE - (DPC)

12.1 All materials used for Damp Proof Course shall comply with EIL Specification No. 6-68-0002.

12.2 The 40 mm thick Damp Proof Course shall consist of plain cement concrete of minimum grade M20 (Nominal mix) with 10mm down aggregates.

12.3 Integral water proofing compound of approved make, conforming to IS:2645, shall be mixed with concrete as per manufacturer's specification.

12.4 The Damp Proof Course shall be laid at plinth level of masonry walls, flush with the floor surface and shall not be carried across doorways.

12.5 Before laying, the top surface of wall shall be thoroughly cleaned and watered. The DPC layer of 40mm thick shall be laid, retaining the edges vertical by necessary formwork and shall be well tamped and troweled to smooth finish. The layer shall be cured by keeping the surface wet for 40 hours and after it has dried, two coats of hot bitumen of grade VG10 conforming to IS:73 shall be applied over it at the rate of 1.7 kg/sqm for each coat. Over the layer of hot bitumen, dry sharp sand shall be sprinkled evenly before hardening of top coat of bitumen paint.

12.6 Payment

This clause shall apply to Item Rate tender only.

Payment shall be made on square metre (sq.m.) basis of the area laid with plain cement concrete. The rate shall be inclusive of formwork, providing and mixing Integral water proofing compound, curing, providing and laying bitumen, supplying and spreading sand over bitumen etc. all complete.

मानक विनिर्देशन
सिविल एवं संरचनात्मक कार्य

बाईपोलर कंक्रीट अंतर्वेशित क्षारण अंतर्अधिमिश्रण

STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS

BIPOLAR CONCRETE PENETRATING CORROSION INHIBITING ADMIXTURE

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
1	18 06 2019	UPDATED AND REISSUED	TK	AJS	RS	RKT
0	26 04 2012	ISSUED AS STANDARD SPECIFICATION	AJS	PKM	SC	DM

ABBREVIATIONS:

AASHTO	:	American Association of State Highway and Transportation Officials
ASTM	:	American Society for Testing & Materials
CPCIA	:	Concrete Penetrating Corrosion Inhibiting Admixture
IS	:	Indian Standard
JIS	:	Japanese Industrial Standard
OPC	:	Ordinary Portland Cement
PPC	:	Portland Pozzolana Cement
PSC	:	Portland Slag Cement
SRC	:	Sulphate Resistant Cement

STRUCTURAL STANDARDS COMMITTEE

Convenor : Mr. Rajanji Srivastava

Members : Mr. Anurag Sinha
Mr. V.K. Panwar
Mr. Samir Das
Mr. Amitabh Kishore
Mr. Gyasuddin
Mr. Charanjit Singh (Projects)
Mr. Ravindra Kumar (Construction)

CONTENTS

1.0 SCOPE

This specification prescribes the requirements and test methods including performance test for evaluating the efficiency of Bipolar Concrete Penetrating Corrosion Inhibiting Admixture (CPCIA) for protecting steel reinforcement embedded in concrete from corrosion. Non-concrete penetrating, Nitrite & Nitrate corrosion inhibitors are excluded from the scope.

2.0 REFERENCES

2.1 Codes

ASTM-G1, ASTM-G3, ASTM-G109, ASTM-C1202, JIS-Z-1535, AASHTO T259, IS:2, IS:101(Part1/Sec.5), IS:456, IS:1202, IS:1448, IS:1786, IS:9103, etc.

2.2 EIL Specifications

6-68-0001 : General Scope
6-68-0002 : Materials

3.0 SAMPLING

3.1 The representative samples of the material shall be drawn as per the table given below:

No. of containers (Lot)	No. of containers to be selected for sampling (N)
Up to 50	1
51-100	2
101-300	3
301-500	4
501& Above	5 Plus 1 for every lot of 300 containers

4.0 TESTING REQUIREMENTS

4.1 The product shall comply with the requirements specified in Annexure-A (Short Term Tests) and Annexure-B (Long Term Tests). Both the tests shall be conducted in an approved laboratory.

4.2 Unless specified otherwise, all the tests under Indian tropical conditions shall be conducted at room temperature 27 ± 2°C and relative humidity at 65 ± 5 % in a well ventilated chamber free from dust.

4.3 The contractor shall select the product from EIL approved vendor list and submit the Manufacturer Test Certificate to the Engineer-in-Charge. Approval for usage of product shall be given after satisfactory Short Term test results. Long Term tests are not mandatory for the products listed in EIL approved vendor list.

If the product is not from an EIL approved vendor, both Short term as well as Long term tests are mandatory. The contractor shall submit the Manufacturer Test Certificate to the Engineer-in-Charge and approval for usage of product shall be given after satisfactory Short Term test results. However, payment shall be released after the product complies with the requirements of Long Term test results.

5.0 HEALTH, SAFETY & ENVIRONMENT CONSIDERATIONS

5.1 The CPCIA shall not cause harm to applicators by mean of inhalation or skin contact. All precautionary measures shall be prescribed by the manufacturers along with instructions of usage. Application methodology shall be approved by the Engineer-in-Charge.

5.2 The waste shall be discharged in accordance with applicable Environmental laws of land.

5.3 CPCIA shall not degrade or damage the construction materials like concrete, aggregates, steel reinforcement, formwork/shuttering.

6.0 PACKAGING

The product shall be supplied in air tight containers and following information shall be labeled on each container:

a) Name of the material
b) Name of the manufacturer
c) Volume/ weight of material
d) Specification number
e) Batch No. or Lot No. in bar code or otherwise
f) Month and year of manufacture
g) Ingredients & method of usage
h) Instructions for safe usage

ANNEXURE-A

SHORT TERM TESTS

S. No.	Characteristics	Requirements	Methods of Tests
1.	Appearance	Brownish Liquid free from any visible residual deposits	Visually
2.	Odour	Mild Ammonical Odour	By smell
3.	Skin irritation	No irritation	By applying on reverse of the palm for 5 minutes.
4.	Ph i) As in supplied condition ii) 1% dilution ,w/w	 i) 9.0-11.0 ii) 9.0-11.0	 pH meter / Standard pH paper
5.	Specific Gravity at 27 ± 2°C	1.04 - 1.06	IS 1448
6.	Viscosity of the material as in supplied condition, by Ford cup No 4, at 27 ± 2°C	10 - 20 sec.	IS: 101(Pt.1/Sec.5)
7.	Accelerated Corrosion Test, for 21 hrs. i) Raw water without CPCIA ii) Raw water with CPCIA	 i) Excessive corrosion spots. ii) There shall not be more than 1-2 corrosion spots.	Modified accelerated corrosion test based on Japanese standard JIS Z 1535 (Refer Appendix-I)

ANNEXURE-B

LONG TERM TESTS
(Shall be performed in triplicate)

S. No.	Characteristics	Requirements		Methods of Tests
		Without CPCIA	With 1% CPCIA	
1.	Immersion test for 720 hrs. (Rebar weight loss method)	40.00 mpy, max.	2.00 mpy, max.	Immersion Test (Rebar weight loss test) as per ASTM G1 (Refer Appendix-II)
2.	Effect of Concrete admixture on compressive strength	Concrete strength in sample with CPCIA* should be ≥concrete strength in sample without CPCIA*		Test for effect on compressive strength by addition of CPCIA as per IS 9103 (Refer Appendix-III)
3.	Polarization test by Tafel polarization with 3.5% Sodium Chloride, for 20 days: Rate of corrosion shall be	45 mpy, max.	9 mpy, max.	Electrochemical polarization test conducted on steel rebars embedded in concrete as per ASTM-G 3 & IS 9103 (Refer Appendix-IV)
4.	Effect of CPCIA* on corrosion of embedded steel rebars exposed to chloride environments after 09 cycles (14 days wetting and 14 days drying): Rate of corrosion shall be	25 Coulombs, max.	0.50 Coulombs, max.	Long term corrosion test as per ASTM G109 (Refer Appendix-V)
5.	Chloride Migration profile properties of concrete (for all types of cements viz. OPC, PPC, PSC, SRC)			AASHTO T-259 (Refer Appendix-VI)
	i) Chloride % in concrete at 30mm depth after 90 days.	0.025%, max.	Nil	Chloride ion penetration (Salt ponding test) as per IS:456
	ii) Ability to resist chloride ion penetration			
	a) Concrete grade M-30, Water cement ratio: 0.45	1650 Coulombs, max.	1000 Coulombs, max.	Electrical indication of concrete ability to resist Chloride Ion Penetration (Rapid Chloride Permeability test) as per ASTM C1202
	b) Concrete grade M-40, Water cement ratio: 0.40	1550 Coulombs, max.	1000 Coulombs, max.	

Notes:

a) CPCIA* : The CPCIA shall be used as 1% w/w of cement or as recommended by the manufacturer for conducting the tests mentioned in Annexure-B except Immersion test for 720 hrs. mentioned at S.No.1 where it shall be used as 1% w/w of water or as recommended by the manufacturer.

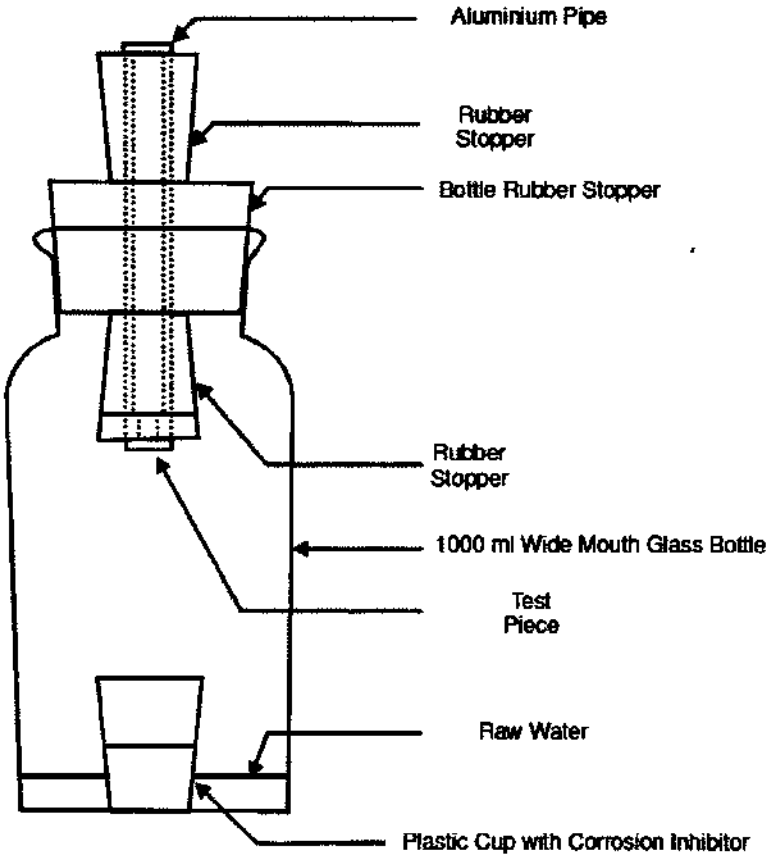
b) Rebars conforming to IS: 1786 shall be used for testing purposes

APPENDIX-I

MODIFIED ACCELERATED CORROSION TEST (BASED ON JAPANESE STANDARD JIS Z 1535)

TEST PROCEDURE

Attach steel test pieces conforming to IS: 1786 (of size approx. 15mm dia and 12mm thickness drilled from one side c/c to a dia of 10mm and a depth of 10 mm to hold the Aluminium pipe) after thorough cleaning to white metal by using 1000 grade grit paper and subsequently polishing with 3/0 grade and finally with 4/0 grade grit paper to the Aluminium pipe with the help of cello tape so that it is firmly attached. The Aluminium pipe is then slid upwards till the test piece rests in the slot provided in the rubber cork, as shown in the figure.



Assembly with Corrosion Inhibitor

Pour 100 ml of tap water in both the bottles. Fill the plastic cup with 25 ml CPCIA solution as in supplied condition. In one of the bottles place the plastic cup with the CPCIA solution so that the cup is placed in the tap water. Allow to remain for 18 hours at ambient temperature. After 18 hrs. add chilled water having temperature below 1.0 °C into the Aluminium pipes and allow to remain for 3 hrs. The temperature of the chilled water in the Aluminium pipes shall be maintained at 2.0 ± 0.5 °C by frequently changing the chilled water with the help of the pipette. Observe the steel test pieces after the experiments i.e. 18+3=21 hrs., for any corrosion spots.

APPENDIX-II

IMMERSION TEST (REBAR WEIGHT LOSS TEST) (AS PER ASTM G 1)

TEST PROCEDURE

Take six pieces of Tor steel rebar conforming to IS: 1786 of size approx. 40 mm length and 10 mm dia. Clean the rebar of any rust, mill scale etc., with the help of steel wire brush, till it has overall a shining surface. Now clean all the six pieces with solvent such as Benzene/Acetone to remove any loose rust /dust from the surface. Dry at 100 ± 2 °C for 15 minutes in an oven. Cool and take the weights of all the six pieces and record it.

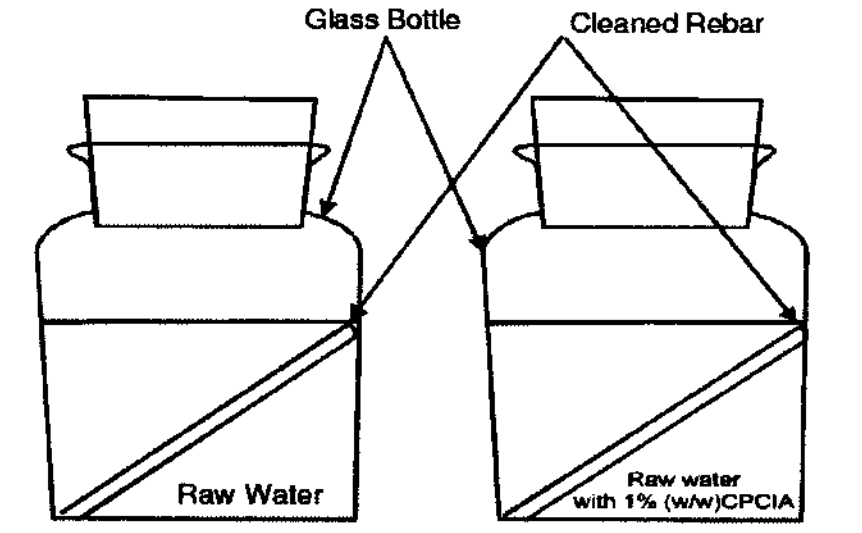
Take six transparent glass/plastic bottles of approx. 150±10 ml with air tight caps. Clean all the bottles with tap water and then fill them with 100 ml of tap water so that the bottles are approx. three fourth filled. In three of the six bottles, add CPCIA 1%, w/w or as recommended by the manufacturer of the water in the bottle. Now put one cleaned and weighed rebar test piece completely immersed in water/water + CPCIA, in all the six bottles and close the cap.

After 30 days (720 hrs.), take out all the six test pieces and put them in Clark solution (prepared by dissolving 20 gms. of Antimony Trioxide and 50 gms of Stannous Chloride in 1000 ml of Conc. Hydrochloric acid, S.G. 1.18) so that corrosion products are dissolved. After complete removal of corrosion products (in 5 minutes approximate), take out the test pieces and wash in running water and finally with distilled water. Then wash the test pieces, with solvent such as Benzene/Acetone. Dry at 100 ± 2 °C for 30 minutes in an oven. Cool and take the weights of all the six pieces and record it.

Calculate the corrosion rate in mpy, by using the formula

Corrosion rate (mpy) = 534 (W1-W2) / DAT

Where W1-W2 is the weight loss in mg., D is the density of steel , A is the area in sq.inch and T is the time of exposure in hrs



APPENDIX-III

TEST FOR EFFECT ON COMPRESSIVE STRENGTH BY ADDITION OF CPCIA

TEST PROCEDURE

Cast three concrete blocks of size 100mm x 100mm x 100mm each without and with CPCIA 1% (w/w) of cement or as recommended by the manufacturer, by casting the concrete of M20 grade as per Clause 6.2.3 of IS 9103.

The above casted blocks shall be demoulded after 24 hrs. These blocks shall be moist cured for 28 days. After completion of the curing period, the blocks of each type shall be tested for compressive strength in compression testing machine (Universal Tensile Machine) and data recorded.

APPENDIX-IV

BRIEF OUTLINES OF ELECTROCHEMICAL POLARIZATION TEST CONDUCTED ON STEEL REBARS EMBEDDED IN CONCRETE (AS PER ASTM G 3)

TEST PROCEDURE

Cast three concrete cylinders, of size 75mm dia and 150mm length each without and with CPCIA 1% (w/w) of cement or as recommended by the manufacturer, by casting the concrete of M 20 grade as per Clause 6.2.3 of IS 9103, and placement of one cleaned rebar conforming to IS:1786 of size 375mm length and 12mm dia (preferably cleaned by pickling in Hydrochloric acid 20% (v/v) approximately, till surface shines and washed in running water) in each block .

The above casted blocks shall be demoulded after 24 hrs. These blocks shall be moist cured for 28 days.

After completion of the curing period, the blocks shall be subjected for Polarization test for 20 days as per ASTM G-3 and observations recorded.

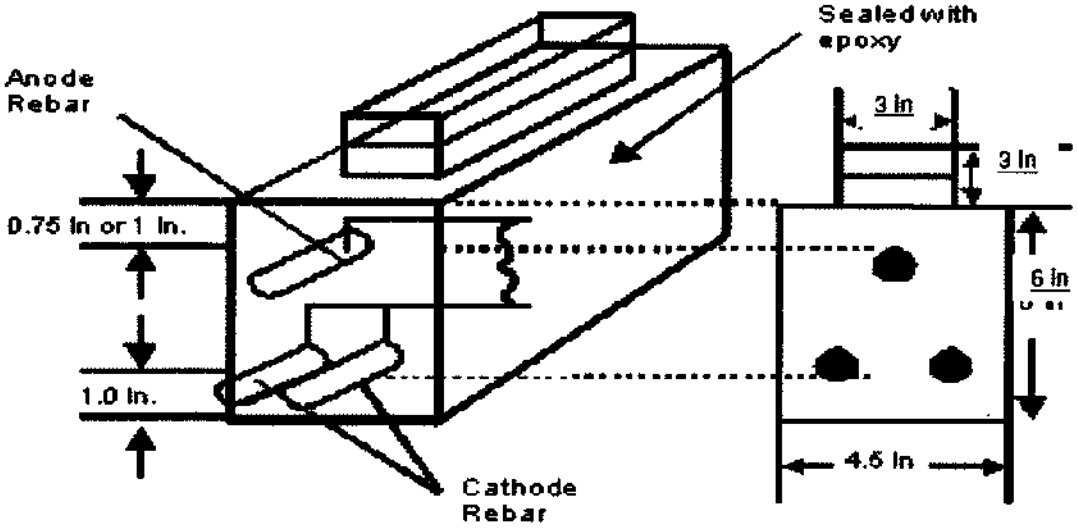
APPENDIX-V

BRIEF OUTLINES OF LONG TERM CORROSION TEST (AS PER ASTM G 109)

TEST PROCEDURE

Three specimens each of control concrete and that of CPCIA admixed concrete (1% w/w of cement or as recommended by the manufacturer) should be cast as per the size 280mmx150mmx115mm and with placement of three cleaned reinforcement bars conforming to IS:1786 (preferably cleaned by picking in Hydrochloric acid 20% (v/v) approx, till surface shines and washed in running water) of size 12mm and length 375mm as per the details shown in the figure. Admixture shall be added as per manufacturers recommended dosage. All the casted concrete samples shall be moist cured for 28 days.

Ponding of samples with 3% NaCl solution as shown in the figure to be continued and measuring of voltage across 100 ohm resistor to be continued beginning of the second week of ponding. Calculate the current IJ from the measured voltage and record. Also measure the corrosion potential of the bars against reference electrode. The experiment should be continued till the macrocell current reaches a value of 10 μA. After the experiment break the specimens and examine the rebars for extent of corrosion, measure the corroded area and record.



Note - All Measurements in In. (25.4 mm = 1 In.)

APPENDIX-VI
(Sheet 1 of 2)

BRIEF OUTLINES OF RESISTANCE OF CONCRETE TO MIGRATION OF CHLORIDE ION TEST (AS PER AASHTO T259)

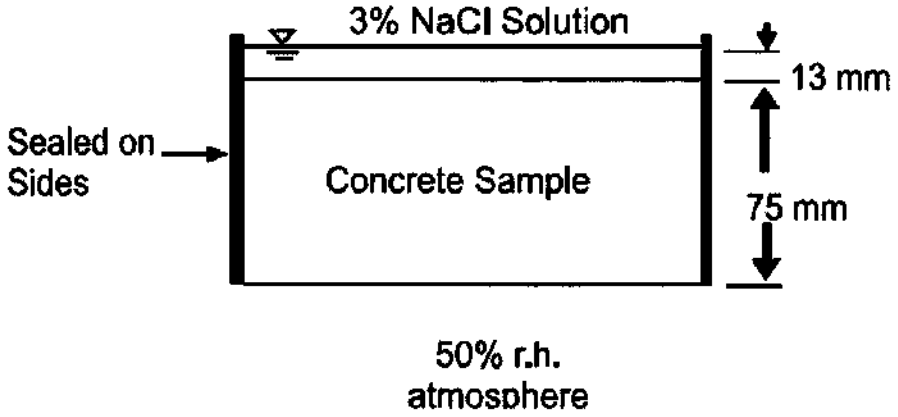
Part-A : Chloride Ion Penetration (Salt Ponding Test As per IS:456)

TEST PROCEDURE

Cast three concrete blocks of size 300mmx300mmx75mm each without and with CPCIA 1% (w/w) or as recommended by the manufacturer, by using the concrete mix as under:

S.No.	Material	M30 (Kg)	M40 (Kg)
i)	53 Grade Cement	50	50
ii)	Coarse Sand	104	87
iii)	Aggregate, passes through 20 mm and retained on 10 mesh	160	134
iv)	Water (subject to 55±5 slump)	24	20
v)	CPCIA	0.5*	0.5*
	* as recommended by the manufacturer with each type of cement viz. Ordinary Portland Cement, Portland Pozzolana Cement, Portland Slag cement, Sulphate resisting Cement		

AASHTO T259 test (commonly referred to as the salt ponding test) is a long-term test for measuring the penetration of Chloride ions into concrete. Three slabs of 75 mm thick and having a surface area of 300 mm square shall be casted. These slabs are moist cured for 14 days and then stored in drying room at 50 percent relative humidity for 28 days. The sides of the slabs are sealed except for bottom and top face. After the conditioning period, a 3% NaCl solution is ponded on the top surface for 90 days, while the bottom face is left exposed to the drying environment (see figure below).



At the end of this time (90 days) the slabs are removed from the drying environment and the Chloride concentration of 10 mm thick slices is then determined (AASHTO T259).Two or three slices are taken at progressive depth. The salt ponding test does provide a crude one-dimensional chloride ion ingress profile. Test results should meet the requirements as stipulated in IS: 456.

APPENDIX-VI
(Sheet 2 of 2)

BRIEF OUTLINES OF RESISTANCE OF CONCRETE TO MIGRATION OF CHLORIDE ION TEST (AS PER AASHTO T259).....Contd.

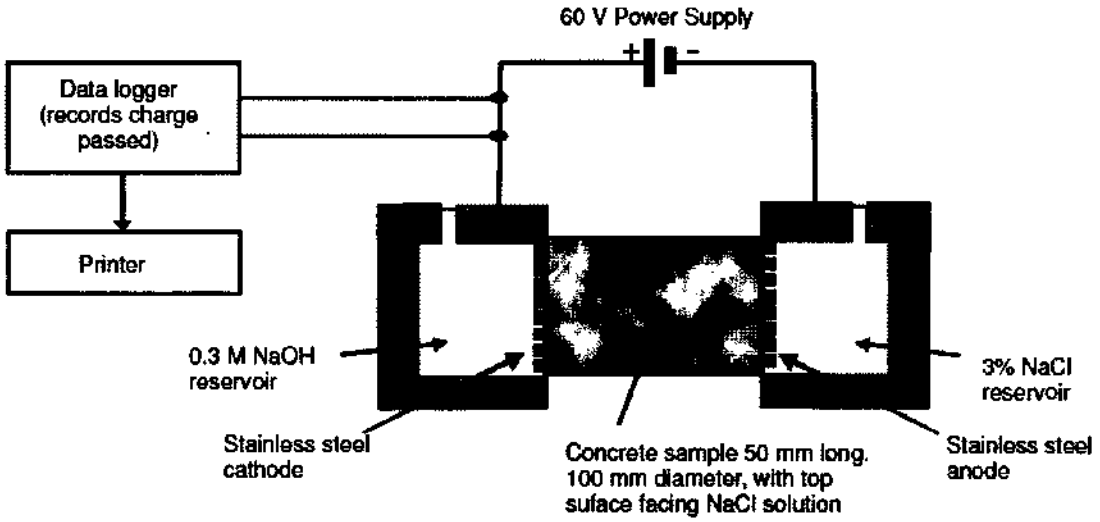
Part-B : Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration (Rapid Chloride Permeability test As per ASTM C-1202)

TEST PROCEDURE

Cast three concrete cylinders of size 50 mm thick, 100 mm diameter without and with CPCIA 1% (w/w) or as recommended by the manufacturer, by using the concrete mix as under:

S.No.	Material	M 30 (Kg)	M 40 (Kg)
i)	53 Grade Cement	50	50
ii)	Coarse Sand	104	87
iii)	Aggregate, passes through 20 mm and retained on 10 mesh	160	134
iv)	Water (subject to 55±5 slump)	24	20
v)	CPCIA	0.5*	0.5*
	* as recommended by the manufacturer with each type of cement viz. Ordinary Portland Cement, Portland Pozzolana Cement, Portland Slag cement, Sulphate resisting Cement		

As per ASTM C-1202, water-saturated concrete specimen is subjected to a 60 V applied DC voltage for 6 hrs. using the apparatus shown in Figure below. In one reservoir is a 3.0% NaCl solution and in the other reservoir is a 0.3 M NaOH solution. The total charge passed is determined and this is used to rate the concrete's resistance to chloride ion penetration.



प्रबलित कंक्रीट भूस्तंभ की सामग्री हेतु मानक विनिर्देश

STANDARD SPECIFICATION FOR MATERIALS FOR REINFORCED CONCRETE PILES

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	22.09.2020	REAFFIRMED & REISSUED	GK	VKP	AS	SM
3	26.09.2014	REVISED & ISSUED AS STANDARD SPECIFICATION	GK	VKP	SD	S Chanda
2	03.03.2008	REVISED & ISSUED AS STANDARD SPECIFICATION	VKP	SDN	VK	VC
1	26.03.1998	REVISED & ISSUED AS STANDARD SPECIFICATION	SDN	UB	ECHGR	ASONI
0	21-05-1985	ISSUED AS STANDARD SPECIFICATION	RKMB	MI	MI	JRP

Abbreviations:

IS: Indian Standard

Structural Standards Committee

Convenor: Mr. Anurag Sinha

Members:
Mr. C Damodaran
Mr. V.K.Panwar
Mr. Samir Das
Mr. Amitabh Kishore
Mr. Gyasuddin
Mr. Charanjit Singh (Projects)
Mr. Ravindra Kumar (Constn.)

CONTENTS

1.0 GENERAL

1.1 Scope

1.1.1 This specification establishes the material specifications of reinforced cement concrete to be used in pile foundations. Any special requirements as shown or noted on the drawings shall govern over the provisions of these specifications.

1.1.2 For specific work requirements concerning design and construction or otherwise modifying or supplementing the provision of this specification, refer to the specific requirements. In case of conflict between specific requirements and provision of this specification, former shall govern.

1.2 Definitions

1.2.1 Reference to Indian Standard Codes shall always mean reference to the latest issue of the relevant standards including all its amendments up to date.

1.3 Codes

All design and construction shall be performed in accordance with the Indian Standard Code of Practice for Plain and Reinforced Concrete IS: 456.

2.0 MATERIALS FOR CONCRETE

2.1 General

All materials which may be used in the Plain or Reinforced Cement concrete work shall be of standard quality conforming to IS or equivalent and shall have IS certification mark as far as possible unless otherwise approved by the Engineer-in-Charge. The contractor shall get all materials approved by Engineer-in-Charge shall have the right to determine whether all or any of the materials offered or delivered for use in the works are acceptable. Any material brought to site and not conforming to specification and instruction of Engineer-in-Charge shall be rejected and the contractor shall have to remove the immediately from site at his own expenses.

2.2 Cement

2.2.1 General

The cement used shall be ordinary Portland Cement or Portland slag cement conforming to IS: 455 or Portland pozzolana cement conforming to IS: 1489 or as specified and / or directed by the Engineer-in-Charge.

2.2.2 Tests after Delivery

Each consignment of cement, may after delivery on the site and at the discretion of the Engineer-in-Charge , be subjected to any or all of tests and analysis required by the relevant Indian Standard Specifications. Facilities for testing shall be provided by contractor at his own cost.

2.2.3 Storage on the Site

The cement shall be stored in a suitable weather-tight building and in such a manner as to permit easy access for proper inspection to prevent deterioration. Cement of different types and brands shall be kept in separate storage.

All accepted cement stored on the site shall be arranged in batches and used in the same order as received from the manufacturer. The contractor shall maintain a cement register in which all entries shall be completed day to day showing the quantities received, date of receipt, source of dispatch, type of cement, etc. and also the daily cement consumption on site. The register shall be accessible to the Engineer-in-Charge for his verification.

2.2.4 **Rejection of Cement**

The Engineer-in-Charge may reject any cement as a result of any tests thereof, notwithstanding the manufacturer's certificate. He may also reject cement which has deteriorated owing to inadequate protection from moisture or due to intrusion of foreign matter or other causes. Any cement which is considered defective by the Engineer-in-Charge shall not be used, and shall be promptly removed from the site of the work by the contractor at his own expense.

2.3 Aggregates for Concrete

2.3.1 General

Coarse and fine aggregates for concrete shall conform in all respect to IS: 383, "Specification for Coarse and Fine Aggregates from Natural Sources for Concrete". Aggregates shall be obtained from a source known to produce those satisfactory for concrete. Aggregates shall consist of naturally occurring sand and gravel or stone, crushed or uncrushed, or a combination thereof. They shall be chemically inert, hard, strong, dense, durable, clean and free from veins, adherent coatings and shall be of limited porosity.

Flaky and elongated pieces shall not be used.

The source of aggregates shall be approved by the Engineer-in-Charge and shall not be changed during the course of the job without his approval. Rejected aggregates shall be removed from the work site by the contractor at his own expense.

2.3.2 Deleterious Materials

Aggregates shall not contain any harmful materials such as iron pyrites, coal, mica, shale or similar laminated materials, clay, alkali, soft fragments, sea shells, organic impurities etc. in such quantities as to affect the strength or durability of the concrete. In addition to the above, for reinforced concrete, any material which might cause corrosion of the reinforcement and aggregates which are chemically reactive with the alkalies of cement shall not be used.

The maximum quantities of deleterious materials in the aggregates, as determined in accordance with IS: 2386 (part-II) "Methods of Test for Aggregates for Concrete" shall not exceed the limits given in Table – I of IS: 383.

The sum of the percentages of all deleterious materials shall not exceed five. Deleterious materials also include material passing 75 micron IS sieve.

2.3.3 Coarse Aggregates

Coarse aggregate is aggregate most of which is retained on 4.75mm IS sieve. These may be obtained from crushed or uncrushed gravel or stone as per CL.2.3.1 and may be supplied as single sized or graded aggregates given in Table –II of IS: 383.

2.3.4 **Fine Aggregates**

Fine aggregate is aggregate most of which passes 4.75mm IS Sieve but not more than 10% pass through 150micron IS Sieve. These shall comply with the requirements of grading zones I, II and III and given in Table – III of IS: 383. Fine aggregate conforming to grading zone IV shall not be normally used in reinforced concrete unless tests have been made by the contractor to ascertain the suitability of the proposed mix proportions and approved by the Engineer-in-charge.

Fine aggregate shall consist of sand resulting from natural disintegration of rock and which has been deposited by streams or glacial agencies, or crushed stone sand or crushed gravel sand.

2.3.5 **Sampling and Testing**

In case of doubt the Engineer-in-Charge may require the contractor to carry out tests, at the contractor's expense in accordance with,

IS: 516 – Method of Tests for Strengths of Concrete; and

IS: 2386 – Method of Tests for Aggregates for Concrete.

2.3.6 **Storage of Aggregates**

The contractor shall at all times maintain at the site of work such quantities of aggregate as are considered by the Engineer-in-Charge to be sufficient to ensure continuity of work.

Each type and grade of aggregate shall be stored separately on hard firm ground having sufficient slope to provide adequate drainage to rain water.

Any aggregate delivered to site in a wet condition or becoming wet at site due to rain shall be kept in storage for at least 24 hrs. to obtain adequate drainage, before it is used for concreting, or the water content of mix must be suitably adjusted as directed by Engineer-in-Charge.

2.4 Water

Water used for concrete shall be clear and free from injurious amounts of Oil, Acid Alkali, Organic matters or other harmful substances in such amount that may impair the strength or durability of structure. Potable water shall generally be considered satisfactory for mixing and curing concrete.

The Engineer-in-Charge may require the contractor to prove at latter's expense, that the concrete mixed with water proposed to be used should not have a compressive strength, lower than 90% of the strength of concrete mixed with distilled water.

The Engineer-in-Charge may require the contractor to get the water tested from an approved laboratory at his own expenses and in case the water contains any sugar or excess of acid, alkali, any injurious salts etc. the Engineer-in-Charge may refuse to permit its use.

3.0 ADMIXTURES

3.1 Admixtures such as CICO grade I or puddlo or equivalent may be used in concrete only with the approval of Engineer-in-Charge.

4.0 REINFORCEMENT

4.1 Hard-Drawn Steel wire Fabric

4.1.1 When specified on the drawings, hard-drawn steel wire fabric shall be used conforming to IS: 1556; it shall be of an approved type and of the weights and dimensions shown on the drawing.

4.2 High Yield Deformed Steel Reinforcement

4.2.1 Cold twisted high yield deformed steel bars, shall conform to IS: 1786.

4.3 Other Bars & Sections

4.3.1 Any other type of reinforcement bars specified on the drawings shall conform to its respective Indian Standard specification. Medium tensile steel bars when specified on the drawings shall conform to IS; 432.

4.4 Welding

4.4.1 Field welding of reinforcing bars will not be permitted without the written consent of the engineer-in-charge. Where welding is permitted it must be at staggered locations. Tests shall be made to prove that the joints are of the full strength of bars connected. Welding of reinforcement shall be done in accordance with the recommendation of IS: 2751.

4.5 Storage

4.5.1 The steel reinforcement shall be stored in such a way as to avoid distortion and to prevent deterioration and corrosion.

4.6 Other Specifications

4.6.1 General construction details and workmanship relative to reinforcement including bars bonds, lap splices and installation shall be in accordance with IS: 2502 – Code of Practice for Bonding and Fixing of Bars for concrete reinforcement, as well as the detailing of reinforcement given in IS:456.

4.6.2 Hot bending of bars shall not be allowed.

4.6.3 The number sizes, shape and position of all the reinforcement shall, unless otherwise directed or authorized by the Engineer-in-Charge, be strictly in accordance with the drawings. The reinforcement shall be adequately secured and held in position by metal chairs and spacers. Ties of inter-sections shall be made with 18 SWG soft black annealed binding wire.

4.6.4 The contractor must obtain the approval of the Engineer-in-Charge for the reinforcement placed, before any concrete is placed in the forms. The reinforcement of this time shall be free from loose rust or scale or other coatings that will des troy or reduce bond.

4.6.5 Concrete spacer blocks of the same strength as parent concrete shall be used to ensure correct cover to the reinforcement. This clear cover shall be as shown on the drawings or as per instructions of the Engineer-in-Charge.

4.6.6 All the reinforcing bars shall be so tied as to form a rigid cage to prevent displacement before or during concreting.

आर.सी.सी. बोर्ड कास्ट-इन-सिटू पाइलों के डिजाइन, निर्माण तथा अधिष्ठापन के लिए मानक विनिर्देश

STANDARD SPECIFICATION FOR DESIGN, CONSTRUCTION AND INSTALLATION OF RCC BORED CAST-IN-SITU PILES

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	23.09.20	Reaffirmed and Reissued	SB	VKP	AS	SM
3	18.06.14	Updated & Reissued	Shobha	VKP	SD	S.Chanda
2	21.04.09	Updated & Issued as Standard Specs.	S.Bhowmik	S.Debnath	V.Kumar	N.Duari
1	23.06.98	Revised & Issued as Standard Specs.	S.Debnath	ECHGR	ECHGR	AS
0	22.12.88	Issued as standard specification	ECHGR	SM	RKMB	AS

Abbreviations:

IS	:	Indian Standards
RQD	:	Rock Quality Designation
SPT	:	Standard Penetration Test

Structural Standards Committee

Convenor: Mr. Anurag Sinha

Members:
Mr. C Damodaran
Mr. V.K.Panwar
Mr. Samir Das
Mr. Amitabh Kishore
Mr. Gyasuddin
Mr. Charanjit Singh (Projects)
Mr. Ravindra Kumar (Constn.)

CONTENTS

1.0 SCOPE

1.1 This standard specification covers the construction and installation of load bearing reinforced concrete bored cast-in-situ piles.

1.2 For specific work requirements concerning construction or otherwise modifying or supplementing the provisions of this specification, reference may be made to 'Specific Requirements'. In case of any conflict between requirements set forth in 'Specific Requirements' and the provisions of this specification, the 'Specific Requirements' shall govern.

2.0 CODES

2.1 IS:2911 (Part I/Sec.2) - Indian Standard Code of Practice for Design and Construction of pile foundations for Bored Cast-in-Situ Piles, shall be referred to in conjunction with these specifications during the entire design, construction and installation work.

2.2 Reference to any code shall always mean reference to the latest revised edition of the code including all its amendments upto date, unless otherwise specified. In the event of any conflict between the requirements of this specification and those of the referred codes, the former shall govern.

3.0 MATERIALS

3.1 All materials, viz. cement, steel, aggregates, water etc. which are to be used in the construction work, shall conform to EIL Standard Specification for Reinforced Concrete Piles No. 6-74-006.

3.2 Concrete

3.2.1 Methods of the manufacture of cement concrete shall in general, be in accordance with IS:2911 (Part I/Sec.2) and as per following clauses.

3.2.2 The grade of concrete shall be M-25 with a minimum cement content of 400 kg/m³.

3.2.3 **Slump of Concrete**

Slump of concrete shall range between 150 to 180 mm depending on the manner of concreting. The table below gives the general guidance:

PILING	SLUMP (in mm)		TYPICAL CONDITIONS OF USE
	Min.	Max.	
A.	100	180	Poured into water-free unlined bore having widely spaced reinforcement. Where reinforcement is not spaced widely enough, cut-off level of pile is within the casing and diameter of pile is less than or equal to 600mm, higher order of slump within this range may be used.
B.	150	180	Where concrete is to be placed under water or drilling mud, by tremie or by placer.

4.0 DESIGN CONSIDERATIONS

4.1 Structural Design

The piles shall have necessary structural strength to transmit the loads imposed on it, to soil. Relevant parts of IS:2911 (Part I/Sec.2) and specific requirements shall be considered to apply for assessing the structural capacity of piles.

4.2 Reinforcement

4.2.1 The minimum longitudinal reinforcement shall be 0.4% of the cross sectional area of the pile.

4.2.2 Clear cover to the main reinforcement shall be 50mm. This shall be increased to 75mm in case of aggressive soils and ground water conditions.

4.2.3 The vertical reinforcement shall project 40 times its diameter above the cut-off level.

4.2.4 The minimum clear distance between the two adjacent main reinforcement bars should normally be 100mm for the full depth of cage. The bars shall be so placed as not to impede the placing of concrete.

4.2.5 The lateral ties in the reinforcing cage shall be preferably spaced not closer than 150 mm centre to centre.

4.2.6 The minimum diameter of the lateral ties shall be 8mm.

5.0 EQUIPMENT & ACCESSORIES

5.1 The equipment and accessories for installation of bored cast-in-situ piles shall be selected giving due consideration to the subsoil conditions and the method of installation etc. These shall be of standard type and shall have the approval of the Engineer-in-Charge.

5.2 The capacity of the rig shall be adequate so as to reach the desired depth.

5.3 Provision shall be kept for chiselling within the borehole in case of any underground obstruction/hard strata. However, chiselling shall be carried out only with the approval of Engineer-in-Charge.

5.4 In case pile is required to be socketted in medium or good quality rock strata, the equipment mobilized shall have adequate capability to do so upto the required socket length. For the purpose of classification of rock for the determination of length of socketting, pilot drill holes shall be carried out in the areas to be piled.

5.5 Pilot drill holes shall be of Nx or Bx size as per specific requirements. Rock drilling shall be carried out using double tube core barrel. Drilling and storing of rock cores shall conform to relevant IS codes. Rock quality shall be classified as under depending upon the RQD.

RQD (%)	ROCK QUALITY
<25	Poor
25 to 75	Medium
>75	Good

6.0 PILING INSTALLATION

6.1 Control of Alignment

6.1.1 The piles shall be installed as accurately as possible as per the designs and drawings. The permissible positional deviations shall be governed by IS: 2911 (Part I/ Sec.2). In case of piles deviating beyond such permissible limits, the piles shall be replaced or supplemented by additional piles, as directed by Engineer-in-Charge.

6.2 Boring

6.2.1 The boring shall be done by one of the following methods:

(a) Direct mud circulation

(b) Reverse mud circulation

(c) Bailer bentonite.

(d) Hydraulic auger bentonite

The actual method of construction to be followed shall be as per specific requirements.

6.2.2 In very soft soil a permanent liner shall be installed to ensure stability of borehole. A liner shall be used to protect the green concrete where a high hydrostatic pressure exists in the subsoil or where an underground flow of water exists and which is likely to damage the concrete on withdrawal of casing.

6.2.3 Use of temporary liner only in lieu of bentonite to stabilise sides of boreholes shall not be permitted.

6.2.4 Properties of bentonite used and quality control shall be as per IS:2911 (Part I/Sec.2).

6.3 Concreting of Piles

6.3.1 Reinforcement

6.3.1.1 The reinforcements shall be made into cages sufficiently rigid to withstand handling without damage. In case the reinforcement cage is made up of more than one segment, the same shall be assembled by providing necessary laps preferably by welding.

6.3.1.2 Stirrups to the main bars shall be tack welded.

6.3.1.3 Care shall be taken to ensure that the reinforcement bars do not come closer while the cage is lowered down the hole.

6.3.1.4 Proper cover and central placement of the reinforcement shall be ensured by use of suitable concrete spacers or rollers, cast specifically for the purpose.

6.3.2 Concreting

6.3.2.1 Concreting shall not be commenced until the Engineer-in-Charge satisfies himself that at final borehole depth the soil is not weaker than that taken as the basis for pile design. If necessary, SPT or similar test shall be conducted to ensure the above.

6.3.2.2 Borehole bottom shall be thoroughly cleaned to make it free from sludge or any foreign matter before lowering the reinforcement cage. The full length of reinforcement cage shall be in position before start of concreting.

6.3.2.3 Concreting shall be done by tremie method. The operation of tremie concreting shall be governed by IS: 2911 (Part I/Sec.2).

6.3.2.4 The concrete placing shall not proceed if specific gravity of fluid near about the bottom of borehole exceeds 1.2. Determination of the specific gravity of the drilling mud from the base of the borehole shall be carried out by taking samples of fluid by suitable slurry sampler approved by the Engineer-in-Charge, in first few piles and at a suitable interval of piles thereafter and the results recorded. Control of consistency of drilling mud shall be carried out throughout boring as well as concreting operations.

6.3.2.5 Care shall be exercised to preserve correct cover and alignment of reinforcements and avoid any damage to it throughout the complete operation of placing the concrete.

6.3.2.6 The top of the pile shall be brought up above the cut off level minimum by 0.75 m so as to permit removal of all laitance and weak concrete before capping and to ensure good and sound concrete at the cut-off level for proper embedment into the pile cap. Any defective concrete in the head of the completed piles shall be cut-away and made good with new concrete.

7.0 DEFECTIVE PILES

7.1 Defective piles shall be removed or left in place, as judged convenient by the Engineer-in-Charge, without affecting the performance of adjacent piles or capping above and additional piles shall be provided to replace them.

8.0 RECORDING OF DATA

8.1 A competent supervisor shall be present to record the necessary information during the installation of piles. The data to be recorded shall include:

a) The dimensions of the piles, including the reinforcement detail and the mark of the pile.

b) The boring method employed.

c) The type of soil/rock in which pile is terminated.

d) The depth bored.

e) The depth of water table.

f) When drilling mud is used, the specific gravity of the fresh supply and contaminated mud in the borehole before concreting is taken up, in case of first few piles and subsequently at suitable interval of piles.

g) The time taken for concreting.

h) The cut-off level/working level, and

i) The consumption of concrete and cement.

j) Any other important observations.

8.2 Typical data sheets of recording piling data shall be as given in Appendix - D of IS:2911 (Part I/Sec.2).

8.3 Any deviation from the designed location, alignment or load carrying capacity of any pile shall be noted and promptly reported to the Engineer-in-Charge.

सतह तैयारी एवं जंगरोधक रंगसाजी हेतु मानक विनिर्देश

STANDARD SPECIFICATION FOR SURFACE PREPARATION AND PROTECTIVE COATING

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by: Standards Committee Convenor	Approved by: Standards Bureau Chairman
1	06.06.2024	ISSUED AS STANDARD SPECIFICATION	SAHIL	SRIDHAR	P.SAHA	M NANDI
0	30.06.12	6-44-0004 REV. 3 REVISED, RE-NUMBERED & ISSUED AS STANDARD SPECIFICATION	A.SRIDHAR	R.CHAUDHURY	P.P.LAHIRI	D.MALHOTRA

Abbreviations:

AS	:	Alloy Steel
ASTM	:	American Society for Testing and Materials
AWWA	:	American Water Works Association
CS	:	Carbon Steel
DFT	:	Dry Film Thickness
GI	:	Galvanized Iron
ID	:	Internal Diameter
ISO	:	International Organization for Standardization
LTCS	:	Low temperature Carbon Steel
MS	:	Mild Steel
MR	:	material requisition
NB	:	Nominal Bore
NA	:	Not applicable
OD	:	Outside Diameter
OEM	:	Original Equipment Manufacturer
OSHA	:	Occupational Safety and Health Act
RCC	:	Reinforced Cement Concrete
RH	:	Relative humidity
SS	:	Stainless Steel
SOR	:	Schedule of Rate
SSPC	:	Steel Structure Painting Council
WFT	:	Wet Film Thickness

Standards Committee

Convener: Mr. Prasenjit Saha

Members: Mr. SS Roy (Projects)
Mr. Dipakkumar Dahyalal Panchal (Projects)
Mr. R. Muthu Ramalingam (SCM)
Dr. Arijit Roy (SMMS)
Mr. Satya Sridhar (SMMS)

1.0 GENERAL

1.1 This standard specification shall be applicable for the work covered by the contract and without prejudice to the provisions of various international codes of practice, standard specifications etc. It is understood that the CONTRACTOR shall carry out the work in all respects with the best quality of materials and workmanship and in accordance with the best engineering practice and instructions of Engineer-In-Charge in consultation with SMMS.

1.2 This specification covers the requirement for protective coating for new construction.

2.0 SCOPE

2.1 Scope of work covered in the specification shall include, without being limited to, the following:

This specification defines the requirements for surface preparation, selection and application of primers and coatings on external surfaces of items mentioned in clause 2.2 of this specification and quality control, inspection & testing of the coating systems. The items listed in clause 2.2 and the heading of tables of paint systems are non-exhaustive. However, the CONTRACTOR is fully responsible for carrying out all the necessary painting, coating and lining job on external and internal surfaces as per the contract requirement.

2.2 Extent of work covered in this standard

2.2.1 The following surfaces and materials shall require shop, pre-erection and field painting, as applicable:

a. All Carbon Steel structures.

b. All Carbon Steel and Alloy steel piping, equipment, valves, fittings & stacks.

c. All Carbon Steel and Alloy steel tanks.

d. Tanks internal as per applicable datasheets & contract requirements.

e. All insulated CS pipes, equipment, valves, fittings & stacks.

f. All insulated SS pipes, equipment, valves, fittings, vessels & stacks.

g. All structural steel supports, walkways, handrails, ladders, platforms etc.

h. Flare lines, external surfaces of steel chimney with or without refractory lining and internal surfaces of steel chimney without refractory lining.

2.2.2 Marking and Identification of painted items:

a. Identification of color bands on all piping, as required, including aluminum cladding over insulation, galvanized, SS and nonferrous piping.

b. Identification lettering/ numbering on all painted surfaces of equipment/piping, aluminum cladding over insulation, galvanized, SS and non-ferrous piping.

c. Marking / identification signs on painted surfaces of equipment and piping including hazardous service.

2.2.3 Supply and prequalification testing of all primers, paints and all other materials required for painting (other than OWNER supplied materials)

2.2.4 Application of pre-erection/fabrication and shop primer.

2.2.5 Repair work of damaged pre-erection/ fabrication and shop primer and weld joints in the field/site before and after erection.

2.2.6 Quality control, testing and inspection during all stages of work (surface preparation, application of coating and testing of applied coating).

2.2.7 Exclusions:

All metallic surfaces do require painting except for following materials. These materials are not painted unless specified by the contractual provisions and the same shall be painted as per the relevant specifications:

a. Un-insulated stainless steel.
b. Plastic and/or plastic-coated materials.
c. Galvanized Iron.
d. Aluminum.
e. Ni-Alloys.
f. Glass.
g. Ceramics.
h. Machined surfaces.
i. Label and names plates.

Note: Galvanized steel doesn't require painting for corrosion protection. However, if painting is mandated due to OWNERs instructions/contractual provision/ for colour coding requirement mentioned in this standard or by OWNER, then the coating system in Table 4.0 shall be followed.

3.0 REFERENCE CODES & STANDARDS

3.1 Latest editions of the following codes and standards are applicable for the work covered by this standard:

Steel Structures Painting Council (SSPC)

SSPC SP-1	Solvent cleaning
SSPC Painting manual Vol.1	Good Painting practices
SSPC Painting manual Vol.2	Systems & specification
SSPC VIS 1	Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
SSPC AB1	Mineral and Slag Abrasives
SSPC PA 2	Measurement of Dry Paint Thickness with Magnetic Gauges

American Society for Testing and Materials (ASTM):

ASTM Volume 6.01	Paint - Tests for Chemical, Physical, and Optical Properties; Appearance
ASTM Volume 6.03	Paint -- Pigments, Polymers, Resins, Naval Stores, Cellulosic Esters, and Ink Vehicles
ASTM D6677	Standard Test Method for Evaluating Adhesion by Knife
ASTM D5894	Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
ASTM D870	Standard Practice for Testing Water Resistance of Coatings Using Water Immersion
ASTM D2485	Standard Test Methods for Evaluating Coatings for High Temperature Service
ASTM D2247	Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity
ASTM D4417	Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM D4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM D4060	Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D4752	Standard Practice for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub
ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D4940	Standard Test Method for Conductimetric Analysis of Water Soluble Ionic Contamination of Blast Cleaning Abrasives
ASTM D4285	Standard Test Method for Indicating Oil or Water in Compressed Air
ASTM D543	Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents
ASTM C868	Standard Test Method for Chemical Resistance of Protective Linings
ASTM G42	Standard Test Method for Cathodic Disbonding of Pipeline Coatings Subjected to Elevated Temperatures
ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM D1475	Standard Test Method for Density of Liquid Coatings, Inks, and Related Products
ASTM D823	Standard Practices for Producing Films of Uniform Thickness of Paint, Coatings and Related Products on Test Panel
ASTM D2369	Standard Test Method for Volatile Content of Coatings
ASTM D1640/D1640M-14	Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings
ASTM D522/D522M	Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings
ASTM D968	Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D1044	Standard Test Method for Resistance of Transparent Plastics to Surface Abrasion

ASTM D1849	Standard Test Method for Package Stability of Paint
ASTM D2247	Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity
ASTM D5146	Standard Guide to Testing Solvent-Borne Architectural Coatings

National Association for Corrosion Engineer (NACE):

NACE RP 0287	Field Measurement of Surface Profile of Abrasive Blast-Cleaned Steel Surfaces Using a Replica Tape
NACE SP 0198	Control of Corrosion under Thermal Insulation and Fireproofing Materials
NACE SP 0188	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

International Organization for Standardization (ISO):

ISO 12944	Corrosion Protection of steel Structures by Protective Paint System
ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles-Specifications and test methods.
ISO 8501-1/ SIS-05 59 00	Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness— Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings
ISO 8502-3	Preparation of steel substrates before application of paints and related products -Tests for the assessment of surface cleanliness - Part 3: Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method)
ISO 8502-9	Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness—Part 9: Field method for the conductometric determination of water-soluble salts
ISO 2808	Paints and varnishes - Determination of film thickness
ISO 2811	Paints and varnishes — Determination of density

Other Standards

NORSOK M-501	Surface preparation and protective coating
RAL CLASSIC	Color matching system

4.0 SURFACE PREPARATION

4.1 General

Adhesion of the paint film to the surface depends largely on the degree of cleanliness of the metal surface and proper surface preparation have large contribution to the success of the paint protective system. Following method shall be employed for surface preparation:

a. Abrasive blast cleaning: Applicable in all cases.

b. Mechanical or power tool cleaning: Shall be used for repair & touch up, and any other area due to practical constraints with prior permission from EIL Engineer-in charge.

4.2 Applicable Standards:

Latest editions of the following codes and standards are applicable for the surface preparation work:

TABLE-1: SURFACE PREPARATION STANDARDS

Sl. No.	GRADE OF SURFACE CLEANLINESS	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)		
		ISO 8501-1/ SIS-05 59 00	SSPC, USA	NACE, USA
1.	Solvent cleaning	-	SSPC-SP-1	-
2.	Manual or hand tool cleaning	St 2	SSPC-SP-2	-
3.	Mechanical or power tool cleaning	St 3	SSPC-SP-3	-
4.	White metal	Sa 3	SSPC-SP-5	NACE No.1
5.	Near white metal	Sa 2½	SSPC-SP-10	NACE No.2
6.	Commercial Blast	Sa 2	SSPC-SP-6	NACE No.3
7.	Brush-off Blast for SS, galvanized steel and non-ferrous metals	-	SSPC-SP-16	-
8.	Surface Preparation of Concrete	-	SSPC-SP-13	NACE No.6

4.3 Sequence of surface preparation:

4.3.1 Solvent Cleaning

Mill scale, rust, rust scale and foreign matter shall be removed fully to ensure that a clean and dry surface is obtained. Unless otherwise specified, surface preparation shall be done as per provisions of relevant tables given elsewhere in this specification. Before surface preparation by blast cleaning, the surface shall be cleaned to remove all grease, oil etc. as per SSPC-SP-1.

4.3.2 Blast cleaning with abrasives

The surfaces shall be blast cleaned using one of the abrasives listed below and at an appropriate distance & angle depending on nozzle size maintaining constant velocity and pressure.

a. The quality of abrasives shall be free from contaminants and impurities and shall meet the requirements of SSPC AB1.

b. The compressed air shall be free from moisture and oil.

c. On completion of blasting operation, the blasted surface shall be clean and free from any scale or rust. Blast cleaning shall not be done outdoors in bad weather without adequate protection. If there is dew on the metal surface, it shall be cleaned. If possible, a vacuum collector shall be installed to collect and recycle the abrasives.

d. Surface roughness profile: The surface roughness profile for carbon steel and low alloy steels to be coated shall be in accordance with the written recommendations of the paint Manufacturer and shall be measured as per ASTM D4417, method B. When roughness profile is not specified by the paint Manufacturer, then surface roughness profile as specified below in this specification shall be followed.

- The surface roughness profile shall be between 40 µm and 70 µm for coatings up to thickness 500 µm and between 70 µm and 125 µm for coating systems over 500 µm thickness. In all cases, the surface roughness shall have a sharp angular profile.

- If stainless steel, hot dip galvanised or non-ferrous metal surfaces are to be painted then blast cleaning shall be carried out as per SSPC-SP-16, using a fine non-iron containing abrasive.

- On galvanised surfaces, the zinc layer shall not be damaged; a smooth uniform surface roughness shall be achieved. No defects such as break through or crisping of the zinc layer shall occur. The surface roughness shall be in the range of 20 µm to 30 µm or as agreed with the paint Manufacturer.

e. Abrasives: Abrasive for use in blast cleaning steels shall be in accordance with ISO 8504-2. Steel or iron grit is commonly used as recyclable abrasives. When steel shot is used, it shall be used together with steel grit. The shot content of such a mix shall not exceed 67 %.For blasting stainless steel, non-(free) iron containing abrasive shall be used, e.g. Garnet or aluminium oxide. Abrasives used for blast cleaning shall be free from oil, grease, moisture, chloride contamination etc. and shall have crystalline silica not more than 1%

Test methods for abrasives shall be in accordance with the tests specified in the ISO 11125 and ISO 11127 series for metallic and non-metallic abrasives respectively. Each batch of abrasive should be tested to check that the abrasive meets the requirements as specified in the relevant ISO standard. The conductivity of non-metallic abrasives to be used for stainless steels shall be maximum 15 mS/m. For all other non-metallic abrasives, the conductivity shall not exceed 25 mS/m. OWNER/PMC shall approve the use of alternative abrasive materials. Abrasive used shall be as per following specification:

Type	Generic Name	Standard
Metallic	Iron grit	ISO 11124-2
	Steel grit	ISO 11124-3
Natural mineral	Staurolite	ISO 11126-9
	Garnet	ISO 11126-10
Synthetic mineral	Copper slag	ISO 11126-3
	Aluminium oxide	ISO 11126-7

4.3.3 Mechanical or power tool cleaning

Power tool cleaning shall be done by mechanical striking tools, chipping hammers, grinding wheels or rotating steel wire- brushes. Excessive burnish of the surface shall be avoided as it can reduce paint adhesion. On completion of cleaning, the detached rust, mill scale etc. shall be removed by clean rags and /or washed by water/steam and thoroughly dried with compressed air jet before application of paint.

4.4 General Notes for surface preparation/blasting:

a. Surface shall not be coated in rain, wind or in an environment where injurious airborne elements exist.
b. Surface shall not be coated when the steel surface temperature is less than 3 ^{0}C above dew point.

c. Surface shall not be coated, when the relative humidity is greater than 85%.

d. Surface shall not be coated when the temperature is below 10°C and the ambient/substrate temperature is below the paint manufacturers recommended temperature of application and curing.

e. The paint application shall not be done when the wind speed exceeds 20 km per hour.

f. The illuminance during coating and inspection shall be at least 1000 Lux.

4.5 Use of Dehumidifier

In case of internal coating of storage tanks, dehumidifier shall be used to control humidity level below 60%. Dehumidifier should depress the dew point of air in the enclosed space, sufficient enough so as to maintain it more than 3°C below the metal substrate temperature during entire period of blasting and coating application. During the interval time between application of primer coat and subsequent intermediate and top coats or between blast cleaning completion and start of application of primer coat, dehumidifier unit should be in continuous operation to ensure that no condensation occurs on the substrate.
The Engineer in-Charge shall have the right to disallow usage of dehumidifier if the performance is not meeting the specified requirements. Under such circumstances, the CONTRACTOR shall remove the equipment and replace the same with another equipment to provide satisfactory results without any additional cost to the OWNER.

4.6 Surface preparation of concrete:

The external surface of RCC to be painted shall be dry and clean. Any loose particle of sand, cement, aggregate etc. shall be removed and surface shall be prepared as per SSPC-SP-13.

5.0 COATING APPLICATION

5.1 Blast cleaned surface shall be coated with complete application of primer as soon as practicable but in no case later than 4 hours the same day. However, at times of unfavorable weather conditions, the Engineer-In-Charge shall have the liberty to control the time period, at his sole discretion and/or to insist on re-cleaning before primer application is taken up. In general, during unfavorable weather conditions, blasting and painting shall be avoided as far as practicable.

5.2 To the maximum extent practicable, each coat of paint shall be applied as a continuous film with uniform thickness and free of probes. Any spots or areas missed in application shall be re-coated and permitted to dry before the next coat is applied.

5.3 Each coat shall be in proper state of cure or dryness before the application of succeeding coat. Material shall be considered dry for re-coating when an additional coat can be applied without the development of any detrimental film irregularities such as lifting or loss of adhesion of the under coat. Manufacturer's instructions shall be followed for inter-coat interval.

5.4 When the successive coat of the same colour have been specified, alternate coat shall be tinted, when practical, sufficiently to produce enough contrast to indicate the complete coverage of the surface. The tinting material shall be compatible with the material underneath and shall not be detrimental to its service life and shall be recommended by the original paint manufacturer.

5.5 Airless spray application shall be in accordance with steel structure paint manual Vol.1 & Vol.2 by SSPC, USA

5.6 Brush application of paint shall be in accordance with the following:

a. Brushes shall be of a style and quality that will enable proper application of paint.

b. Round or oval brushes are most suitable for rivets, bolts, irregular surfaces, and rough/ pitted steel. Wide flat brushes are suitable for large flat areas but they shall not have width over 5 inches.

c. Paint shall be applied into all corners.

d. Any runs or sags shall be brushed out.

e. There shall be a minimum of brush marks left in the applied paint.

f. Surfaces not accessible to brushes shall be painted by spray, daubers, or sheepskin.

5.7 Applied paint should have the desired wet film thickness specified by manufacturer. For each coat, the painter should know the WFT corresponding to the specified DFT and standardize the paint application technique to achieve the desired WFT. This has to be ensured in the qualification trial.

5.8 Irregular surfaces such as sharp edges, welds, small brackets, and interstices may stripe coated to ensure specified DFT is achieved. Paint manufacturer recommendation should be followed before deciding for brush application.

5.9 Unless otherwise instructed, final coating (i.e. application of field primer, intermediate and top coats) on pre-erection/ shop primed equipment shall be applied at site, only after all welding & testing like NDT are completed as well as after completion of steam blowing.

5.10 Drying of coated surfaces

a. No coat shall be applied until the preceding coat has dried. The material shall be considered dry for re-coating when another coat can be applied without the development of any film irregularities such as lifting or loss of adhesion of undercoats. Drying time of the applied coat should not exceed maximum specified for it as a first coat. If this exceeds, the paint material has possibly deteriorated or mixing is faulty.

b. No paint shall be force dried under conditions which will cause chalking, wrinkling, blistering formation of pores, or detrimentally affect the conditions of the paint.

c. No drier shall be added to paint on the job unless specifically called for in the manufacturers' specification for the paint.

d. Paint shall be protected from rain, condensation, contamination, snow and freezing until dried to the fullest extent practicable.

5.11 Spot repair of damaged primer

a. Where pre-erection/shop primer has been damaged at isolated localized spots during handling and transportation or after erection / welding, its repair shall be done as given below and as per the Table-3 of this specification.

b. Surface preparation: Quickly remove the primer from damaged area by mechanical scraping and emery paper conforming to SSPC-SP-3 to expose the white metal. Blast clean the surface, if possible. Feather the primed surface, over the intact adjacent surface surrounding the damaged area, by emery paper.

Primer coating: One coat of F-8/F-9/F-16 shall be applied (as per the applicable design temperature and in conjunction with Table-3) wherever damage was observed on pre-erection / pre fabrication or shop primer.

c. If damaged areas are found to be extensive and spread over large areas (as required by Engineer-in charge), then entire pre-erection/pre-fabrication/shop primer shall be removed by blasting to achieve SSPC-SP-10 and entire blasted surface shall be primed again with F-8/ F-9 or F-16, as applicable, for the intended design temperature. (See note of Table-3). If the prepared surface lies adjacent to a sound coated surface, the surface preparation shall overlap the coated surface by at least 50mm. The remainder of existing coated surface shall be properly protected with shields or screens to prevent any possible damage to the coating.

5.12 Equipment:

a. All tools, brushes, rollers, spray guns, blast material, hand power tools for cleaning, all equipment, scaffolding materials, shot & grit blasting equipment , air compressors etc. required shall be suitable for the work and shall be arranged by the CONTRACTOR in sufficient quantity at the site. The manufacturers test certificates / data sheets for all the above mentioned items shall be reviewed by Engineer-In-Charge at site before start of the work.

b. All paint spraying equipment, including mixers, shall be thoroughly cleaned before mixing of new materials. All coating materials shall be mixed and thoroughly stirred in accordance with the instructions of the paint Manufacturer. Sufficient agitation to maintain good mixing shall be applied until the product is used. If air is entrapped in the product during mixing/stirring, sufficient time should be allowed for the air bubbles to escape before application. Only thinners specified by the paint Manufacturer shall be used.

5.13 Shop coating

a. Shop coated equipment (coated with primer & finishing coat) should not be repainted unless paint is damaged. Repair of primer shall be carried out as per Table-3 of paint systems depending upon the compatibility of paint. Intermediate and final coats over repaired primer shall be as per applicable tables mentioned in this specification.

c. Shop primed equipment and surfaces will only be 'spot cleaned' in damaged areas by means of power tool brush cleaning or hand tool cleaning and then spot primed before applying one coat of field primer, unless otherwise specified. If shop primer is not compatible with field primer, then shop coated primer should be completely removed before application of selected paint system for a particular environment.

d. For package units/Items/ OEM equipment, shop primer & coating system should be as per the paint system given in this specification. However, manufacturers' standard may be followed after review by EIL but shall adhere to the minimum DFT specified in ISO-12944-5; C5 (Very high durability). For system under insulation, minimum guidelines as per NACE RP 0198 shall be followed.

In this case, guarantee of the coating system lies with package supplier/OEM. EIL's decision in this regard is final and binding on Supplier/Contractor/manufacturer

5.12 Guidelines for Documentation / records

a. A written quality plan with procedure for qualification trials and for the actual work including test and inspection plan & procedure for approval before start of work.

b. Daily progress report with details of weather conditions, particular of applications, no. of coats and type of materials applied, anomalies, progress of work versus program.

c. Results of measurement of temperatures, relative humidity, surface profile, film thickness, holiday detection, adhesion tests with signature of appropriate authority.

d. Particulars of surface preparation and paint application during trials and during the work.

e. Details of non-compliance, rejects and repairs.

f. Type of testing equipment and calibration.

g. Code and batch numbers of paint materials used.

Note: The coating applicator must maintain a job record consisting of all the information as per 5.12.b. to 5.12.g above as well as the approved procedure of work (5.12.a. above). The job record consisting of information in accordance to 5.12.b. to 5.12.g shall be entered on daily basis and should be daily signed by Engineer-in-charge.

6.0 PAINT MATERIALS

Typical characteristics and codes of various paint materials used in this specification are as follows.

TABLE-2: PAINT MATERIALS
(Refer to *general notes* at the end of this table)

DESCRIPTION	P-6	P-7	P-4
Technical name	Epoxy Zinc Phosphate Primer	Cold Galvanizing product	Etch Primer/Wash Primer
Type and composition	Two component polyamine cured epoxy resin medium, pigmented with zinc phosphate.	One pack synthetic resin-based zinc galvanizing containing min 92% of electrolytic zinc dust of 99.95% purity.	Two pack polyvinyl butyral resin medium cured with phosphoric acid solution pigmented with zinc tetroxy chromate.
Volume solids % Minimum	49	37	9
DFT per coat, µ	40-50	40-50	8-10
Theoretical covering capacity in m^2/coat/ litre	9.8-12.2	3.4-4.4 m^2/kg	9.0-11.2
Weight per liter in Kg/litre (min.)	1.4±0.05	2.67 kg at 15°C	1.2±0.05
Touch dry at 30°C (max.)	30 min.	10 min.	2 hrs.
Hard dry at 30°C (max.),Hrs.	8	24	24
Over-coating interval, hrs.	Min. 8	Min. 4	Min. 4-6
Pot life at 30°C for two Component paints, hrs.	6 - 8	NA	NA
Adhesion (ASTM D 4541)	>7	NA	NA
Temperature resistance (min) ° C (ASTM D 2485) *Note 8	80 (Method A)	50 (Method A)	NA

TABLE- 2: PAINT MATERIALS (Contd.)

DESCRIPTION	F-2	F-3	F-6A/B	F-6C
Technical name	Acrylic Polyurethane finish paint	Chlorinated rubber-based finish paint	Epoxy-High Build coating	Solvent less epoxy coating
Type and composition	Two-pack aliphatic isocynate cured acrylic finish	Single pack Plasticized chlorinated rubber based	F-6A Two-Pack Aromatic polyamine cured epoxy resin	Two pack, cured with Amine Adduct; catalyzed epoxy

	paint (free of alkyd/polyester resins).	medium with chemical and weather resistant pigments.	medium suitably pigmented. F-6B: polyamide cured epoxy resin medium suitably pigmented with MIO.	resin suitably pigmented
Volume Solids % (min.)	40	36	57	98
DFT per coat, μ	30-40	30-40	100-125	300-450
Theoretical covering capacity in m^2/coat/litre	10-13.3	9-12	4.6-5.7	2-3.9
Weight per liter in Kg/litre (min.)	1.15	1.15	1.42	1.40
Touch dry at 30°C (max)	30 min.	30 min.	3 hrs.	3 hrs.
Hard dry at 30°C (max.).	8 hrs.	8 hrs.	16 hrs.	16 hrs.
Full cure at 30°C (for immersion/ high temperature service)	NA	NA	5 days	5 days
Over-coating Interval, hrs	Min.12.	Min. Overnight	Min. Overnight Max. 5 days	Min. 8. Max. 48
Pot life (approx.) at 30°C for two component paints, hrs	5-8	NA	3-6	0.5
Adhesion (ASTM D 4541)	>5	>4	>7	>8
Abrasion Resistance (ASTM D4060) For 1000 g load	<300 mg /1000 cycles/CS17 or <100 mg /1000 cycles/CS10	NA	NA	NA
Temperature resistance (min.) °C (ASTM D 2485) *Note 8	80 (Method A)	60 (Method A)	80 (Method A)	120 (Method A)

TABLE- 2: PAINT MATERIALS (Contd.)

DESCRIPTION	F-7	F-8	F-9	F-11	F-12
Technical name	High build coal tar epoxy coating.	Self-priming type surface tolerant high build epoxy coating (complete rust control Coating)	Inorganic zinc silicate Coating containing zinc content min. 80%. Shall pass MEK rub test as per ASTM D4752 with resistance rating >4	Heat resistant synthetic medium based two pack Aluminum Paint suitable up to 250°C dry temp.	Heat resistant silicone Aluminum Paint suitable up to 540°C dry temp.
Volume Solids % Minimum.	62	75	57	35	18
DFT per coat in μ	100-125	100-125	65-75	15-20	15-20
Theoretical covering capacity in M^2/coat/ litre	5-6.2	6-7.5	7.6-8.8	17.5-23.3	9-12
Weight per liter in Kg/litre (min.)	1.40	1.41	2.3	0.95	1.00
Touch dry at 30°C (maximum)	4 hrs.	3 hrs.	0.5 hrs.	3 hrs.	0.5 hrs.
Hard dry at 30°C (maximum),	48 hrs.	24 hrs.	12 hrs.	12 hrs	24 hrs.
Full cure 30°C (for immersion /high Temperature sev.)	5 days	5 days	NA	NA	NA
Over-coating interval, hrs	Min. 24 hrs Max.5days	Min. 10	Min. 12 hrs at 20°C & 50% RH	Min. 24	Min. 24
Pot life at 30°C for two component Paints, hrs	4-6	1.5	4-6	NA	NA
Adhesion MPa (ASTM D 4541)	>5	>5	>5	NA	NA
Temperature resistance (min.) ° C (ASTM D 2485) *Note 8	80 (Method A)	80 (Method A)	400 (Method B)	250 (Method A)	540 (Method B)

TABLE- 2: PAINT MATERIALS (Contd.)

DESCRIPTION	F-14	F-15	F-16	F-17	F-20
Technical name	Polyamine cured coal tar epoxy	Two-component Epoxy phenolic coating cured with Polyamine adduct hardener	Inert polymeric matrix coating suitable for under insulation for CS and SS.	Novolac epoxy phenolic coating cured with Polyamine adduct hardener	Glass flake reinforced vinyl ester coating.
Type & composition	Specially formulated polyamine cured coal tar epoxy suitable for application under insulation	Two pack ambient temperature curing epoxy phenolic coating system suitable for application under insulation	Suitable for high temperature service and under insulation coating for CS, alloy steel and SS	Novolac epoxy phenolic coating cured with Polyamine adduct hardener	Two component glass flake filled vinyl ester lining for under immersion services up to 90 deg. C.
Volume Solids % Minimum.	67	67	50	98	98
DFT per coat in microns	100-125	75-100	100-125	300-450	500-600
Theoretical covering capacity in M^2/coat/ litre	5.4-6.7	6.7-8.9	4-5	2.2-3.3	1.6-2
Weight per liter in Kg/litre (min.)	1.45	1.65	>1.3	1.7	>1.2
Touch dry at 30°C (max)	4 hrs.	3 hrs.	1 hrs.	2 hrs.	2 hrs.
Hard dry at 30°C (max).	24 hrs.	24 hrs.	16 hrs.	24 hrs.	4 hrs.
Full cure 30°C (for immersion / high temp service)	168 hrs (7 days)	168 hrs (7 days)	NA	168 hrs (7 days)	96 hrs (4 days)
Over-coating interval	Min. 6 hrs Max.5 days	Min. 36 hrs Max.21 days	Min.6 hrs Max. Not applicable	Min. 16 hrs Max.21 days	Min. 4 hrs Max.3 days

Pot life at 30°C, hrs (for two component paints)	4	4-6	1	1	50 min-1 hr.
Adhesion, MPa (ASTM D 4541)	>6	>7	NA	>8	>7, Tensile strength >20N/mm2 (ASTM D 638)
Temperature resistance (min.) ° C (ASTM D 2485) *Note 8 & 9	125 (Method A)	150 (Method A)	650 (Method B)	200 (Method A)	90 (Method A)

General notes for TABLE-2:

1. Covering capacity and DFT achieved per coat depends on method of application. Covering capacity specified above is theoretical. For estimation of actual quantity of paints required, include the losses during application. Minimum specified DFT should be maintained in any case.

2. All primers and finish coats should be ambient temperature curing and air drying unless otherwise specified.

3. All paints shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. Wherever a deviation is noticed from the specification in manufacturer data sheet, more stringent one between the data sheet and the specification shall prevail e.g. if this specification recommends Sa 2 ½ and the manufacturer data sheet requires Sa3, the surface preparation shall be done as per Sa 3. However, in another case if this specification requires the surface preparation of Sa 2 ½ and the manufacturer data sheet recommends only Sa 2 as minimum, the surface preparation shall be done as per Sa 2 ½.

4. Technical data sheets for all paints shall be supplied at the time of submission of quotations.

5. Internationally recognized & acceptable testing method shall be used for lab testing wherever testing standards are not mentioned.

6. Touch dry, hard dry, pot life, full cure period, & over coating interval shall be as per manufacturer's data sheets and no testing is required. Slight variation in the values of these parameters along with weight per liter may be permissible with the discretion of engineer-in-charge in consultation with SMMS.

7. Temperature resistance tests (ASTM D2485) shall be carried out for minimum required temperature resistance indicated.
8. Wherever ASTM D 2485 method B is applicable, test results of the panels subjected to salt spray (ASTM B 117) after muffle furnace exposure shall be submitted for pre-qualification purpose.

9. F6-C shall be suitable for drinking water service and should have certification from competent authority.

7.0 SELECTION OF COATING SYSTEMS

The external coating system for EIL projects should be selected based on the C5 environment (very high durability) as per ISO12944-2, design temperature, involved services of the steel substrate and plant location.

The paint system to be applied for a specific job shall be arrived at sequentially as given below:

a. Identify the environment from area classification details and choose the appropriate table.
b. Identify the design temperature from the technical documents.
c. Identify the specific field paint system and surface preparation requirement from the above identified table and temperature range.
d. Identify the shop priming requirement from based on compatibility of the above paint system.
e. Identify the need of repair of shop primer and execute as per Table-3.

7.1 Classification based on plant location:

a) Plant located in inland area (more than 50 km from coast).

- For offsite areas and utilities: Table-5 to be followed.
- For process units, DM plant, CPP and Cooling towers: Table-6 to be followed.

b) Plant located on sea coast or within 50 km from sea coast.

- For process units, DM plant, CPP, Cooling tower, offsite & utilities etc.: Table-6 to be followed.

c) For external surface of above ground tanks, Table-8 to be followed for all locations (inland or coastal)

TABLE-3: REPAIR OF PRE-ERECTION/PRE-FABRICATION OR SHOP PRIMER AFTER ERECTION/WELDING
(For all un-insulated CS, LTCS & alloy steel items in all environments)

Sl. No.	Design Temp. in °C	Surface Preparation	Coating System	Total DFT in Microns (min.)	Remarks
3.1	-45 to 80	SSPC-SP-3	1 coat of F-8 @ 125 µ DFT/coat	125	See Note-1 below and clause 5.11
3.2	81 to 400	SSPC-SP-3	1 coat of F-9 @ 65-75 µ DFT/coat	65-75	
3.3	401 to 550	SSPC-SP-3	1 coat of F-16 @ 125 µ DFT/coat	125	

Note for Table-3:

1. The application and repair of pre-erection/pre-fabrication and shop primer given in above tables shall be done for all the items to be painted. In case the damages of primer are severe and spread over large area, entire primer shall be removed by blasting to achieve SSPC-SP-10 and surfaces to be primed again with F-8/ F-9/F-16, as applicable. After the repairs of the primer,

suitable intermediate and final coats shall be applied as per applicable coating systems mentioned in Table 5.0 to Table 13.0.

TABLE-4: COATING SYSTEM FOR GALVANIZED ITEMS (Refer clause 2.2.7)

Sl. No.	Design Temp. in °C	Coating System	Total DFT in Microns (min.)	Remarks
4.1	Up to 60	Hot Dip Galvanizing with thickness as per ISO 1461, Surface preparation over galvanization as per SSPC SP 16 & ISO 12944-4; 1 coat of F-6B @ 100µ DFT/coat + 1 coat of F-2 @ 40 microns DFT/coat	140µ of finish coat (excluding the thickness of galvanizing)	Special primers like etch primer may also be considered for coating on galvanized surfaces

Notes for Table-4:

1. F-6B shall be modified type and suitable for coating over galvanization.
2. Repair of the damaged areas of galvanized coatings due to welding during erection shall be carried out as per recommended practice ISO 1461, using cold galvanizing spray process. Organic paint systems are not acceptable for the repair.
3. After repair of damaged galvanized coating by cold galvanization (P-7), the repaired area shall be top coated with paint system as given in table-4 above (i.e. 1 coat of F-6B @ 100µ DFT/coat + 1 coat of F-2 @ 40µ DFT/coat).
4. Galvanized gratings don't require painting in general until otherwise specified elsewhere or as per the requirement of the OWNER. Galvanized items may require painting to meet the colour coding requirement of the OWNER. Contractor has to ensure the applicable colour coding prior to application of coating as per this clause.

TABLE-5: COATING SYSTEM FOR INLAND PLANTS (OFFSITES & UTLITIES)

(For all un-insulated above ground CS, LTCS & Alloy steel piping, equipment, structures, valves, Vessels & columns, stacks etc.)

Sl. No.	Design Temp. in °C	Surface Preparation & Pre-erection/Shop Primer	Coating System		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
5.1	-45 to -15	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	-	-	65-75	a. No over-coating shall be done on F-9. b. Surface profile for F-9
5.2	-16 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	1 coat of P-6 @ 40 µ DFT/coat	1coat of F-6B @ 100 µ DFT/coat+ 1 coat of F-2 @ 40µ DFT/coat	245-255	

5.3	81 to 250	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	-	2 coats of F-11 @ 20µ DFT/coat (2x20=40)	105-115	shall be 30-40 µm c. F-12 shall be ambient temperature curing type
5.4	251 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	-	2 coats of F-12 @ 20µ DFT/coat (2x20=40)	105-115	
5.5	401-650	SSPC-SP-10; 1 coat of F-16 @ 125 µ	-	1 coat of F-16 @ 125 µ	250-300	-

TABLE-6: COATING SYSTEM FOR CORROSIVE AREAS (PROCESS UNITS, COOLING TOWER, DM AND CPP etc.)

(For all un-insulated above ground CS, LTCS & Alloy steel piping, equipment, structures, valves, vessels & columns, furnace stacks etc.)

Sl. No.	Design Temp. °C	Surface Preparation & Pre-erection/Shop Primer	Coating System		Total DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
6.1	-45 to -15	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/	-	-	65-75	a)No over coating on F-9 is allowed b) F-12 shall be ambient temperature curing type c) Surface profile for F-9 shall be 30-40 µm
6.2	-16 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/ coat	1 coat of P-6 @ 40 µ DFT/ coat	2 coats of F-6B @ 100 µ DFT/coat + 1 coat of F-2 @ 40µ DFT/coat (2x100 + 40= 240)	345-355	
6.3	81 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/ coat	-	2 coats of F-12 @ 20µ DFT/coat 2x20=40	105-115	
6.4	401-650	SSPC-SP-10; 1 coat of F-16 @ 125 µ	-	1 coat of F-16 @ 125 µ	250-300	-

NOTES for TABLE-5 & TABLE-6:

1. The list of items given in the heading of the above table is not exhaustive. There may be more items for a particular contract where these specifications are used. The CONTRACTOR is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated as per contract document and scope of work.

2. If the application of pre-erection/pre-fabrication/shop primer has already been completed, the same shall not be repeated in the field. In case the damages to the primer coat are severe and spread over large areas, the Engineer-In-Charge may decide & advise re-blasting and re-application of the primer coat. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table-3.

3. Flare line within unit or offsite areas shall be coated as per clause 6.3 of Table-6.

4. For external surface of RCC Chimney, 2 coats of F-6 B@ 100µ DFT/coat to obtain a total DFT of 200 µ shall be applied after proper surface preparation as per guidelines in clause 4.6.

TABLE-7: COATING SYSTEMS FOR EFFLUENT TREATMENT PLANT (ETP)

Sl. No.	Design Temp. in °C	Surface Preparation	Coating system		Total DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
7.1	For external surfaces of steel items: screens, walk way bridges, clarifier/thickener scrapping mechanism, baffles, Media filters/vessels (PSF, DMF, MMF, & ACF etc.), vertical pumps, CS/MS tanks/ vessels and structures.					
	-14 to 80	SSPS-SP-10	1 coat of F-9 @ 65-75µ DFT/coat	2 coats of F-6B @100µ DFT/coat + 1 coat of F-2 @ 40µ DFT/coat (2x100+40= 240)	305	-
7.2	For internal surfaces of steel items: all effluent handling units such as TPI, DAF, tube settlers, clarifiers, tanks, sludge tanks and sewage tank, wet slop oil tanks etc., scrapping mechanism in clarifier etc.					
	-14 to 80	SSPS-SP-10	1 coat of F-15 @ 80µ DFT/coat.	2 coats of F-15 @180µ DFT/coat (2x80=160)	240	-
7.3	All R.C.C./concrete surfaces exposed to effluent water / liquid such as tanks, structures, drains etc., all effluent handling units such as API, TPI, DAF, tube settlers, clarifiers, tanks, sumps, sludge sumps/tanks and sewage sumps/tank, wet slop oil sump/tanks etc.					
	-14 to 80	As per clause 4.6 of this specification	Epoxy screed lining		3000	Note 1
7.4	Internal surface of equipment like Media filters/vessels (PSF, DMF, MMF, & ACF etc.), activated carbon filters, alkaline, acids & other high corrosive service					
	Up to 90	SSPC-SP-10	1 coat of clear two component solvent free vinyl ester primer @ 100µ DFT/ Coat + 2 coats of F-20 @ 500µ DFT/ Coat		1100	Note-2

NOTES for TABLE-7:

1. Contractor shall follow manufacturer recommendations to develop epoxy screed lining procedure for EIL review and approval.
2. This coating system is applicable in conjunction with relevant PDS of the equipment.

TABLE-8: EXTERNAL COATING SYSTEMS FOR CARBON STEEL AND LOW ALLOY STEEL STORAGE TANKS

Sl. No.	Design Temp. in °C	Surface Preparation	Coating system (Note-1)		Total DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
8.1	All external surfaces of shell, wind girders, appurtenances, roof tops of all above ground tank including top side of external and internal floating roof and associated external structural works.					
8.1.1	-14 to 80	SSPC-SP-10	1coat of F-9 @ 65-75µ DFT/coat + 1coat of P-6 @ 40µ DFT/ coat	2 coats of F-6B @ 100µ DFT /coat + 1 coat of F-2 @ 40µ DFT/ coat	345-355	-
8.1.2	81 to 450	SSPC-SP-10	1coat of F-9 @ 65-75µ DFT/coat	1 coat of F-16 @ 125 µ DFT / coat	190-200	
8.2	External surfaces of bottom plate (in contact with soil) for all storage tanks.					
8.2.1	-14 to 80	SSPC-SP-10	1 coat of F-9 @ 65-75µ DFT/ coat	3 coats of F-7@ 150µ DFT/coat (3x150=450)	515-525	-
8.2.2	81 to 200	SSPC-SP-10	1 coat of F-17 primer @ 400µ DFT/ coat	1 coat of F-17 finish coat @ 400µ DFT/ coat	800-825	Note-4
8.3	For underside of the bottom plate (not in contact with soil)(in case tank is not lifted during PWHT) (Note- 2)					
8.3.1	-29 to 400	SSPC SP-10	1 coat of F-16 @ 125 µ	1 coat of F-16 @ 125 µ	250-300	Note-3

Notes for TABLE-8:

1. All paint coating application including primer for tanks shall be carried out at field after erection and completion of entire welding.

2. For underside of bottom plate as per clause no.8.3.1:

   a) Painting shall be carried out before laying the bottom plate for tanks with non-Post Weld Heat Treatment (PWHT).

   b) For tanks with PWHT, painting shall be carried out after PWHT.

   c) In case tank is not lifted during PWHT then painting shall be applied before laying the bottom plate.

3. This coating system is also applicable for temperature ranges not covered in 8.2 above.

4. This coating system is also applicable for bottom plates having MOC as Stainless Steel.

TABLE-9: INTERNAL COATING SYSTEMS FOR CARBON STEEL AND ALLOY STORAGE TANKS

Sl. No.	Design Temp. in °C	Surface Preparation	Coating system		Total DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
9.1	Internal side of bottom plate and first shell course of Crude oil tanks					
9.1.1	-14 to 90	SSPC-SP-10	1 Coat of F-6A @ 100 µ DFT/coat	1 Coat of F-6C @ 400 µ DFT/coat	500	-
9.2	Underside of floating roof, internal surfaces of shell for full height above first course, oil side surfaces of deck plates, oil side surfaces of pontoons, support structures, roof legs, drain pipes and ladders etc. of crude oil tanks					
9.2.1	-14 to 90	SSPC-SP-10	1 coat of F-15 primer @ 80µ DFT/ coat	1 coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/ coat	240	-
9.3	All internal surfaces of hydrocarbon, slops, amine solutions, sour water and other hydrocarbon-water solutions tanks but not limited to: Underside of floating roofs, internal surface of cone roof, inside of bottom plate, internal surfaces of shell for full height, underside of floating roof, oil side surfaces of deck plates, oil side surfaces of pontoons, support structures, roof legs, drain pipes and ladders etc.					
9.3.1	-14 to 45	SSPC-SP-10	1 coat of F-9 @ 65-75 µ DFT/coat	-	65-75	-

9.3.2	46 to 90	SSPC-SP-10	1 coat of F-15 primer @ 80µ DFT/ coat	1 coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/ coat	240	-
9.3.3	91 to 200	SSPC-SP-10	-	1 coat of F-17 @ 400µ DFT/coat	400	-
9.4	Potable, Raw & Fire water, De-mineralized (DM) water & Condensates etc. All internal surfaces but not limited to internal surfaces of shell for full height, bottom plate, accessories, roof and roof structures of cone and dome roof tanks etc.					
9.4.1	-14 to 60	SSPC-SP-10	1 Coat of F-6A @ 100µ DFT/coat	1 coat of F-6C @ 300-350 µ DFT/ coat	400-450	-
9.4.2	61 to150	SSPC-SP-10	1 coat of F-15 primer @ 80µ DFT/ coat	1 coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/ coat (80+80=160)	240	-
9.5	Hydrochloric acid (HCl) 10 %. All internal surfaces but not limited to internal surfaces of shell for full height, bottom plate, accessories, roof and roof structures of cone and dome roof tanks etc.					
9.5.1	-14 to 60	SSPC-SP-10	1 Coat of clear two component solvent free vinyl ester primer @ 100µ DFT/ Coat	2 Coats of F-20 @ 500µ DFT/ Coat	1100	-
9.6	Aggressive solvents like hexane, hexene, benzene, xylene and toluene etc.. All internal surfaces but not limited to internal surfaces of shell for full height, bottom plate, accessories, roof and roof structures of cone and dome roof tanks etc.					
9.6.1	-14 to 65	SSPC-SP-10	1 coat of F-9 @ 65-75µ DFT/ coat	-	65-75	-
9.7	Ethylene glycol tanks: All internal surfaces but not limited to internal surfaces of shell for full height, bottom plate, accessories, roof and roof structures of cone and dome roof tanks etc.					
9.7.1	All	SSPC-SP-10	-	3 coats of vinyl chloride co-polymer @ 75µ /Coat; (3x75=225)	225	-
9.8	Inside pontoon and inside of double deck of all floating roofs					
9.8.1	-14 to 80	SSPC-SP-3	1 coat of F-8 @ 100µ DFT/coat	1 coat of F-8 @ 100µ DFT/coat	200	-

9.8.2	81 to150	SSPC-SP-10	1 coat of F-15 primer @ 80µ DFT/ coat	1 coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/ coat (80+80=160)	240	-
9.8.3	151 to 200	SSPC-SP-10	-	1 coat of F-17 @ 400µ DFT/coat	400	-
9.9	Alkalis up to 50 % concentration: All internal surfaces but not limited to internal surfaces of shell for full height, bottom plate, accessories, roof and roof structures of cone and dome roof tanks etc.					
9.9.1	Up to 60°C	SSPC-SP-10	1 coat of F-15 primer @ 80µ DFT/ coat	2 Coats of F-6 A @ 100µ DFT/coat (2x100=200)	280	-

General Note for Table-9: The list of surfaces to be painted are not exhaustive. All internal surfaces of all type of tanks including structural items shall be coated as per the above table. No CS surface shall be kept un-painted.

TABLE-10: COATING SYSTEMS FOR EXTERNAL SIDE OF UNDERGROUND CARBON STEEL PLANT PIPING AND VESSELS

Sl. No.	Design Temp. in °C	Surface Preparation & Shop Primer	Coating system		Total DFT in Microns (min.)	Remarks
			Surface Preparation & Primer	Finish Coat		
10.1	Underground carbon steel plant piping.					
10.1.1	25 to 65	-	SSPC-SP-10; 1 coat of synthetic fast drying primer 25 @µ DFT/ coat	1 layer of coal tar tape coating @ 2mm +1 coat of synthetic fast drying primer @25 µ DFT/ coat + 1 layer of coal tar tape coating @ 2mm /layer as per 6-79-0011 Latest revision	4 mm	The primer DFT is not measurable. Re-conciliation primer shall be done by coverage of maximum 10 sq.m/litre
10.1.2	61 to 200	-	SSPC-SP-10; 1 coat of F-17 primer @400 µ DFT/ coat	1 coat of F-17 @ 400 DFT/coat	800	-

10.2	External side of underground storage vessels					
10.2.1	-45 to 80	SSPC-SP -10; 1 coat of F-9 @ 65-75µ DFT/ coat	-	3 coats of F-7 @ 100µ DFT/coat	365-375	-
10.2.2	81 to 200	SSPC-SP -10	1 coat of F-17 primer @400 µ DFT/ coat	1 coat of F-17 @400µ DFT/ coat	800	-

TABLE-11: COATING SYSTEMS FOR UNDER INSULATION (ALL UNIT AREAS & OFFSITES)
(For insulated piping, equipment, storage vessels, tanks, columns etc. of CS, LTCS, Alloy steel, SS, DSS and SDSS in all environments.)

Sl. No.	Design Temp. °C	Surface Preparation & Pre-erection/Shop Primer	Coating system		Total DFT Microns (min.)	Remarks
			Primer	Finish paint		
11.1	Carbon steel, LTCS and Alloy steel Piping, Storage tanks, Vessels, Equipment etc.					
11.1.1	-45 to 125	SSPC-SP-10; 1coat of F-15 @ 75µ DFT/coat	None	2 coats of F-15 @75µ DFT/coat	225	Note 1
11.1.2	126 to 450	SSPC-SP-10; 1 coat of F-16 @ 125µ DFT/coat	None	1 coat F-16 @ 125µ DFT/coat	250	
11.2	Stainless Steel, Duplex Stainless steel, Super Duplex stainless steel & Piping, Tanks, Vessels & Equipment etc.					
11.2.1	-45 to 125	SSPC-SP-16; (15-25µ surface profile) 1 coat of F-15 @75 µ DFT/coat	None	2 coats of F-15 @75µ DFT/coat	225	Note 1
11.2.2	126 to 650	SSPC-SP-16; (15-25µ surface profile) 1 coat of F-16 @125µ DFT/coat	None	1 coat of F-16 @125µ DFT/coat	250	

11.3	Cyclic service of CS, LTCS, SS, DSS, SDSS & Alloy Steels (Note-1)					
11.3.1	-45 to 150 (Note-1)	SSPC-SP-10 For CS, LTCS & Alloy steel. SSPC-SP-16 for SS; (15-25µ surface profile) 1 coat of F-15 @75 µ DFT/coat	None	2 coats of F-15 @75µ DFT/coat	225	Note-2&3
11.3.2	-180 to 650	SSPC-SP-10 for CS, LTCS & Alloy steel. SSPC-SP-16 for SS (15-25µ surface profile) 1 coat of F-16 @ 125µ DFT/coat	None	1 coat of F-16 @ 125µ DFT/coat	250	-

Notes

1. Coating system for any other design temperature range not covered in Sr. No. 11.1 & Sr. No. 11.2 shall be as per Sr. No. 11.3.2.
2. In case of overlapping of cyclic temperature ranges as mentioned in 11.3.1 and 11.3.2 then clause 11.3.1 shall be followed.
3. Alternatively, for this temperature range, 1 coat of F-17 @ 400 µ is also acceptable.

General notes for TABLE-11:

1. "Cyclic Service" is characterized by rapid or periodical temperature fluctuation or temperature cycles or as defined in the process datasheet.
2. The blasting abrasives for SS and alloy steels shall be aluminum oxide or garnet only.
3. The coating system applicable for any other temperature range shall be reviewed if it is encountered.

TABLE-12: INTERNAL COATING SYSTEMS FOR WATER SIDE COMPONENTS OF CS, SS, DSS & NON-FERROUS HEAT EXCHANGERS

Sl. No.	Design Temp. in °C	Surface Preparation & Pre-erection/Shop Primer	Coating System		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
12.1	Up to 80	SSPC-SP-10 for CS and SSPC-SP-16 for SS	1 coat of F-15 @ 80 µ DFT/coat	2 coats of F-15 @ 80 80 µ DFT/coat	240	-

12.2	81 to 200	SSPC-SP-10 for CS and SSPC-SP-16 for SS	-	2 coats of F-17@ 400µ/coat	800	-

Note for Table-12:

1. Coating systems are applicable as per requirement specified in the data sheets of the respective exchangers or equipment.

GENERAL NOTES FOR TABLE: 5 TO 12

1. For uninsulated or insulated items, scope of surface preparation, application of primers to finish coat including repair shall be as per applicable contractual documents like SOR, MR, and PR etc. The list of items are not exhaustive.

8.0 GUIDELINES FOR STORAGE & HANDLING

8.1 All paints and painting materials shall be stored in rooms only which are to be arranged by CONTRACTOR and approved by Engineer-In-Charge for the purpose. All necessary precautions shall be taken to prevent fire. The storage building shall preferably be separate from adjacent building. A signboard bearing the word "PAINT STORAGE- NO NAKED LIGHT-HIGHLY INFLAMMABLE" shall be clearly displayed outside. Manufacturers' recommendation /Materials safety datasheet shall be followed for storage and handling of paint materials.

Note: This standard doesn't address all the safety concerns if any, associated with its use. It is responsibility of the user of this standard to establish appropriate safety and health practice and determine the applicability of regulatory limitations prior to use.

9.0 COLOUR CODE

The colour coding system as per Annexure-1 of this specification shall be followed. However, OWNER's colour code prevails, if available. It is the CONTRACTOR's responsibility to obtain the same.

9.1 Identification

The system of colour coding consists of a ground colour and secondary colour bands superimposed over the ground colour. The ground colour identifies the basic nature of the service and secondary colour band over the ground colour distinguishes the particular service. The ground colour shall be applied over the entire length of the un-insulated pipes. For insulated lines, ground colour shall be provided as per specified length and interval to identify the basic nature of service and secondary colour bands to be painted on these specified length to identify the particular service. Above colour code is applicable for both unit and offsite pipelines.

9.2 Ground colour

On un-insulated pipes, the entire pipe has to be painted in ground colour. On metal cladded insulated lines, minimum 2 m long portion should be painted.

9.3 Colour bands

9.3.1. Location of colour bands:

a. At battery limits.
b. Intersection points & change of direction points in piping.
c. Midway of piping section, near valves, across culverts.
d. At 50 m interval on long stretch pipes.
e. At starting and termination points.

9.3.2. Minimum width:

NB	Width
3" and below	75 mm
Above 3" to 6"	NB X 25 mm
Above 6" to 12"	NB X 18 mm
Above 12"	NB X 15 mm

For insulated pipes, NB indicates OD of the insulation.

Sequence: Colour bands shall be arranged in sequence as shown above and the sequence follows the direction of flow. The width of the 1st Band to 2nd band is 4:1.
Wherever deemed required by process department or safety, pipes handling hazardous substances will be given hazard marking of 30 mm wide diagonal stripes of black and golden yellow.

9.4 Identification markings on equipment/piping

Equipment tag numbers shall be stenciled/neatly painted using normal 'Arial' lettering style on all equipment and piping (both insulated & un-insulated) after completion of all paint works. Lettering colour shall be either black or white, depending upon the background, so as to obtain good contrast.

Operations group shall specify the location of the marking.

Size of the making shall be as follows:

Columns, vessels, heaters	: 150 mm
Pumps and other machinery	: 50 mm
Piping	: OD / 2 with maximum 100 mm
Storage tanks	: (as per drawings)

9.5 Colour coding for control valve

a) Carbon steel body : Signal grey (RAL7004)
Alloy steel body Golden yellow (RAL1004)
Stainless steel body Natural

b) The actuator of the control valve shall be painted as:

Direct action (open on-air failure) valves : Traffic Green (RAL 6024)
Reverse acting (close on-air failure) valves: Traffic Red (RAL 3020)

The painting status shall be comprehensively updated every 6 months for compliance.

10.0 IDENTIFICATION OF VESSELS, PIPING ETC.

10.1 Equipment number shall be stenciled in black or white on each vessel, column, equipment & machinery (insulated or un-insulated) after painting. Line number in black or white shall be stenciled on all the piping of more than one location as directed by Engineer-In-Charge. Size of letter printed shall be as below:

Column & vessels	:	150 mm (high)
Pump, compressor & other machinery:		50 mm (high)
Piping	:	40-150 mm

10.2 Identification of storage tanks

The storage tanks shall be marked as detailed in the drawing.

11.0 PAINTING FOR CIVIL DEFENCE REQUIREMENTS

Painting for civil defense is a specific requirement and should be applicable as per instructions of OWNER and competent government authorities.

11.1 The following items shall be painted for camouflaging, if required by the client:

a. All columns
b. All tanks in offsite
c. Large vessels
d. Spheres

11.2 Two coats of selected finishing paint as per defense requirement shall be applied in a particular pattern as per clause 11.3 and as per the instructions of Engineer-In-Charge.

11.3 Method of camouflaging

a. Disruptive painting for camouflaging shall be done in three colours in the ratio of 5:3:2 (all matte finish).

Dark Green	Light Green	Dark Medium Brown
5	3	2

b. The patches should be asymmetrical and irregular.
c. The patches should be inclined at 30° to 60° to the horizontal.
d. The patches should be continuous where two surfaces meet at an angle.
e. The patches should not coincide with the corners.
f. Slits and holes shall be painted in dark shades.
g. Width of patches should be 1 to 2 m.

12.0 QUALITY CONTROL, INSPECTION AND TESTING

12.1 All painting materials including primers and thinners brought to site by CONTRACTOR for application shall be procured directly from manufactures as per specifications and shall be accompanied by manufacturers' test certificates. Paint formulations without certificates are not acceptable (see section 14.0 & 15.0).

12.2 The CONTRACTOR must produce test certificate from pre-qualified paint manufacturer for various tests as detailed out in section 15.0 of this document. The Engineer-In-Charge, in consultation with SMMS, shall have the right to test wet samples of paint at random for verifying quality of paint supplied. CONTRACTOR shall arrange to have such tests, as instructed, performed at his cost at any one of the NABL accredited laboratories under a TPI agency.

Samples for the test will be drawn at random in presence Engineer-In-Charge or his representations. Following tests to be carried out if called:

a. Specific Gravity
b. % solids by weight (% zinc content in case of inorganic or organic zinc primer)
c. Drying time (touch dry & full curing)
d. Adhesion test on a test panel prepared at the site (ASTM D 6677).

Test methods for above tests shall be as per relevant ASTM or ISO Standard.

12.3 The painting work shall be subject to inspection by Engineer-In-Charge at all times. In particular, following stage-wise inspection will be performed and CONTRACTOR shall offer the work for inspection and approval of every stage before proceeding with the next stage. The record of inspection shall be maintained in the registers. Stages of inspection are as follows:

a. Surface preparation
b. Primer application
c. Each coat of paint

12.3.1 Following tests are to be carried out during surface preparation:

a. Test for presence of oil/grease and contamination

The steel substrate after degreasing as per SSPC-SP-1 shall be tested as per following procedure to validate absence of oil and grease contamination:

- Visual inspection - continue degreasing until all visible signs of contamination are removed.
- Conduct a solvent evaporation test by applying several drops or a small splash of residue-free tri-chloromethane on the suspect area especially pitting, crevice corrosion areas or depressed areas. An evaporation ring formation is indicative of oil and grease contamination. Continue degreasing and inspection till test is passed.

b. **Tests for surface finish of blasted surface** shall be done by visual inspection using SSPC-VIS1. Clear cellophane tape test as per ISO 8502-3 shall be used to confirm absence of dust on blasted surface. Checks shall be done on each component at least once per 200 m^2 of blasted surface and a minimum of 3 checks per shift.

c. **Test for presence of soluble salt** as per method ISO 8502-9. Maximum allowable salt content shall be considered 20 mg/m^2.Checks shall be done on each component at least once per 200 m^2 of blasted surface and minimum of 3 checks per shift. In case salt exceeds specified limit, the contaminated surface shall be cleaned by method as per Annexure-C of ISO 12944-4 (water cleaning). After cleaning, surface shall be retested for salt after drying.

d. **Blast Profile Measurement**: (In-Process testing during actual production before application coating). The angular profile depth measurement shall be done by profile tape as per method

ASTM D 4417 method B (Profile depth gauge micrometer)/ calibrated Digital gauge meter. Spot measurement shall be carried out every 15m^2 of blasted surface. At each spot three measurements shall be taken over an area of 10 cm^2 and average of measurements to be recorded and reported. If profile is less than specified range, blasting shall continue till greater specified depth profile is achieved.

e. **Tests for blasting media:** Blasting Media (For every fresh batch of media and one random test during blasting). Blasting Media shall be visually inspected for absence of contamination and debris using 10 X magnification.

- Inspection for the absence of oil contamination shall be conducted using following procedure :
  - Fill a small clean 200 ml bottle half full of abrasive.
  - Fill the bottle with potable water, cap and shake the bottle.
  - Inspect water for oil film/slick. If present, the blasting media is not to be used.
- Soluble salt contamination if suspected shall be verified by method ASTM D 4940. If present, media to be replaced.
- Clean blasting equipment, especially pot and hoses, and then replace blasting media and retest.

f. **Test for Blasting Air** (Once Daily before start of blasting and once at random during Blasting). The air for blasting shall be free from moisture and oil. The compressor air shall be checked for oil and water contamination per ASTM D 4285.

In addition to above, record should include type of shop primer already applied on equipment e.g. zinc silicate or zinc rich epoxy or zinc phosphate. Any defect noticed during the various stages of inspection shall be rectified by the CONTRACTOR to the entire satisfaction of Engineer-In-Charge before proceeding further. Irrespective of the inspection, repair and approval at intermediate stages of work, CONTRACTOR shall be responsible for rectifying any defects found during final inspection/guarantee period/defect liability period as defined in general conditions of the contract. Dry film thickness (DFT) shall be checked and recorded after application of each coat and extra coat of paint should be applied to make-up the DFT specified without any extra cost to OWNER. the extra coat should have prior approval of Engineer-in-charge.

12.4 Final inspection of finished coating shall consist of the following:

a. **Coating DFT & WFT check:** DFT measurement shall be as per ISO 2808. Type-II electronic gauge shall be used as described in ASTM D7091. DFT gauge calibration, adjustment of gauge coating thickness, frequency and number of coating thickness measurement shall be as per ASTM D7091 and SSPC-PA2. Measured DFT shall have a tolerance as per SSPC-PA-2 level-3 of the dry film thickness, specified in this specification. Once in every layer of coating application, spot checks of WFT shall be carried out during the coating application according to ISO 2808 Method No. 1A comb gauge. This is to ensure that film thickness is being achieved as per the specification.

b. **Adhesion testing:** Adhesion of the primer to the steel substrate and inter-coat adhesion of the subsequent coat(s) after curing for at least a week after application of the topcoat shall be examined by a knife test in accordance with ASTM D6677. For the knife test, if the rating is better than 8, the adhesion is considered acceptable. The adhesion is destructive and tested areas shall be repaired afterward using the spot repair procedure. Alternatively, the applicator may perform

the adhesion test on a steel panel coated using the same surface preparation and coating application procedure as the work piece. Adhesion testing shall be carried out for each component at least once per 200 m^2 of coated surface.

c. **Holiday detection check:** Holiday testing of non-conductive coatings shall be carried out in accordance with NACE SP0188. For immersion, buried & under insulation services, 100% of coated area shall be inspected for holidays. For atmospheric exposure, 10% of coated area which must include weld seams, corners and edges to be holiday tested. Voltage at which test is to be carried out will depend upon DFT of coating being tested and shall be as per NACE SP0188. Any holiday is unacceptable and should be marked and repaired immediately.

The CONTRACTOR shall arrange for spot checking of paint materials for specific gravity, glow time (ford cup) and spreading rate.

13.0 PAINT MATERIAL GUARANTEE CERTIFICATE

The CONTRACTOR shall guarantee that the chemical and physical properties of paint materials used are in accordance with the specifications contained herein/to be provided during execution of work and shall submit necessary certificate of the paint material.

14.0 QUALIFICATION CRITERIA OF PAINTING CONTRACTOR/SUB-CONTRACTOR

Painting CONTRACTOR who is awarded any job for EIL, Projects under this standard must have necessary equipment, machinery, tools and tackles for surface preparation, paint application and inspection. The CONTRACTOR must have qualified, trained and experienced surface preparator, paint applicator, inspector and supervisors. The CONTRACTOR supervisor, inspector, surface preparator and paint applicator must be conversant with the standards referred in this specification.

15.0 PRE-QUALIFICATION/ACCEPTANCE CRITERIA FOR PAINT COATING SYSTEM

15.1 Pre-qualification of paint coating manufacturer and their products

Paint manufacturer meeting the following requirements shall be considered by the CONTRACTOR for supply of the paint products.

a) Manufacturer should have been in continuous business of paint coating formulation and manufacturer for at least past 5 years.

b) Manufacturer should possess past experience of supplying his products to hydrocarbon, petrochemical, fertilizer. Chemical processing industry or offshore platforms in the past 5 years.

c) Coating manufacturer should have supplied at least 10000 litre of an individual product to hydrocarbon, petrochemical, fertilizer. Chemical processing industry or offshore platforms.

d) The manufacturer's manufacturing procedure & QA/QC system shall meet ISO 9001 requirements and preferably should possess ISO 14000 certificate.

e) The Quality control set up should be manned by qualified paint technologists whose biodata should be sent along with quality control organization chart.

The Past Track record of the manufacturers as mentioned above shall be substantiated by providing relevant documents to EIL-SMMS for their review and acceptance. This shall include Work Orders, Purchase orders and ISO 9001 certification covering all the requirements mentioned from bullets a) to e) above.

CONTRACTOR shall procure the paint materials from the qualified manufacturer meeting above requirements and after obtaining prequalification testing approval as per requirements mentioned in clause 15.2 below.

15.2 Pre-Qualification Testing procedure:

The paint manufacturer engaged by the mechanical contractor shall carry out the tests in NABL accredited government laboratories or in suggested list of laboratories below, as a part of qualification. Paint manufacturer shall provide the paint samples to laboratory for testing of the parameters mentioned in Table-2 (typical characteristics) and Table-13 (tests on coating systems) of this specification. The testing laboratory will confirm the compliance of the paint material with respect to the acceptance criteria mentioned in the respective tables. Colored photographs of coated test panels should be taken before and after the test and should be enclosed along with test report. Contractor shall furnish these test certificates along with all necessary supporting documents/information to EIL-SMMS for approval/ acceptance. The paint manufacturer will be qualified and approved by EIL-SMMS for supply of paints after review/assessment of the submissions made by the contractor. Test certificates which are more than 3 years old will not be considered. Paint manufacturers are advised to carryout pre-qualification testing accordingly for paints supply to EIL projects.

List of suggested laboratories:

1. National Test house – Kolkata
2. National Test house-Mumbai
3. HBTU- Kanpur
4. GIRDA (Gujarat Industrial Research & Development Agency)- Vadodara
5. Indian institute of chemical technology – Hyderabad
6. RITES – Kolkata
7. ICT- Mumbai

TABLE-13: PRE-QUALIFICATION TESTING

SYSTEM No.	COATING SYSTEM	REFERENCE CLAUSE (from table-3 to 12)	TOTAL DFT µ (min)
1.	F-9+P6+F6B+F2	6.2	345
2.	F9+F12+F12	6.3	105
3.	F15+F15+F15	9.2.1	240
4.	F16+F16	8.3.1	250
5.	F17	9.3.3	400
6.	F8	3.1	125
7.	F20+F20	9.3.1	1100
8.	F6A+F6C	9.1.1	500
9.	F9+F7+F7+F7	10.2.1	365
10.	F15+F6A+F6A	9.9.1	280

S. No.	TEST	FOR SYSTEM NUMBER	DURATION	ACCEPTANCE CRITERIA
1.	Cyclic Test Salt Spray : 72 hrs. Drying in air: 16 hrs. UV-A340 nm weather meter: 80 hrs. One cycle: 168 hrs. (25 cycles at 168 hrs. each cycle) (ASTM D5894)	1	4200 hrs.	Shall pass. No chalking, cracking, flaking, blistering or peeling shall be observed.
2.	Chemical Resistance Test (ASTM D543)			
2a.	10% & 40% NaOH	3, 5, 7, 9 & 10	1000 hrs.	Shall pass. No cracking, discoloration, blistering, peeling or softening of film shall be observed.
2b.	5% H2SO4		168 hrs.	
2c.	Xylene		4 weeks	
2d.	Acetone		4 weeks	
2e.	Ethanol		4 weeks	
2f.	Kerosene		4 weeks	
2g.	Sea water		2000 hrs.	
3.	Immersion in DM/DI water @90^0 (ASTM C868)	3, 5, 7, 9 & 10	30 days	No softening, blistering or film damage.
4.	Resistance to DM water using water immersion. (ASTM D870)	8	2000 hrs.	Shall pass. No chalking, cracking, flaking, blistering or peeling.
5.	100% Humidity Test (ASTM D2247)	1 to 10 (except system-2)	1440 hrs.	Shall pass
6.	Thermal Shock Resistance Test; 5 cycles @ 30 minutes in furnace at 120 ° C and 15 minutes in water after quenching in water for each cycle. (ASTM D2485 method A)	2, 3, 4, & 10 (For system-2, testing to be done after heating the panels at 400°C for 2 hrs.)	-	Shall pass

7.	Cathodic Disbondment Test (ASTM G42 @80°C)	3, 5, 9, & 10	-	Diameter of cathodic Disbondment < 10 mm with 6 mm diameter artificial holiday.
8.	Assessment of Adhesion and artificial ageing as per ISO 19277	3, 4, 5, 9 & 10	-	Shall Pass

Each coating product to be qualified shall be identified by the Specific gravity of base and curing agent (ISO 2811). The identification shall be carried out on the batch, which is used for the pre-qualification testing.

15.3 Information to be furnished during delivery of paint materials:

CONTRACTOR along with delivery of paint material has to furnish following information from paint manufacturer to EIL for acceptance/approval of products:

a) Batch test certificates:

Along with paint products delivery to site from the pre-qualified coating manufacturer, CONTRACTOR has to produce test certificate (from paint manufacturer) for each category of product for the following test items. All test results must mention clearly the batch no. and category of product tested. Tests to be conducted for following properties:

- Specific Gravity
- % solids by weight (% zinc content in case of inorganic or organic zinc primer) ~ ASTM D521.

b) Product information sheet/ technical data sheet for each category of product.
The contractor shall be fully responsible for the quality of the paints products as per prequalification testing. After the paint materials are supplied to site, the supplier shall organize random sampling and testing in a NABL laboratory as per discretion of the Engineer-in-charge in consultation with SMMS. Failing to meet the specified quality requirements may cause rejection of the paint products.

16.0 METHOD OF SAMPLING & DISPATCH FOR LABORATORY TESTING
(Pre-Qualification tests (sec. 15.2), Batch testing (sec. 15.3) and Inspection testing (sec. 12.0))

16.1 Samples of coating materials should be submitted to the laboratory in sealed containers with batch no. and test certificate on regular format of manufacturer's testing laboratory.

16.2 All test panels should be prepared by testing laboratory. Surface preparation for a system shall be done in accordance with this specification. For individual products testing, minimum shall be Sa 2.5. Colour photographs of test panels should be taken before and after the test and should be enclosed along with test report. Sample batch no. and manufacturer's test certificate should be enclosed along with the report. Test report must contain details of observation and rusting if any, as per the testing code.

16.3 Manufacturers should intimate EIL, details of sample submitted for testing, name of testing agency, date, and contact personnel of the testing agency.

ANNEXURE-1: COLOUR CODE

SR. No.	SERVICE	RECOMMENDED COLOUR FOR PAINT SYSTEM	RAL COLOUR CODE	
			BASE COLOUR	BAND COLOUR
		HYDROCARBON LINES (UNINSULATED)		
1	CRUDE SOUR	Basalt Grey with 1 deep orange band	7012	2011
2	CRUDE SWEET	Basalt Grey with 1 signal red band	7012	3001
3	LUBE OILS	Basalt Grey with 1 grass green band	7012	6010
4	FLARE LINES	White Aluminum		9006
5	LPG	Deep Orange with 1 oxide red band	2011	3009
6	PROPYLENE	Deep Orange with 2 Cobalt blue bands	2011	5013
7	NAPTHA	Deep Orange with 1 grass green band	2011	6010
8	M.S.	Deep Orange with 1 Basalt Grey band	2011	7012
9	AV.GASOLINE (96 RON)	Deep Orange with 1 band each of grass green, white and signal red bands	2011 6010	9010 3001
10	GASOLINE (regular, leaded)	Deep Orange with 1 Jet black band	2011	9005
11	GASOLINE (premium, leaded)	Deep Orange with 1 Cobalt blue band	2011	5013
12	GASOLINE (white)	Deep Orange with 1 white band	2011	9010
13	GASOLINE (Aviation 100/130)	Deep Orange with 1 signal red band	2011	3001
14	GASOLINE (Aviation 115/145)	Deep Orange with 1 traffic purple band	2011	4006
15	N-PENTANE	Deep Orange with 2 Cobalt blue bands	2011	5013
16	DIESEL OIL (White)	Oxide red with 1 white band	3009	9010
17	DIESEL OIL (Black)	Oxide red with 1 traffic yellow band	3009	1023
18	KEROSENE	Oxide red with 1 grass green band	3009	6010
19	HY.KEROSENE	Oxide red with 2 grass green bands	3009	6010
20	DISUFIDE OIL (EX-MEROX)	Oxide red with 1 jet black band	3009	9005
21	M.T.O	Oxide red with 3 grass green bands	3009	6010
22	DHPPA	Oxide red with 2 white bands	3009	9010
23	FLUSHING OIL	Oxide red with 2 jet black bands	3009	9005
24	LAB FS	Oxide red with 2 Basalt Grey bands	3009	7012
25	LAB RS	Oxide red with 3 Basalt Grey bands	3009	7012

26	LAB (Off. Spec)	Oxide red with 1 light grey band	3009	7035
27	N-PARAFFIN	Oxide red with 1 Cobalt blue band	3009	5013
28	HEAVY ALKYLATE	Oxide red with signal red band	3009	3001
29	BLOW DOWN, VAPOR LINE	Off white / Aluminum with 1-Brown band	9006	8004
30	BLOWDOWN	Off white / Aluminum with 2 copper brown bands	9006	8004
31	A.T.F.	Clay Brown with 1 white band	8003	9010
32	TOULENE	Clay Brown with 1 traffic yellow band	8003	1023
33	BENZENE	Clay Brown with 1 grass green band	8003	6010
34	LAB PRODUCT	Clay Brown with 1 Cobalt blue band	8003	5013
35	FUEL OIL	Jet Black with 1 traffic yellow band	9005	1023
36	FULE OIL (Aromatic rich)	Jet Black with 2 traffic yellow bands	9005	1023
37	ASPHALT	Jet Black with 1 white band	9005	9010
38	SLOP AND WASTE OILS	Jet Black with 1 deep orange band	9005	2011
39	SLOP AROMATICS	Jet Black with 2 deep orange bands	9005	2011
		CHEMICAL LINES		
40	TRI-SODIUM PHOSPHATE	Lemon Yellow with 1 violet blue band	1012	5000
41	CAUSTIC SODA	Lemon Yellow with 1 jet black band	1012	9005
42	SODIUM CHLORIDE	Lemon Yellow with 1 white band	1012	9010
43	AMMONIA	Lemon Yellow with 1 Cobalt blue band	1012	5013
44	CORROSION INHIBITOR	Lemon Yellow with 1 Aluminum band	1012	9006
45	HEXAMETA PHOSPHATE	Lemon Yellow with 2 jet black bands	1012	9005
46	ACID LINES	Golden Yellow with 1 signal red band	1004	3001
47	RICH AMINE	Lemon Yellow with 2 Cobalt blue bands	1012	5013
48	LEAN AMINE	Lemon Yellow with 3 Cobalt blue bands	1012	5013
49	SOLVENT	Lemon Yellow with 1 grass green band	1012	6010
50	LCS	Lemon Yellow with 1 Blue Grey	1012	7031
		WATER LINES		
51	RAW WATER	Sky blue with 1 jet black band	5015	9005
52	INDUSTRIAL WATER	Sky blue with 2 signal red band	5015	3001

53	TREATED WATER	Sky blue with 1 oxide red band	5015	3009
54	DRINKING WATER	Sky blue with 1 grass green band	5015	6010
55	COOLING WATER	Sky blue with 1 light brown band	5015	1011
56	SERVICE WATER	Sky blue with 1 signal red brown	5015	3001
57	TEMPERED WATER	Sky blue with 2 grass green bands	5015	6010
58	DM WATER	Sky blue with 1 aluminum band	5015	9006
59	DM WATER ABOVE 150°F	Sky blue with 2 jet black bands	5015	9005
60	SOUR WATER	Sky blue with 2 traffic yellow bands	5015	1023
61	STRIPPED WATER	Sky blue with 2 Cobalt blue bands	5015	5013
62	ETP TREATED WATER	Sky blue with 2 oxide red bands	5015	3009
	FIRE PROTECTION SYSTEM (ABOVE GROUND)			
63	FIRE WATER FOAM & EXTINGUISHERS	Carmine Red	3002	
	AIR & OTHER GAS LINES (UNINSULATED)			
64	SERVICE AIR	Yellow green with 1 signal red band	6018	3001
65	INSTRUMENT AIR	Yellow green with 1 jet black band	6018	9005
66	NITROGEN	Yellow green with 1 deep orange band	6018	2011
67	FREON	Yellow green with 1 traffic yellow band	6018	1023
68	CHLORINE	Lemon Yellow with 1 oxide red band	1012	3009
69	SO_2	Lemon Yellow with 2 white bands	1012	9010
70	H_2S	Deep Orange with 2 oxide red bands	2011	3009
71	GAS (Fuel)	Deep Orange with 1 aluminum band	2011	9006
72	GAS (Sour)	Deep Orange with 2 aluminum bands	2011	9006
73	GAS (Sweet)	Deep Orange with 2 signal red band	2011	3001
74	HYDROGEN	Deep Orange with 1 Pale green band	2011	6021
	STEAM AND CONDENSATE LINES (UNINSULATED)			
75	HP STEAM	White Aluminum with 1 traffic yellow band	9006	1023
76	MP STEAM	White Aluminum with 1 signal red band	9006	3001
77	MLP STEAM	White Aluminum with 1 orange band	9006	2011

78	LP STEAM	White Aluminum with 1 light green band	9006	6021
79	CONDENSATE	Sky blue with 1 white band	5015	9010
80	CONDENSATE ABOVE 150°F	Sky blue with 3 oxide red band	5015	3009
81	BFW	Sky blue with 2 signal red bands	5015	3001
Note: For all insulated steam lines, the colour coding shall be followed as given for un-insulated lines with the specified length of colour bands.				
INSULATED HYDROCARBON PIPING				
82	IFO SUPPLY	Jet Black ground colour with 1 traffic yellow band in centre	9005	1023
83	IFO RETURN	Jet Black ground colour with 1 grass green band in centre	9005	6010
84	HPS	Jet Black ground colour with 1 signal red band in centre	9005	3001
85	BITUMEN	Jet Black ground colour with 2 signal red bands in centre	9005	3001
86	CLO	Jet Black ground colour with 1 brown band in centre	9005	8004
87	VB TAR	Black ground colour with 2 copper brown bands in centre	9005	8004
88	VR AM (BITUMEN / VBU FEED)	Jet Black ground colour with 1 Cobalt blue band in centre	9005	5013
89	VR BH	Black ground colour with 2 Cobalt blue bands in centre	9005	5013
90	VAC. SLOP	Black ground colour with 1 white band in centre	9005	9010
91	SLOP	Black ground colour with 1 deep orange band in centre	9005	2011
92	CRUDE SWEET	Basalt Grey ground colour with 1 signal red band in centre	7012	3001
93	CRUDE OUR	Basalt Grey ground colour with 1 deep orange band in centre	7012	2011
94	VGO / HCU	Oxide red ground colour with 2 iron grey bands in centre	3009	7011
95	OHCU BOTOM / FCCU FEED	Oxide red ground colour with 2 iron grey bands in centre	3009	7011
UNINSULATED EQUIPMENT, TANKS AND STRUCTURES				
96	HEATER STRUCTURE	Iron grey	7011	
97	HEATER CASING	White Aluminum	9006	
98	VESSELS & COLUMNS	White Aluminum	9006	
99	HYDROGEN BULLETS	Antique Pink	3014	
100	LPG VESSELS	Oxide red	3009	

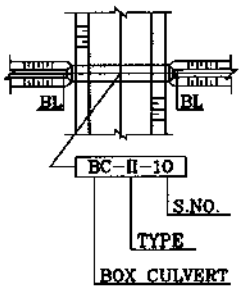
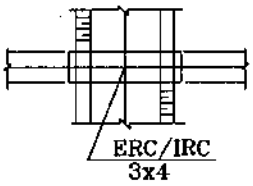
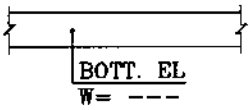
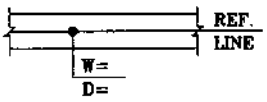
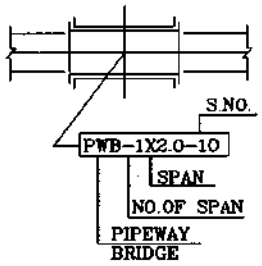
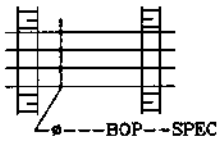
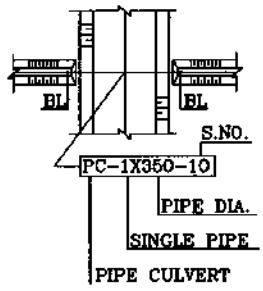
101	SO_2 VESSEL	Lemon Yellow	1012	
102	HEAT EXCHANGER	White Aluminum	9006	
103	FO TANK AND HOT TANKS	Jet Black	9005	
104	ALL OTHER TANKS	White Aluminum	9006	
105	CAUSTIC / AMINE / ACID TANKS	Golden yellow	1004	
106	SOUR WATER	Sky Blue	5015	
107	OUTER SURFACE IN BOILER HOUSE	Aluminum	9006	
108	COMPRESSORS AND BLOWERS	Basalt Grey	7012	
109	PUMPS	Pigeon Blue	5014	
110	MOTORS & SWITCH GEAR	Pastel Blue	5024	
111	HAND RAILING	Signal red	3001	
112	STAIRCASE, LADDER AND WALKWAYS	Jet Black	9005	
113	LOAD LIFTING EQUIPMENT AND MONORAILS ETC	Clay Brown	8003	
114	GENERAL STRUCTURE	Jet Black	9005	
115	FLUE GAS STACK	Jet Black	9005	
	PIPES AND FITTINGS OF ALLOY STEEL AND SS MATERIAL IN STORE			
115	IBR	Signal red	3001	
116	9Cr-1Mo	Pale Green	6021	
117	5Cr-0.5Mo	Light Blue	5012	
118	$2_{1/4}$Cr-1 Mo	Luminous Yellow	1026	
119	$1_{1/4}$Cr-½ Mo	Traffic Yellow	1023	
120	SS-304	Grey Blue	5008	
121	SS-316	Blue Lilac	4005	
122	SS-321	Pigeon Blue	5014	
	SAFETY COLOUR SCHEMES			
123	DANGEROUS OBSTRUCTION	Jet Black and Bright Red Orange band	9005	2008
124	DANGEROUS OR EXPOSED PARTS OF MACHINERY	Bright Red Orange	2008	

ABBREVIATIONS

ABD	AMINE BLOW DOWN
API	AMERICAN PETROLEUM INSTITUTE
ANSI	AMERICAN NATIONAL STANDARD INSTITUTE
AWWA	AMERICAN WATER WORKS ASSOCIATION
BC	BOX CULVERT
BCR	BEARING COOLING RETURN
BE	BEVEL END
BF	BLIND FLANGE
BL	BED LEVEL
BOP	BOTTOM OF PIPE
BOTT.EL	BOTTOM ELEVATION(CABLE DUCT ETC)
CBD	CLOSE BLOW DOWN
CI	CAST IRON
C/C	CENTRE TO CENTRE
CL OR ℄	CENTRE LINE
CONC.RED	CONCENTRIC REDUCER
CONC	CONCRETE
CPLG	COUPLING
CS	CARBON STEEL
CONN	CONNECTION
CONT	CONTINUATION
CRWS	CONTAMINATED RAIN WATER SEWER
CW	CONSTRUCTION WATER/CARRIAGE WAY
CWPH	COOLING WATER PUMP HOUSE
CWS	CAUSTIC WASTE SEWER
COL	COLUMN
DIA	DIAMETER
DWG	DRAWING
DISCH.	DISCHARGE
DS	SANITARY SEWER
ETP	EFFLUENT TREATMENT PLANT
ECC	ECCENTRIC
EL	ELEVATION
ERC	ELECTRIC CABLE ROAD CROSSING
EW&SS	EYE WASH & SAFETY SHOWER
FCR	FOR CONTINUATION REFER
FF	FLAT FACE
FGL	FINISHED GROUND LEVEL
F TO F	FACE TO FACE
FFL	FINISHED FLOOR LEVEL
FLGD.	FLANGED
FDN	FOUNDATION
GLV	GALVANISED
GT	GALVANISED BLACK STEEL TUBE
GR	GROUND/GRADE
HC	HOSE COUPLING
HP	HORSE POWER
HS	HOSE STATION
HPP	HIGH POINT OF PAVEMENT
ID	INSIDE DIAMETER
INST	INSTRUMENT
INV	INVERT
IRC	INSTRUMENT CABLE ROAD CROSSING
MDS	MECHANICAL DATA SHEET
MK	MARK
MR	MATERIAL REQUISITION
MTO	MATERIAL TAKE OFF
MS	MILD STEEL
MH	MANHOLE
NGL	NATURAL GROUND LEVEL
OD	OUTSIDE DIAMETER
OHT	OVERHEAD TANK
OWS	OILY WATER SEWER
PC	PIPE CULVERT
PDS	PROCESS DATA SHEET
PE	PLAIN END
PR	PURCHASE REQUISITION
PWS	PROCESS WASTE SEWER
PWB	PIPE WAY BRIDGE
RCC	REINFORCED CEMENT CONCRETE
R	RADIUS
RF	RAISED FACE
REF	REFERENCE
RW	ROAD WAY
SO	SLIP ON
SOR	SCHEDULE OF RATES
SS	STORM SEWER
STD	STANDARD
SCRC	STREET CABLE ROAD CROSSING
STN	STATION
SWS	SANITARY WASTE SEWER
TEMP	TEMPERATURE
TOS	TOP OF SLEEPER
TYP	TYPICAL
TWDK	TEMPORARY DRINKING WATER
WCS	COOLING WATER SUPPLY
WCR	COOLING WATER RETURN
WDK	DRINKING WATER
WF	FIRE WATER
WR	RAW WATER
WH	HORTICULTURE WATER
WT	TREATED WATER
WF	FILTERED WATER
WWS	WASTE WATER SYSTEM

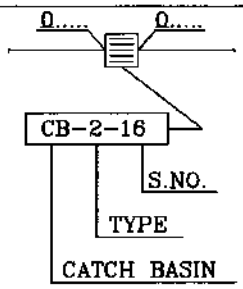
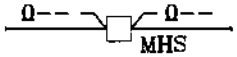
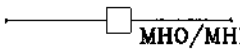
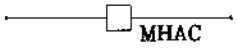
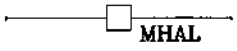
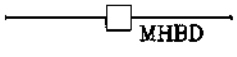
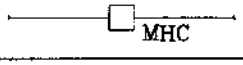
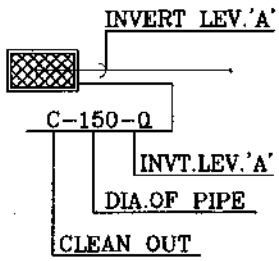
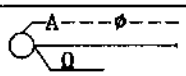
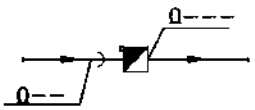
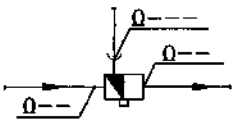
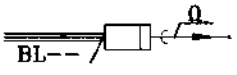
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
4	06.09.18	REVISED & ISSUED AS STANDARD	CV/CS	RKS	RS	RKT
3	01.10.09	REVISED & ISSUED AS STANDARD	SKP	RKS/RBB	NK	ND

LEGENDS

○	NATURAL GROUND LEVEL		BOX CULVERT REPRESENTATION ON AREA DRAWING
●	FINISHED GROUND LEVEL		
⊖	ROAD TOP LEVEL/ PAVEMENT TOP LEVEL		
⊕	FINISHED FLOOR LEVEL OF BUILDING		
—·—·—	CENTRE LINE		
— — —	LAND ACQUISTION LIMIT		ERC-ELELCTRIC CABLE 3x4 ROAD CROSSING NO.OF PIPE IN EACH LAYER LAYERS
▬▬▬	COMPOUND WALL		
———	BATTERY LIMIT		
—·—·—	MATCHING LINE		R.C.C. CABLE TRENCH
ROAD-A	ROAD-A REPRESENTATION ON LAYOUTS		
ROAD-A	ROAD-A REPRESENTATION IN AREA DRAWINGS		BURIED CABLE TRENCH D=DEPTH W=WIDTH
HIGHER EDGE / LOWER EDGE	SIDE SLOPE		PIPEWAY BRIDGE
BL	TRAPEZOIDAL DITCH REPRESENTATION ON AREA DRAWING		
BL TYPE---	RECTANGULAR DITCH REPRESENTATION ON AREA DRAWING		
BL	TRAPEZOIDAL DITCH REPRESENTATION ON LAYOUT DRAWING		
BL TYPE---	RECTANGULAR DITCH REPRESENTATION ON LAYOUT DRG.		PIPE SLEEVES
BL BL PC/BC---	PIPE CULVERT BOX CULVERT REPRESENTATION ON LAYOUT DRG.		
	PIPE CULVERT REPRESENTATION ON AREA DRAWING	CW	CONSTRUCTION WATER PIPE LINE
		WT	TREATED WATER PIPE LINE
		TWDK	TEMPORARY DRINKING WATER PIPE LINE
		WDK	DRINKING WATER PIPE LINE

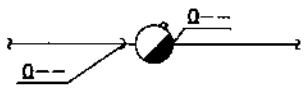
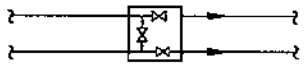
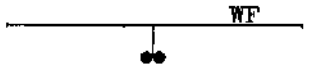
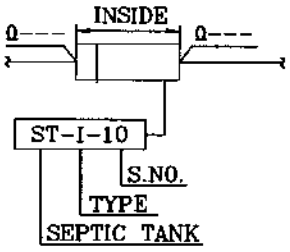
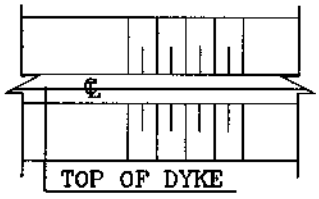
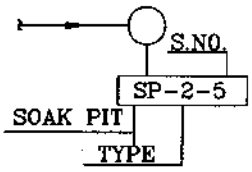
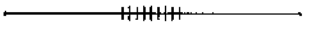
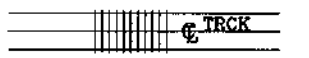
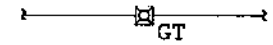
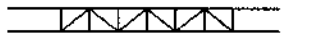
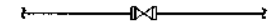
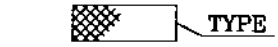
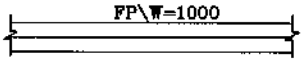
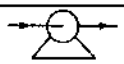
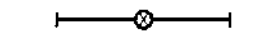
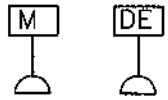
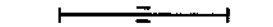
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
4	06.09.18	REVISED & ISSUED AS STANDARD	CS	RKS	RS	RKT
3	01.10.09	REVISED & ISSUED AS STANDARD	SKP	RKS/RBB	NK	ND

Approved by

WCS	COOLING WATER SUPPLY PIPE		45° BEND (TURNED DOWN)
WCR	COOLING WATER RETURN PIPE		CATCH BASIN
WF	FIRE WATER PIPE LINE		
WH	HORTICULTURE WATER PIPE LINE		
WS	SERVICE WATER PIPE LINE		
ø-----SS	STORM SEWER		PIPE INVERT LEVEL
ø-----DS	SANITARY WATER SEWER		SANITARY SEWER MANHOLE
ø-----OWS/PWS	OILY WASTE SEWER/ PROCESS WASTE SEWER		OILY/PROCESS SEWER MANHOLE
ø-----CTBD	COOLING TOWER BLOW DOWN		ACIDIC SEWER MANHOLE
ø-----ACID	ACIDIC SEWER		ALKALI SEWER MANHOLE
ø-----ALKALI	ALKALI SEWER		CTBD SEWER MANHOLE
ø----C1 SANITARY PUMPING	SANITARY PUMPING MAIN		CHEMICAL SEWER MANHOLE
	GATE VALVE		CIRCULAR MANHOLE
	GLOBE VALVE		CLEAN OUT
	BUTTERFLY VALVE		
	CHECK VALVE		
	FLOAT VALVE		
	PIPE WITH FLANGED END		FUNNEL FOR STORAGE TANK DRAIN
	BLIND FLANGED END		RECTANGULAR SEALED MANHOLE (SINGLE COMPARTMENT)
TYPE	VALVE PIT IN PIPE LINE		
	90° BEND (TURNED UP)		RECTANGULAR SEALED MANHOLE (DOUBLE COMPARTMENT)
	90° BEND (TURNED DOWN)		
	45° BEND (TURNED UP)		SAND TRAP

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
4	06.09.18	REVISED & ISSUED AS STANDARD	CS	RKS	RS	RKT
3	01.10.09	REVISED & ISSUED AS STANDARD	SKP	RKS/RBB	NK	ND

Approved by

	SEALED MANHOLE (CIRCULAR)		WATER MONITOR FOR FOR FIRE WATER SYST.
			FOAM MONITOR FOR FOR FIRE WATER SYST.
	TRIPPLE VALVE PIT (VALVE PITS OUTSIDE TANKFARM AREA FOR DRAINAGE)		DOUBLE HEADED FIRE HYDRANT AWAY FROM HEADER
	SEPTIC TANK		FIRE HOSE COUPLING
			EARTHEN DYKE
	SOAK PIT		RAILWAY TRACK REPRESENTATION ON LAYOUT
			RAILWAY TRACK REPRESENTATION ON AREA DWG.
	GULLY TRAP		PIPE RACK
	GATE		
	BARBED WIRE FENCING	EQPT. SYMBOLS	
	CHAIN LINK FENCING	HC	HOSE CABINET
	R.C.C. PAVEMENT	HR	HOSE REEL
	FOOTPATH 1000 MM W=WIDTH OF FOOTPATH		DELUGE VALVE ASSEMBLY
	SLIDING SLEEPER		PUMP (HORIZONTAL)
	ANCHOR SLEEPER		PUMP VERTICAL a) ELECT. DRIVE B) DEISEL DRIVE
	GUIDE SLEEPER		
	JUMP OVER SLEEPER		
	FIRE HYDRANT SINGLE HEADED		LONGRANGE WATER MONITOR
	FIRE HYDRANT DOUBLE HEADED		REMOTE CONTROLLED LONG RANGE WATER/ COME FOAM ON ELEVATED PLATFORM

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
4	06.09.18	REVISED & ISSUED AS STANDARD	CVCS	RKS	RS	RKT
3	01.10.09	REVISED & ISSUED AS STANDARD	SKP	RKS/RBB	NK	ND

Approved by

कार्यशाला एवं कार्यस्थल पर रंगसाजी हेतु मानक विनिर्देशन

STANDARD SPECIFICATION FOR SHOP & FIELD PAINTING

			G.V. Swamy			
3	15.10.07	REVISED BY SMMS & ISSUED AS STANDARD SPECIFICATION	GVSwamy	R Nanda	DM	VC
2	04.08.98	REVISED & UPDATED BY SMMS DEPT. & ISSUED AS STANDARD SPECIFICATION	GVS	GS	NS	AS
1	19.05.92	ISSUED AS GENERAL REVISION	AKG/BPV	GS	GRR	AS
0	15.12.87	ISSUED AS STANDARD SPECIFICATION	RNG	GRR	SLG	AK
NO.	DATE	REVISION	BY	CHECKED	CONVENOR	CHAIRMAN (S.B.)
Rev. No	**Date**	**Purpose**	**Prepared by**	**Checked by**	**Standards Committee Convenor**	**Standards Bureau Chairman**
					Approved by	

Abbreviations:

AS	:	Alloy Steel
CS	:	Carbon Steel
LTCS	:	Low Temperature Carbon Steel
MS	:	Mild Steel
SS	:	Stainless Steel
GI	:	Galvanized Iron
DFT	:	Dry Film Thickness
WFT	:	Wet Film Thickness
DM	:	De-mineralized
ID	:	Internal Diameter
OD	:	Outside Diameter
NB	:	Nominal Bore
RCC	:	Reinforced Cement Concrete
IRN	:	Inspection Release Note
RH	:	Relative Humidity

Piping Standards Committee

Convenor : Mr D Malhotra

Members :
Mr Sohan Singh
Mr S Chanda
Mr V K Bhatli
Mr R Nanda
Mr L B Ajwani
Mr A T Dharmik
Mr P K Bali
Mr. G.V.Swamy(SMMS)
Mr S K Kohli (HMTD)
Mr P P Lahiri (SMMS)
Mr R Kannan (Construction)
Mr S Kaul(Proj)

CONTENTS

1.0 GENERAL

1.1 These technical specifications shall be applicable for the work covered by the contract, and without prejudice to the provisions of various codes of practice, standard specifications etc. It is understood that contractor shall carry out the work in all respects with the best quality of materials and workmanship and in accordance with the best engineering practice and instructions of Engineer-In-Charge.

1.2 Wherever it is stated in the specification that a specific material is to be supplied or a specific work is to be done, it shall be deemed that the same shall be supplied or carried out by the contractor.

Any deviation from this standard without written deviation permit from appropriate authority will result in rejection of job.

2.0 SCOPE

2.1 Scope of work covered in the specification shall include, without being limited to the following.

2.1.1 This specification defines the requirements for surface preparation, selection and application of primers and paints on external surfaces of equipment, vessels, machinery, piping, ducts, steel structures, external & internal protection of storage tanks for all services, MS Chimney without Refractory lining and Flare lines etc. The items listed in the heading of tables of paint systems is indicative only, however, the contractor is fully responsible for carrying out all the necessary painting, coating and lining on external and internal surfaces as per the tender requirement.

2.2 Extent of Work

2.2.1 The following surfaces and materials shall require shop, pre-erection and field painting:

a. All uninsulated C.S. & A.S. equipment like columns, vessels, drums, storage tanks(both external & internal surfaces), heat exchangers, pumps, compressors, electrical panels and motors etc.

b. All uninsulated carbon and low alloy piping, fittings and valves (including painting of identification marks), furnace ducts and stacks.

c. All items contained in a package unit as necessary.

d. All structural steel work, pipe, structural steel supports, walkways, handrails, ladders, platforms etc.

e. Flare lines, external surfaces of MS chimney with or without refractory lining and internal surfaces of MS chimney without refractory lining.

f. Identification colour bands on all piping as required including insulated aluminium clad, galvanised, SS and nonferrous piping.

g. Identification lettering/ numbering on all painted surfaces of equipment/piping insulated aluminium clad, galvanized, SS and non-ferrous piping

h. Marking / identification signs on painted surfaces of equipment/piping including hazardous service.

i. Supply of all primers, paints and all other materials required for painting (other than Owner supplied materials)

j. Over insulation surface of equipments and pipes wherever required.

k. Painting under insulation for carbon steel, alloy steel and stainless steel as specified.

l. Painting of pre-erection/fabrication and Shop primer.

m. Repair work of damaged pre-erection/ fabrication and shop primer and weld joints in the field/site before and after erection as required.

n. All CS Piping, equipments, storage tanks and internal surfaces of RCC tanks in **ETP plant.**

2.2.2 The following surfaces and materials shall not require painting in general. However, if there is any specific requirement by the owner, the same shall be painted as per the relevant specifications:

a. Uninsulated austenitic stainless steel.

b. Plastic and/or plastic coated materials

c. Non-ferrous materials like aluminum.

2.3 **Documents**

2.3.1 The contractor shall perform the work in accordance with the following documents issued to him for execution of work.

a. Bill of quantities for piping, equipment, machinery and structures etc.

b. Piping Line List.

c. Painting specifications including special civil defence requirements.

2.4 Unless otherwise instructed, final painting on pre-erection/ shop primed pipes and equipments shall be painted in the field, only after the mechanical completion, testing on systems are completed as well as after completion of steam purging wherever required.

2.5 Changes and deviations required for any specific job due to clients requirement or otherwise shall be referred to EIL for deviation permit.

3.0 REFERENCE CODES & STANDARDS

3.1 Without prejudice to the provision of Clause 1.1 above and the detailed specifications of the contract, latest editions of the following codes and standards are applicable for the work covered by this contract.

IS-5	:	Colour coding.
RAL DUTCH	:	International Standard for colour shade (Dutch Standard)
IS-101	:	Methods of test for ready mixed paints and enamels.
IS-2379	:	Indian Standard for Pipe line identification-colour code.
ASTM-Vol 6.01 & 6.03:		American standard test methods for Paints and Coatings.
ANSI A 13.1	:	Scheme for identification of piping systems: American National Standards Institution.

3.2 Surface Preparation Standards

The latest editions of any of the following standards shall be followed for surface preparation:

3.2.1 ISO 8501-1 / SIS-05 59 00: ISO standard for Preparation of steel substrates before application of paints and related products. This standard contains photographs of the various standards on four different degrees of rusted steel and as such is preferable for inspection purpose by the Engineer-In-Charge.

3.2.2 Steel Structures Painting Council, U.S.A. (Surface Preparation Specifications (SSPC-SP).

3.2.3 National Association of Corrosion Engineers, U.S.A., (NACE).

3.2.4 Various International Standards equivalent to Swedish Standard for surface preparations are given in Table-I.

3.3 The contractor shall arrange, at his own cost, to keep a set of latest edition of above standards and codes at site.

3.4 The paint manufacturer's instructions shall be followed as far as practicable at all times for best results. Particular attention shall be paid to the following:

a. Instructions for storage to avoid exposure as well as extremes of temperature.

b. Surface preparation prior to painting shall be followed as per Table 8.0 to 17.0 of this standard shall be followed.

c. Mixing and thinning.

d. Application of paints and recommended limit on time intervals in between coats.

4.0 EQUIPMENT

4.1 All tools, brushes, rollers, spray guns, blast material, hand power tools for cleaning and all equipments, scaffolding materials, shot & grit blasting equipments & air compressors etc. required to be used shall be suitable for the work and all in good order and shall be arranged by the contractor at site and in sufficient quantity. The manufacturer's test certificates / data

sheets for all the above items shall be reviewed by Engineer-in-charge at site before start of work.

4.2 Mechanical mixer shall be used for paint mixing operations in case of two pack systems except that the Engineer-In-Charge may allow the hand mixing of small quantities at his discretion in case of specific requirement for touch up work only.

5.0 SURFACE PREPARATION, SHOP PRIMER COATING APPLICATION & REPAIR AND DOCUMENTATION

5.1 General

5.1.1 In order to achieve the maximum durability, one or more of following methods of surface preparation shall be followed, depending on condition of surface to be painted and as instructed by Engineer-In-Charge. Adhesion of the paint film to surface depends largely on the degree of cleanliness of the metal surface. Proper surface preparation contributes more to the success of the paint protective system.

a. Manual or hand tool cleaning.

b. Mechanical or power tool cleaning.

c. Blast cleaning.

5.1.2 Mill scale, rust, rust scale and foreign matter shall be removed fully to ensure that a clean and dry surface is obtained. Unless otherwise specified, surface preparation shall be done as per provisions of relevant tables given elsewhere in this specification The minimum acceptable standard in case of manual or hand tool cleaning shall be St. 2 or equivalent, in case of mechanical or power tool cleaning it shall be St. 3 or equivalent, in case of blast cleaning it shall be Sa 2-1/2 as per Swedish Standard SIS-055900(latest edition) or SSPC-SP or ISO 8501-01.Blast cleaning shall be Sa 3 as per Swedish Standard in case of highly corrosive environment.

Remove all other contaminants, oil, grease etc. by use of an aromatic solvent prior to surface cleaning.

5.1.3 Blast cleaning shall not be performed where dust can contaminate surfaces undergoing such cleaning or during humid weather conditions having humidity exceed 85%. Incase of internal coating of storage tanks, De-humidifiers shall be used to control the humidity levels during rainy season, if painting is to be carried out during the no rain days in case of exigency of project schedule with prior permission of Engineer-in-charge of OWNER/EIL

5.1.4 Irrespective of the method of surface preparation, the first coat of primer must be applied by airless spray/ air assisted conventional spray if recommended by the paint manufacturer on dry surface. This should be done immediately and in any case within 4 hours of cleaning of surface. However, at times of unfavorable weather conditions, the Engineer-In-Charge shall have the liberty to control the time period, at his sole discretion and/or to insist on re-cleaning, as may be required, before primer application is taken up. In general, during unfavorable weather conditions, blasting and painting shall be avoided as far as practicable.

5.1.5 The external surface of R.C.C. chimney to be painted shall be dry and clean. Any loose particle of sand, cement, aggregate etc. shall be removed by scrubbing with soft wire brush.

Acid etching with 10-15% HCL solution for about 15 minutes shall be carried and surface must be thoroughly washed with water to remove acid & loose particles and then dried completely before application of paint.

5.2 **Procedure of Surface Preparation** :

5.2.1 Air Blast Cleaning with abrasives

The surfaces shall be blast cleaned using one of the abrasives like copper slag, Al_2O_3 particles, chilled cast iron or malleable iron and steel at pressure of 7kg/cm^2 at a appropriate distance and angle depending of nozzle size maintaining constant velocity and pressure. Chilled cast iron, malleable iron and steel shall be in the form of shot or grit of size with appropriate size of G42 grade (maximum) and S250 grade size of steel shots (maximum) to obtain a desired surface profile of 35-50 microns trough to peak or specified profile in case of steel and malleable iron . The combination of steel grits and shots shall be normally in the ratio of 3 : 1. The quality of abrasives shall be free from contaminants and impurities and shall meet the requirements of SSPC AB1. Compressed air shall be free from moisture and oil. The blasting nozzles should be venturi style with tungsten carbide or boron carbide as the materials for liners. Nozzles orifice may vary from 3/16" to ¾". On completion of blasting operation, the blasted surface shall be clean and free from any scale or rust and must show a grey white metallic luster. Primer/first coat of paint shall be applied within 4 hours of surface preparation. Blast cleaning shall not be done outdoors in bad weather without adequate protection or when there is dew on the metal, which is to be cleaned. Surface profile shall be uniform to provide good key to the paint adhesion (i.e. 35 to 50 microns). If possible vacuum collector shall be installed for collecting the abrasives and recycling.

5.2.2 Mechanical or Power Tool Cleaning

Power tool cleaning shall be done by mechanical striking tools, chipping hammers, grinding wheels or rotating steel wire- brushes. Excessive burnish of surface shall be avoided as it can reduce paint adhesion. On completion of cleaning, the detached rust mill scale etc. shall be removed by clean rags and /or washed by water or steam and thoroughly dried with compressed air jet before application of paint.

5.2.3 Manual or hand tool cleaning

Manual or hand tool cleaning is used only where safety problems limit the application of other surface preparation procedure and hence does not appear in the tables of paint systems.

Hand tool cleaning normally consists of the following:

a. Hand de-scaling and/or hammering

b. Hand scraping

c. Hand wire brushing

Rust, mill scale spatters, old coatings and other foreign matter, shall be removed by hammering, scrapping tools, emery paper cleaning, wire brushing or combination of the above methods. On completion of cleaning, loose material shall be removed from the surface by clean rags and the surface shall be bushed, swept, dusted and blow off with compressed

air/steam to remove all loose matter. Finally the surface may be washed with water and dried for effective cleaning.

5.3 Non-Compatible shop coat primer

The paint system followed for Shop coating of structures/equipments etc., shall be mentioned in IRN. The compatibility of finishing coat should be confirmed from the paint manufacturer. In the event of use of primer such as zinc Rich epoxy, inorganic zinc silicate etc. as shop coat, the paint system shall depend on condition of shop coat. If the shop coat is in satisfactory condition showing no major defect, the shop coat shall not be removed. The touch up primer and finishing coat(s) shall be identified for application by Engineer-in-Charge.

5.4 Shop coated (coated with Primer & finishing coat) equipment should not be repainted unless paint is damaged. Repair shall be carried out as per Table 7.2 of paint systems depending upon compatibility of paint.

5.5 Shop primed equipment and surfaces will only be 'spot cleaned' in damaged areas by means of power tool brush cleaning or hand tool cleaning and then spot primed before applying one coat of field primer unless otherwise specified. If shop primer is not compatible with field primer then shop coated primer should be completely removed before application of selected paint system for particular environment.

5.6 For Package units/equipment, shop primer should be as per the paint system given in this specification. However, manufacturer's standard can be followed after review.

5.7 **Coating Procedure and Application**

5.7.1 Surface shall not be coated in rain, wind or in environment where injurious airborne elements exists, when the steel surface temperature is less than 5°F above dew point when the relative humidity is greater than 85% or when the temperature is below 40°F and when the ambient/substrate temp is below the paint manufacturer's recommended temperature of application and curing. Desiccant type De-humidifier equipment shall be used to control RH and Dew point. The paint application shall not be done when the wind speed exceeds 20KM per hour.

5.7.2 Blast cleaned surface shall be coated with one complete application of primer as soon as practicable but in no case later than 4 hrs the same day.

5.7.3 To the maximum extent practicable, each coat of material shall be applied as a continuous film uniform thickness free of probes. Any spots or areas missed in application shall be recoated and permitted to dry before the next coat is applied. Applied paint should have the desired wet film thickness.

5.7.4 Each coat shall be in proper state of cure or dryness before the application of succeeding coat. Material shall be considered dry for recoating when an additional coat can be applied without the development of any detrimental film irregularities, such as lifting or loss of adhesion of the under coat. Manufacturer instruction shall be followed for inter coat interval.

5.7.5 When the successive coat of the same colour have been specified, alternate coat shall be tinted, when practical, sufficiently to produce enough contrast to indicate complete coverage

of the surface. The tinting material shall be compatible with the material and not detrimental to its service life and shall be recommended by the original paint manufacturer.

5.7.6 Air spray application shall be in accordance with the following:

a. The equipment used shall be suitable for the intended purpose, shall be capable of properly atomizing the paint to be applied, and shall be equipped with suitable pressure regulators and gauges. The air caps, nozzles, and needles shall be those recommended by the manufacturer of the equipment for the material being sprayed. The equipment shall be kept in satisfactory condition to permit proper paint application.

b. Traps or separators shall be provided to remove oil and condensed water from the air. These traps or separators must be of adequate size and must be drained periodically during operations. The air from the spray gun impinging against the surface shall show no condensed water or oil.

c. **Ingredients shall be kept properly mixed in the spray pots or containers during application by continuous mechanical agitation.**

d. The pressure on the material in the pot and of the air at the gun shall be adjusted for optimum spraying effectiveness. The pressure on the material in the pot shall be adjusted when necessary for changes in elevation of the gun above the pot. The atomizing air pressure at the gun shall be high enough to properly atomize the paint but not so high as to cause excessive fogging of paint, excessive evaporation of solvent, or less by over spray

e. Spray equipment shall be kept sufficiently clean so that dirt, dried paint, and other foreign materials are not deposited in the paint film.

Any solvents left in the equipment shall be completely removed before applying paint to the surface being painted.

f. Paint shall be applied in a uniform layer, with overlapping at the edge of the spray pattern. The spray patterns shall be adjusted so that the paint is deposited uniformly. During application, the gun shall be held perpendicular to the surface and at a distance which will ensure that a wet layer of paint is deposited on the surface. The trigger of the gun should be released at the end of each stroke.

g. All runs and sags shall be brushed out immediately or the paint shall be removed and the surface repainted.

h. Areas inaccessible to the spray gun shall be painted by brush; if not accessible by brush, daubers or sheepskins shall be used.

i. All nameplates, manufacturer's identification tags, machined surfaces, instrument glass, finished flange faces, control valve items and similar items shall be masked to prohibit coating deposition. If these surfaces are coated, the component shall be cleaned and resorted to its original condition.

j. Edges of structural shapes and irregular coated surfaces shall be coated first and an extra pass made later.

k. If spray gun shows choking, immediately de-choking procedure shall be followed.

5.7.7 Airless spray application shall be in accordance with the following procedure: as per stesl structure paint Manual Vol.1 & Vol.2 by SSPC, USA, Air less spray relies on hydraulic pressure rather than air atomization to produce the desired spray. An air compressor or electric motor is sued to operate a pump to produce pressures of 1000 to 6000 psi. paint is delivered to the spray gun at this pressure through a single hose within the gun, a single paint stream is divided into separate streams, which are forced through a small orifice resulting in automization of paint without the use of air. This results in more rapid coverage with less over spray. Airless spray usually is faster, cleaner, more economical and easier to use than conventional air spray.

Airless spray equipment is mounted on wheels, and paint is aspirated in a hose that sucks paint from any container, including drums. The unit shall have in built agitator that keep the paint uniformly mixed during the spraying. The unit shall consist of in built strainer. Usually very small quantity of thinning is required before spray. In case of high build epoxy coating (two pack). 30:1 pump ratio and 0.020-0.023" tip size will provide a good spray pattern. Ideally fluid hoses should not be less than 3/8" ID and not longer than 50 ft to obtain optimum results.

In case of gun choking, de-choking steps shall be followed immediately.

5.7.8 Brush application of paint shall be in accordance with the following:

a. Brushes shall be of a style and quality that will enable proper application of paint.

b. Round or oval brushes are most suitable for rivets, bolts, irregular surface, and rough or pitted steel. Wide flat brushes are suitable for large flat areas, but they shall not have width over five inches.

c. Paint shall be applied into all corners.

d. Any runs or sags shall be brushed out.

e. There shall be a minimum of brush marks left in the applied paint.

f. Surfaces not accessible to brushes shall be painted by spray, daubers, or sheepskin.

5.7.9 Manual application by sling (where 6 O' clock position of pipe is not approachable)

A canvas strip (alternatively a tinplate strip) about 450 mm wide and 1.5m long is hold under the pipe by two men holding this sling move it up and down and walk slowly forward while fresh coating is poured on the pipe and they manipulate the sling so that an even coating is obtained all round the bottom. This work shall be done very carefully and by experienced personnel. There shall not be any formation of "Whiskers" and holes in the coating. The coating film shall be inspected by mirror.

5.7.10 For each coat the painter should know the WFT corresponding to the specified DFT and standardize the paint application technique to achieve the desired WFT. This has to be ensured in the qualification trial.

5.8 **Drying of coated surfaces**

5.8.1 No coat shall be applied until the preceding coat has dried. The material shall be considered dry for re-coating when another coat can be applied without the development of any film irregularities such as lifting or loss of adhesion of undercoats. Drying time of the applied coat should not exceed maximum specified for it as a first coat; if it exceeds the paint material has possibly deteriorated or maxing is faulty.

5.8.2 No paint shall be force dried under conditions which will cause checking, wrinkling, blistering formation of pores, or detrimentally affect the conditions of the paint.

5.8.3 No drier shall be added to a paint on the job unless specifically called for in the manufacturer's specification for the paint.

5.8.4 Paint shall be protected from rain, condensation, contamination, snow and freezing until dry to the fullest extent practicable.

5.9 **Repair of damaged paint surface**

5.9.1 Where paint has been damaged in handling and in transportation, the repair of damaged coating of pre-erection / fabrication and Shop primer shall be done as given below and as per the Table 7.2 of this specification.

5.9.2 Repair of damaged inorganic zinc silicate primer after erection / welding in the design temperature of -90°C to 550°C.

Surface Preparation: Quickly remove the primer from damaged area by mechanical scraping and emery paper conforming to SSPC-SP-3 to expose the white metal. Blast clean the surface, if possible. Feather the primed surface over the intact adjacent surface surrounding the damaged area by emery paper.

Primer coating: One coat of F-9 shall be applied wherever damaged was observed on pre-erection pre fabrication / shop primer of inorganic zinc silicate coating (F-9). F-9 shall not be applied if damaged area is not more than 5x5 cm.

5.10 **Paint Application**

5.10.1 Shop priming/pre-erection priming with F9 or F12 shall be done only on blasted surface (SSPC-SP-10)

5.10.2 Shop priming/ pre-erection priming with F9 or F12 shall be done only with airless spray.

5.10.3 For large flat surface field painting shall be done by airless spray otherwise brush can be used.

5.10.4 Assessment of painting requirement

The paint system to be applied for a specific job shall be arrived at sequentially as given below:

- Identify the environment from area classification details and chose the appropriate table.

- Identify the design temperature from the technical documents

- Identify the specific field paint system and surface preparation requirement from the above identified table and temperature range.

- Identify the shop priming requirement from Table 7.1 based on compatibility of the above paint system.

- Identify the need of repair of shop primer and execute as per Table 7.2.

5.11 Documentation

5.11.1 A written quality plan with procedure for qualification trials and for the actual work.

5.11.2 Daily progress report with details of weather conditions, particular of applications, no of coats and type of materials applied, anomalies, progress of work versus program.

5.11.3 Results of measurement of temperatures relative humidity, surface profile, film thickness, holiday detection, adhesion tests with signature of appropriate authority.

5.11.4 Particulars of surface preparation and paint application during trials and during the work.

5.11.5 Details of non-compliance, rejects and repairs.

5.11.6 Type of testing equipments and calibration.

5.11.7 Code and batch numbers of paint materials used.

TABLE-1 (FOR CLAUSE 5.0)

SURFACE PREPARATION STANDARDS

SL. NO.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)			REMARKS
		ISO 8501-1/ SIS-05 59 00	SSPC-SP, USA	NACE, USA	
1	Manual or hand tool cleaning Removal of loose rust, loose mill scale and loose paint, chipping, scrapping, standing and wire brushing. Surface should have a faint metallic sheen	ST.2	SSPC-SP-2	--	This method is applied when the surface is exposed to normal atmospheric conditions when other methods cannot be adopted and also for spot cleaning during maintenance painting.
2	Mechanical or power tool cleaning Removal of loose rust loose mill scale and loose paint to degree specified by power tool chipping, de-scaling, sanding, wire brushing and grinding, after removal of dust, surface should have a pronounced metallic sheen.	ST.3	SSPC-SP-3	--	
3	Dry abrasive Blast cleaning There are four common grades of blast cleaning				
3.1	White metal Blast cleaning to white metal cleanliness. Removal of all visible rust. Mill scale, paint & foreign matter 100% cleanliness with desired surface profile.	SA 3	SSPC-SP-5	NACE#1	Where extremely clean surface can be expected for prolong life of paint system.
3.2	Near white metal Blast cleaning to near white metal cleanliness, until at least 95% of each element of surface area is free of all visible residues	SA 2½	SSPC-SP-10	NACE#2	The minimum requirement for chemically resistant paint systems such as epoxy, vinyl, polyurethane based and inorganic zinc

SL. NO.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)			REMARKS
		ISO 8501-1/ SIS-05 59 00	SSPC-SP, USA	NACE, USA	
	with desired surface profile.				silicate paints, also for conventional paint systems used under fairly corrosive conditions to obtain desired life of paint system.
3.3	Commercial Blast Blast cleaning until at least two-third of each element of surface area is free of all visible residues with desired surface profile.	SA 2	SSPC-SP-6	NO.3	For steel required to be painted with conventional paints for exposure to mildly corrosive atmosphere for longer life of the paint systems.
3.4	Brush-off Blast Blast cleaning to white metal cleanliness, removal of all visible rust, mill scale, paint & foreign matter. Surface profile is not so important	SA 1	SSPC-SP-7	NO.4	

6.0 PAINT MATERIALS

Paint manufacturers shall furnish the characteristics of all paints materials on original printed literature, alongwith the test certificate for all specified characteristics given in this specification. All the paint materials shall be of first quality and conform to the following general characteristics as per the tables 6.1, 6.2, 6.3 and 6.4.

PAINT MATERIALS

TABLE No. 6.1 PRIMERS

Sl. No.	DESCRIPTION	P-2	P-4	P-6	P-7
1	Technical name	Chlorinated rubber Zinc Phosphate primer.	Etch primer/wash primer	Epoxy zinc phosphate primer	ZINGA synthetic zinc primer
2	Type and composition	Single pack, air drying chlorinated rubber based medium plasticised with unsaponifiable plasticizer, pigmented with zinc phosphate.	Two pack polyvinyl butyral resin medium cured with phosphoric acid solution pigmented with zinc tetroxy chromate.	Two component polyamine cured epoxy resin medium, pigmented with zinc phosphate.	One pack Synthetic Resin based zinc primer containing 96% of electrolytic zinc dust of 99.995% purity.
3	Volume Solids (minimum)	40%.	7-8%	40%	37%
4	DFT (Dry Film thickness) per coat (minimum)	30-40µ	8-10µ	40-50µ	40-50µ
5	Theoritical covering capacity in M^2/coat/ litre (minimum)	8-10	8-10	8-10	$4m^2/kg$
6	Weight per litre in kgs/litre (minimum)	1.3	1.2	1.4	2.67 kg at 15°C
7	Touch dry at 30°C (minimum)	30 minutes	2 hrs.	After 30 min.	10 minutes
8	Hard dry at 30°C (maximum.)	24 hrs.	24 hrs.	24 hrs.	24 hrs.
9	Overcoating interval	Min.: 8 hrs	Min: 4-6 hrs.	Min.:8hrs.	Min.:4 hrs
10	Pot life at 30°C for two component paints (minimum)	Not Applicable	Not applicable	6 - 8 hrs.	Unlimited
11	Temperature (Resistance (minimum)	60 °C	NA	80°C	100°C.

PAINT MATERIALS

TABLE No. 6.2 FINISH PAINTS

Sl. No	DESCRIPTION	F-2	F-3	F-6A/B	F-7
1	Technical name	Acrylic Polyurethane finish paint	Chlorinated rubber based finish paint	Epoxy-High Build finish paint.	High build coaltar epoxy coating.
2	Type and composition	Two-pack aliphatic isocynate cured acrylic finish paint.	Single pack plasticised chlorinated rubber based medium with chemical and weather resistant pigments.	F6A: Two-pack polyamine cured epoxy resin medium suitably pigmented. F6B: polyamide cured epoxy resin medium suitably pigmented	Two pack polyamide cured epoxy resin blended with coaltar medium, suitably pigmented
3	Volume Solids (minimum.)	40%.	40%	62%	65%
4	DFT (Dry Film thickness) per coat (minimum)	30-40µ	30-40µ	100-125µ	100-125µ
5	Theoritical covering capacity in M^2/coat/litre (minimum)	10-13	8-10	5-6	5.2-6.5
6	Weight per liter in kgs/litre(minimum)	1.3	1.2	1.4	1.5
7	Touch dry at 30°C	1 hr.	30 minutes.	3 hrs.	4 hrs.
8	Hard dry at 30°C (max) Full cure at 30°C (for immersion/ high temperature service)	16 hrs 5 days	8 hrs NA	16 hrs 5 days	48 hrs. 5 days
9	Over-coating interval at 30 °C	Min.: 12 hrs.	Min.: Overnight	Min.: Overnight Max.: 5 days	Min.: 24 hrs Max.: 5 days.
10	Pot life (approx.) at 30°C for two component paints (minimum)	6-8 hrs.	Not applicable	4-6 hrs	4-6 hrs.
11	Temperature Resistance (minimum)	80 °C	60 °C	80°C	125°C.

PAINT MATERIALS

TABLE No. 6.3 FINISH PAINTS

Sl. No	DESCRIPTION	F-8	F-9	F-11	F-12
1	Technical name	Self priming type surface tolerant high build epoxy coating (complete rust control coating).	Inorganic zinc silicate coating	Heat resistant synthetic medium based two pack Aluminium paint suitable upto 250°C dry temp.	Heat resistant silicone Aluminium paint suitable upto 500°C dry temp.
2	Type & composition	Two pack epoxy resin based suitable pigmented and capable of adhering to manually prepared surface and old coating.	A two pack air drying self curing solvent based inorganic zinc silicate coating with minimum 80% zinc content on dry film. The final cure of the dry film shall pass the MEK rub test.	Heat resistant synthetic medium based two pack Aluminium paint suitable upto 250°C.	Single pack silicone resin based medium with Aluminium flakes.
3	Volume Solids (minimum)	72%.	60%	25%	20%
4	DFT (Dry Film thickness) per coat (minimum)	100-125µ	65-75µ	20-25µ	20-25µ
5	Theoritical covering capacity in M^2/coat/ litre (minimum)	6.0-7.2	8-9	10-12	8-10
6	Weight per liter in kgs/litre (minimum)	1.4	2.3	1.2	1.1
7	Touch dry at 30°C (maximum)	3 hrs.	30 minutes.	3 hrs.	30 minutes.
8	Hard dry at 30°C (maximum) Full cure 30°C (for immersion /high temperature service)	24 hrs 5days	24 hrs NA	24 hrs NA	24 hrs NA
9	Over-coating interval	Min.: 10 hrs	Min.: 12 hrs.at 20°C & 50% RH	Min.: 24 hrs	Min.: 24 hrs
10	Pot life at 30°C for two component paints (minimum.)	90 minutes.	4-6 hrs.	Not applicable	Not applicable
11	Temperature Resistance (min)	80 °C	400 °C	250°C	500°C.

PAINT MATERIALS
TABLE No. 6.4 FINISH PAINTS

Sl. No	DESCRIPTION	F-14	F-15	F-16	F-17
1	Technical name	Polyamine cured coal tar epoxy	Two-component Epoxy phenolic coating cured with Polyamine adduct hardner system (primer + intermediate coat + finish paint)	Ambient temperature curing Poly Siloxane coating/High build cold applied inorganic copolymer based aluminium coating suitable for under insulation coating of CS and SS piping for high temperature service.	Two component solvent free type high build epoxy phenolic/novalac epoxy phenolic coating cured with Polyamine adduct hardner system
2	Type & composition	Specially formulated polyamine cured coal tar epoxy suitable for application under insulation	Two pack ambient temperature curing epoxy phenolic coating system suitable for application under insulation of CS/SS piping	Amercoat 738 from Ameron Products, USA/ Berger 938 from Berger Paints Ltd., or Intertherm 751 CSA from Akzo Nobel coating. Note: 6	Two component solvent free type high build epoxy phenolic/novalac epoxy phenolic coating cured with Polyamine adduct hardner system
3	Volume Solids (minimum)	70%	65%	60%	98-100 %
4	DFT (Dry Film thickness) per coat (minimum)	125 µm	75-100 µm	75-100 µm	125- 150 µm
5	Theoritical covering capacity in M^2/coat/ litre (minimum)	5.5	6.5- 8.5	6.0- 8.0	6.5 - 8
6	Weight per liter in kgs/litre (mix paint) (minimum)	1.5	1.7	1.3	1.7
7	Touch dry at 30°C (maximum)	4 hrs	2 hrs	1 hr	2 hrs
8	Hard dry at 30°C (maximum) Full cure 30°C (for immersion /high temp. service)	24 hrs 168 hrs (7 days)	24 hrs 168 hrs (7 days)	16 hrs -	24 hrs 168 hrs (7 days)
9	Over-coating interval	Min. 6 hrs Max.5 days	Min. 36 hrs Max.21 days	Min.16 hrs Max. Not applicable	Min. 16 hrs Max.21 days
10	Pot life at 30°C for two component paints (minimum.)	4 hrs	1.5 hrs	1 hr	1 hr
11	Temperature Resistance (min)	-45°C to 125°C under insulation	-45°C to 150°C under insulation (Note: 5)	Up to 400 deg. C for CS & SS surfaces under insulation	-45°C to 150°C for immersion service

NOTES (for tables 6.1 to 6.4):

1. Covering capacity and DFT depends on method of application. Covering capacity specified above are theoretical. Allowing the losses during application, min specified DFT should be maintained.

2. All primers and finish coats should be cold cured and air drying unless otherwise specified.

3. All paints shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. The surface preparation, quality and workmanship should be ensured. In case of conflict between this specification and manufacturer's recommendation, the same shall be clarified through SMMS.

4. Technical data sheets for all paints shall be supplied at the time of submission of quotations.

5. F-15: Two-component Epoxy phenolic coating cured with Polyamine adduct hardner system (primer + intermediate coat + finish paint) suitable upto 225°C (Intertherm 228 from M/s Akzo Nobel Coatings & Sealants, Bangalore). For all other companies, the temperature resistance shall be a maximum of 150°C.

6. F-16: Ambient temperature curing epoxy poly siloxane Coating or high build cold applied inorganic co-polymer based aluminium coating.

   'Amercoat 738' from Ameron Products USA/Kansai Nerolac Paints Ltd. Mumbai, suitable upto 400°C for CS surfaces and 600°C for SS surfaces.

   'Berger 938' from Berger Paints Ltd Kolkata, suitable upto 400°C for CS & SS surfaces.

   'Intertherm 751' from Akzo Nobel Coatings and Sealants Pvt Ltd, Bangalore, Inorganic co-polymer cold applied Aluminium spray coating suitable upto 400°C of CS & SS surfaces.

6.5 List of recommended Manufactures

The paints shall conform to the specifications given above and best quality in their products range of manufacturers listed in Annexure-I.

6.6 STORAGE

All paints and painting materials shall be stored only in rooms to be arranged by contractor and approved by Engineer-in-charge for the purpose. All necessary precautions shall be taken to prevent fire. The storage building shall preferably be separate from adjacent building. A signboard bearing the word "PAINT STORAGE – NO NAKED LIGHT – HIGHLY INFLAMABLE" shall be clearly displayed outside. Manufacturer's recommendation shall be followed for storage of paint materials.

7.0 PAINT SYSTEMS

The paint system should be selected based on the areas classified inside the plant as given below. The Geographical corrosive and highly corrosive conditions of a plant located in Coastal and Marine area , Highly Corrosive conditions inside a plant and Industrial Corrosive Environment are taken care in the specifications in total.

ENVIRONMENT/AREA CLASSFICATION

- **Corrosive Environment-Offsite areas** (excluding Cooling Tower area, DM-plant)
- **Corrosive Environment-Unit areas**
- **Highly Corrosive Environment-Unit & Offsite areas** of a plant with corrosive fumes like HCL, H2SO4, Water impingement, Salty water, , Chloride and water mist, Cooling Tower areas, DM Plant area.

Notes:

1. Painting systems (Primers, Finish Paints etc) based upon Area classification/ Environments (Corrosive / Highly Corrosive) / Applications are tabulated in Tables 8.0 to 17.0.
2. Primers & Finish paints covered in Tables 8.0 to 17.0 are listed in Table 7.1.
3. Repair of Pre-Erection/Pre-Fabrication & Shop priming after erection/ welding shall be done as per Table 7.2.

TABLE 7.1: LIST OF PRIMERS & FINISH COATS COVERED IN TABLE NOS. 8.0 - 17.0

PRIMERS	
P-2	Chlorinated rubber zinc Phosphate Primer
P-4	Etch Primer/Wash Primer
P-6	Two component Epoxy Zinc Phosphate Primer cured with polyamine hardner
P-7	Single pack, synthetic resin based 'ZINGA' zinc primer containing 96% of electrolytic zinc dust in dry film.
FINISH COATS/PAINTS	
F-2	Two component Acrylic – Polyurethane finish paint
F-3	Chlorinated Rubber finish paint
F-6A	High Build Epoxy finish coating cured with **polyamine** hardner
F-6B	High Build Epoxy finish coating cured with **polyamide** hardner
F-7	High build Coal Tar epoxy coating cured with **polyamine** hardner
F-8	Self priming surface Tolerant High Build epoxy coating. cured with **polyamine** hardner
F-9	Two component Inorganic Zinc Silicate coating
F-11	Heat resistant synthetic medium based Aluminium paint
F-12	Two component Heat resistant Silicone Aluminium paint.
F-14	Specially formulated coaltar epoxy coating. cured with **polyamine** hardner
F-15	Two component Epoxy phenolic coating cured with Polyamine adduct hardner system
F-16	Engineered Epoxy poly Siloxane Coating or high build cold applied inorganic co-polymer based aluminium coating
F-17	Two component solvent free type high build epoxy phenolic/novalac epoxy phenolic coating cured with Polyamine adduct hardner system

TABLE 7.2 REPAIR OF PRE-ERECTION/PRE-FABRICATION & SHOP PRIMING AFTER ERECTION/WELDING for all insulated and un-insulated CS, LTCS & low allow steel items in all environments. (refer clauses 5.4, 5.5 & 5.9)

Sl. No.	Design Temp. in °C	Surface Preparation	Paint System	Total DFT in Microns (min.)	Remarks
7.2.1	-40 to 150 for structures, hand rails and Gratings only	SSPC-SP-3	1 coat of F-9 or 2 coats of P-7 @ 40μ DFT/coat	65-75 (F-9) or 80 (P-7)	For few isolated damaged areas of more than 5x5 CM
7.2.2	-90 to 400	SSPC-SP-3	1 coat of F-9	65-75	-DO-
7.2.3	401 to 550	SSPC-SP-3	1 coat of F-12	20	-DO-

NOTES:

1 The application and repair of pre-erection/pre-fabrication & Shop Priming given in above tables shall be done for all the items to be painted. In case the damages of primer are severe and spread on large areas, the Engineer-in-Charge may decide to advise re-blasting and priming again if required.

2 The pre-fabrication primer P-7, 'ZINGA' primer is recommended as alternative repair primer to F-9 for Structures, Hand Rails and Gratings only. F-9 shall be used for all other areas.

TABLE 8.0 **PAINT SYSTEM FOR CORROSIVE ENVIRONMENT-OFFSITE AREAS (excluding Cooling Tower area & DM Plant area)** for external surfaces of Un-insulated Structures, Piping, Equipments, Pumps, Vessels etc (Note-1); (For Carbon Steel, LTCS & Low Alloy Steel)

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
8.1	-90 to -15	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	None	65-75	No over-coating to be done on F-9 as it will lead to mud cracking. F-3 paint shall contain pure chlorinated rubber, not modified. F-12 shall be ambient temperature curing type **Flare lines shall be painted as per Table 9.0.**
8.2	-14 to 60	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	1 coat of P-2 @ 40µ DFT/ coat	2 coats of F-3 @ 40µ DFT/coat ; (2x40=80)	185	
8.3	61 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	1 coat of P-6 @ 40µ DFT/ coat	1 coat of F-6B @ 100µ DFT/coat + 1 coat of F-2 @ 40µ DFT/coat; (100+40=140)	245	
8.4	81 to 250	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	3 coats of F-11 @ 20µ DFT/coat; (3x20=60)	125	
8.5	251 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	2 coats of F-12 @ 20µ DFT/coat (2x20=40) or 1 coat of F-16 @ 50 µ DFT/coat.	105-115 or 115-125	
8.6	401 to 550	SSPC-SP-10; 1coat of F-12 @ 20µ DFT/coat	None	2 coats of F-12 @ 20µ DFT/coat (2x20=40)	60	

NOTES

1 The list of items given in the heading of the above table is not exhaustive. There may be more items for a particular contract where these specifications are used. The Contractor is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated through his scope of work as per tender document.

2 For external surfaces of MS chimney with/without refractory lining and for internal surfaces of MS chimney without refractory lining 8.3, 8.4 & 8.5 shall be followed.

3 For external surfaces of RCC chimney: 2 coats of F-6 @ 100µ DFT/coat to obtain 2x100=200µ DFT shall be applied after making surface preparation as per guidelines in 5.1.5.

4 If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2

5 In case of Paint systems as per Sl Nos 8.5 and 8.6, the colour bands shall be applied over the Aluminum paint as per the Colour coding requirement for specific service of piping given in Clause 18.0.

TABLE 9.0 PAINT SYSTEM FOR CORROSIVE ENVIRONMENT-UNIT AREAS
for external surfaces of Un-insulated Structures, Piping, Equipments, Columns, Towers, Vessels, Pumps, Compressors, Blowers etc(Note1); (For Carbon Steel, LTCS & Low Alloy Steel)

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
9.1	-90 to -15	SSPC-SP-10; 1coat of F-9 @65-75µDFT/coat	None	None	65-75	No over-coating to be done on F-9 as it will lead to mud cracking.
9.2	-14 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	1 coat of P-6 @ 40µ DFT/ coat	1 coat of F-6A @ 100µ DFT/coat + 1 coat of F-2 @ 40µ DFT/coat; (100+40=140)	245-255	
9.3	81 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	2 coats of F-12 @ 20µ DFT/coat (2x20=40) or 1 coat of F-16 @50 µ DFT/coat.	105-115 or 115-125	F-12 shall be ambient temperature curing type
9.4	401 to 550	SSPC-SP-10; 1coat of F-12 @ 20µ DFT/coat	None	2 coats of F-12 @ 20µ DFT/coat (2x20=40)	60	

NOTES:

1. The list of items given in the heading of the above table is not exhaustive. There may be more items for a particular contract where these specifications are used. The Contractor is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated through his scope of work as per tender document.

2. If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2.

3. In case of paint systems as per Sl Nos 9.3 and 9.4, the colour bands shall be applied over the Aluminum paint as per the Colour coding requirement for specific service of piping given in clause 18.0.

TABLE 10.0 PAINT SYSTEM FOR HIGHLY CORROSIVE ENVIRONMENT- UNIT & OFFSITE AREAS OF THE PLANT with corrosive fumes like HCL, H2SO4, Water Impingement, Salty Water, Chloride & Water Mist, DM Plant Area, Cooling Tower Area for external surfaces of Un-insulated Structures, Piping, Equipments, Towers, Columns, Vessels, Pumps, Compressors, Blowers etc(Note-1); (For Carbon Steel, LTCS & Low Alloy Steel)

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
10.1	-90 to -15	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	None	65-75	No over-coating to be done on F-9 as it will lead to mud cracking. F-12 shall be ambient temperature curing type
10.2	-14 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	1 coat of P-6 @ 40µ DFT/ coat	2 coat of F-6A @ 100µ DFT/coat + 1 coat of F-2 @ 40µ DFT/coat; (2x100+40=240)	345-355	
10.3	81 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	2 coats of F-12 @ 20µ DFT/coat 2x20=40 or 1 coat of F-16 @ 50µ DFT/coat.	105-115 or 115-125	
10.4	401 to 550	SSPC-SP-10; 1coat of F-12 @ 20µ DFT/coat	None	2 coats of F-12 @ 20µ DFT/coat; (2x20=40)	60	

NOTES:

1. The list of items given in the heading of the above table is not exhaustive. There may be more items for a particular contract where these specifications are used. The Contractor is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated through his scope of work as per tender document.

2. If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2.

3. In case of paint systems as per Sl Nos 10.3 and 10.4, the colour bands shall be applied over the Aluminum paint as per the Colour coding requirement for specific service of piping given in clause 18.0.

TABLE 11.0 PAINT SYSTEM FOR CARBON STEEL AND LOW ALLOY STEEL STORAGE TANKS (EXTERNAL)
All areas (Units & Offsites)

Sl. No.	Design Temperature in °C	Surface Preparation	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
11.1	All external surfaces of shell, internal surfaces of shell above maximum liquid level exposed to atmosphere, wind girders, appurtenances, roof tops of all above ground tank including top side of floating roof of open tank as well as covered floating roof tank and associated structural works, rolling and stationary ladders, spiral stairways, hand rails for all environments for crude oil, LDO, HSD, ATF, Kerosene, Gasolene, motor spirit, DM water, firewater, raw water, potable water, acids, alkalis, solvents and chemicals etc.					
11.1.1	-14 to 80	SSPC-SP-10;	1coat of F-9 @ 65-75µ DFT/coat + 1coat of P-6 @ 40µ DFT/ coat ; (65/75+40=105/115)	2 coats of F-6A @ 100µ DFT /coat + 1 coat of F-2 @ 40µ DFT/ coat; (2x100+40=240)	345-355	F-6 should be suitable for occasional water immersion
11.1.2	81 TO 150	SSPC-SP-10;	1 coat of F-15 primer @ 80µ DFT/ coat + 1 coat of F-15 intermediate coat @ 80µ DFT/coat ; (80+80=160)	1 coat of F-15 finish coat @80µ DFT/ coat + 1coat of F-2 @ 40µ DFT/ coat; (80+40=120)	280	
11.1.3	151TO 500	SSPC-SP-10;	1 coat of F-9 @ 65-75µ DFT/ coat	2 coats of F-12 @ 20µ DFT/coat; (2x20=40) or 1 coat of F-16 @ 50µ DFT/coat	105-115 OR 115-125	F-12 shall be ambient temperature curing type
11.2	External surfaces of bottom plate (soil side) for all storage tanks.					
11.2.1	-14 TO 80	SSPC-SP-10;	1 coat of F-9 @ 65-75µ DFT/ coat	3 coats of F-7@ 100µ DFT/coat (3x100=300)	365-375	F-7 should be suitable for immersion service of the products given
11.2.2	81 TO 150	SSPC-SP-10;	1 coat of F-15 primer @ 80µ DFT/ coat + 1 coat of F-15 intermediate coat @ 80µ DFT/coat ; (80+80=160)	1 coat of F-15 finish coat @ 80µ DFT/ coat	240	

NOTES

1. If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2

TABLE 12.0 PAINT SYSTEM FOR CARBON STEEL AND LOW ALLOY STEEL STORAGE TANKS (INTERNAL)
All Areas (Units & Off-sites)

Sl. No.	Design Temperature in °C	Surface Preparation	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
12.1	Underside of floating roof, internal surface of cone roof, bottom plate, bottom course up to 1meter height, oil side surfaces of deck plates, oil side surfaces of pontoons, roof structures, structural steel, ladders, supports for storing crude oil, LDO, HSD and Gas Oil (Excluding white oil products)					
12.1.1	-14 to 80	SSPC-SP-10	1coat of F-9 @ 65-75µ DFT/coat + 1coat of P-6 @ 40µ DFT/ coat ; (65/75+40=105/115)	2 Coats of F-6A @ 100µ DFT/coat; (2x100=200)	305-315	Note-2
12.2	Inside of bare shell of floating roof tanks and cone roof tanks for items mentioned in 12.1					
12.2.1	-14 TO 80	SSPC-SP-10	1coat of Phosphating treatment with phosphating chemical @ 10 M²/Litre of coverage	1coat of Phosphating treatment with phosphating chemical @ 10 M²/Litre of coverage	2 coats	DFT need not be measured reconciliation of Chemical used shall be done (Note : 4)
12.3	Floating / Cone roof tanks for petroleum products such as ATF, Gasoline, Naptha, Kerosene, Motor spirit, inside of bottom plate, bottom course upto 4 meters height inside shell, underside of floating roof and shell above maximum liquid level, oil side surfaces of deck plates, oil side surfaces of pontoons, support structures and ladders etc.					
12.3.1	-14 to 80	SSPC-SP-10	1 coat of F-9 @ 65-75µ DFT/coat	3 coats of F-6A @ 100µ DFT/ coat; (3x100=300)	365-375	Note-2
12.4	Inside of Bare shell of floating/cone roof tanks for products mentioned in 12.3.					
12.4.1	-14 to 80	SSPC-SP-10	1 Coat of F-9 @ 65-75µ DFT/Coat	None	65-75	
12.5	Internal protection of fixed roof type storage tanks for potable water: Inside of shell, under side of roof and roof structure inside surface, bottom plate and structural steel works, ladders, walkways, platforms etc.					
12.5.1	-14 to 80	SSPC-SP-10	2 Coats of P-6 @ 40µ DFT/coat; (2x40=80)	2 Coats of F-6B @ 100µ DFT/ Coat; (2x100=200)	280	Note-2
12.6	D.M. (De-mineralized water) and hydrochloric acid (HCL): Internal shell, bottom plate & all accessories					
12.6.1	-14 to 60	SSPC-SP-10	None	Natural Rubber lining as per SMMS specifications 6-06-204	4.5MM	For DM tanks **without** steam blanketing
12.6.2	61 to150	SSPC-SP-10	1 coat of F-15 primer @ 80µ DFT/ coat	1 coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/ coat; (80+80=160)	240	For DM tanks **with** steam blanketing
12.7	EG(Ethylene Glycol) tanks (internal shell, bottom plate roof and all accessories)					
12.7.1	All	SSPC-SP-10	None	3 coats of vinyl chloride co-polymer Amercoat 23 @ 75µ /Coat ; (3x75=225)	225	

12.8	Inside pontoon and inside of double deck of all floating roofs.					
12.8.1	-14 to 80	SSPC-SP-3	1 coat of F-8 @ 100µ DFT/coat	1 coat of F-8 @ 100µ DFT/coat	200	
12.9	Internal surfaces of wet slop, amine, sour water , water draw off storage tanks					
12.9.1	-14 TO 80	SSPC-SP-10	1 coat of F-15 primer @ 80µ DFT/ coat	1 coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/ coat; (80+80=160)	240	
12.10	Underside of floating roof, internal surface of cone roof, bottom plate, bottom course up to 4meter height, oil side surfaces of deck plates, oil side surfaces of pontoons, roof structures, structural steel, ladders, supports for storing Vacuum Residue, Fuel oil , dry slop and other high temperature hydrocarbon liquids.					
12.10.1	81 TO 150	SSPC-SP-10	1 coat of F-17 primer @ 125µ DFT/ coat	1 coat of F-17 intermediate coat @ 125µ DFT/coat + 1 coat of F-17 finish coat @125µ DFT/ coat; (125+125=250)	375	Note:3
12.11	Inside of Bare shell of floating/cone roof tanks for products mentioned in 12.10					
12.11.1	81 TO 150	SSPC-SP-10	1 coat of F-17 primer @ 125µ DFT/ coat	None	125	

NOTES

1. If the Pre-erection/Pre-fabrication & Shop Primer has already been completed, the same shall not be repeated again in the field. In case the damages of primer are severe and spread over large areas, the engineer-in-charge may decide & advise re-blasting and priming again. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table 7.2.

2. F-6A/F6B should be suitable for immersion service of the products given.

3. This system can be used where maximum operating temperature is below 150°C and design temperature is upto 200°C. Cases of operating temperature > 150°C **are not covered in this spec, such cases shall be covered in the job specifications.**

4. The phosphating chemical shall be applied on blast cleaned surface inside the shell of carbon steel storage tanks at the time of erection. Incase, any corrosion is observed at the time of commissioning, 2 coats of the phosphating chemical shall be applied at the discretion of Engineer-in-charge.

5. **The surface preparation and paint/coating application for internal surfaces of storage tanks and vessels shall be done under controlled conditions of RH and temperature as per manufacturer's recommendations. The same shall be maintained by using Desiccant type De-humidifier Equipment to provide best adhesion and long life of coating system for immersion service.**

TABLE 13.0 COATING SYSTEM FOR EXTERNAL SIDE OF UNDERGROUND CARBON STEEL PLANT PIPING AND UNDERGROUND TANKS IN ALL AREAS

Sl. No.	Design Temperature in °C	Surface Preparation	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
13.1	Underground carbon steel plant piping (Yard/ Over the Ditch Corrosion protection Coating)					
13.1.1	25 to 65	SSPC-SP-10	1 coat of synthetic fast drying primer 25 @µ DFT/ coat	1 layer of coaltar tape coating @ 2mm +1 coat of synthetic fast drying primer 25 @µ DFT/ coat +1 layer of coal tar tape coating @ 2mm /layer as per EIL Standard Spec.No 6-79-0011	4 mm	The primer DFT is not measurable. . Reconciliation primer shall be done by coverage of maximum 10 sq.m/litre
13.2	Carbon steel plant piping (underground).					
13.2.1	66 to 150	SSPC-SP-10	1 coat of F-17 primer @ 125µ DFT/ coat	1 coat of F-17 intermediate coat @ 125µ DFT/coat + 1 coat of F-17 finish coat @125µ DFT/ coat; (125+125=250)	375	
13.2.2	151 to 400	SSPC-SP-10	1 coat of F-16 primer @ 125µ DFT/ coat	1 coat of F-16 finish coat @125µ DFT/ coat	250	
13.3	External side of un-insulated underground storage tanks:					
13.3.1	-40 to 80	SSPC-SP-10	1 coat of F-9 @ 65-75µ DFT/ coat	3 coats of F-7 @ 100µ DFT/coat (3x100=300)	365-375	
13.3.2	81 to 150	SSPC-SP-10	1 coat of F-17 primer @ 125µ DFT/ coat	1 coat of F-17 intermediate coat @ 125µ DFT/coat + 1 coat of F-17 finish coat @125µ DFT/ coat; (125+125=250)	375	
13.3.2	151 to 400	SSPC-SP-10	1 coat of F-16 primer @ 125µ DFT/ coat	1 coat of F-16 finish coat @125µ DFT/ coat	250	

TABLE 14.0 PAINTING UNDER INSULATION (ALL ENVIRONMENTS)

All areas (Units & Off-sites) for insulated Piping, Storage Tanks, Equipments etc (Note-1); (For Carbon Steel, LTCS, Low Alloy Steel & Stainless Steel)

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
14.1	Insulated carbon steel, LTCS and low allow steel Piping, Storage Tanks, Equipment etc					
14.1.1	-45 to 125	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	2 coats of F-14 @ 125µ DFT/coat; (2x125=250) or 3 coats of F-15 @ 80µ DFT/coat ; (3x80=240)	315-325 or 305-315	No over-coating to be done on F-9 as it will lead to mud cracking.
14.1.2	126-400	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	None	3 coats of F-12 @ 20µ DFT/coat; (3x20=60) or 1 coat F-16 @ 60 µ DFT/coat	125 – 135	F-12 shall be ambient temperature curing type
14.2	Insulated stainless steel including Alloy-20 piping (Note:2)					
14.2.1	Below 0°C to all minus temperature	Aluminium sheeting with aluminium foil and "Chloride free mineral sealant coating barium chromate" shall be applied.				If the piping & equipments are already erected than surface shall be prepared by cleaning with emery paper and wash/flush with chloride free DM water followed by wiping with organic solvent
14.2.2	0 to 125	SSPC-SP-10 (15-25µ surface profile) 1 coat of F-14 @ 125µ DFT/coat	None	1 coats of F-14 @ 125µ DFT/coat;	250	
	0 to 125 (alternate)	SSPC-SP-10 (15-25µ surface profile) 1 coat of F-15@ 80µ DFT/coat	None	1 coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/ coat; (80+80=160)	240	
14.2.3	121 to 400	SSPC-SP-10; 1 coat of F-16@ 125 µ DFT/coat	None	1 coat of F-16@ 125 µ DFT/coat	250	
14.2.4	401 to 600	SSPC-SP-10; 1 coat of Amercoat 738 @ 125µ DFT/coat	None	1 coat of Amercoat 738 @ 125µ DFT/coat	250	Only Amercoat 738 is suitable for the temperature of 600 deg.C and cyclic temperature.
14.2.5	Cyclic service (-)196 to 480 excepting (-)45 to 120	SSPC-SP-10 1 coat of Amercoat 738 @ 125µ DFT/coat	None	1 coat of Amercoat 738 @ 125µ DFT/coat	250	
14.3	No painting is required for insulated monel, incoloy and nickel lines.					

NOTES

1. Refer Notes 1 & 4 of Table 8.0.
2. The blast cleaning abrasives for SS and Alloy steel surfaces shall be SS grits/shots or Aluminium oxide grits/shots.
3. For SS surfaces with cyclic temperature of -45 to125 deg.C, both 14.2.1 & 14.2.2 are applicable.

TABLE 15.0 INTERNAL PROTECTION OF CARBON STEEL COOLERS / CONDENSERS
Water boxes, channels, partition plates, end covers and tube sheets etc.

Sl. No.	Design Temperature in °C	Surface Preparation & Pre-erection/Shop Primer	Paint system (Field)		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
15.1	Upto 65	SSPC-SP-10; 1 coat of P-6 @ 40µ DFT/coat	None	2 coats of F-7 @ 125µ DFT/coat; (2x125=250)	290	For CS surfaces
15.2	Upto 65	SSPC-SP-3; 1 coat of P-4 @8-10µ DFT/ coat+ 1coat of P-6 @ 40µ DFT/coat.	None	2 coats of F-7 @ 125µ DFT/coat; (2x125=250)	300	(Non ferrous and brass tube sheets)

TABLE 16.0 PAINTING SYSTEM FOR GI TOWERS/NON-FERROUS TUBE SHEET

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

TABLE 17.0 PAINTING SYSTEM FOR EFFLUENT TREATMENT PLANT

Sl. No.	Design Temperature in °C	Surface Preparation	Paint system		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
17.1	For external surfaces of CS/MS items: Screens, Walk way bridges, Baffles, Dual media filters, Vertical pumps, piping in treated effluent sump, bio-sludge pump, Screw pump and pump house, CS tanks , sumps and vessels					
17.1.1	-14 to 80	SSPC-SP-10	1 coat of F-9 @ 65-75µ DFT/coat	2 coats of F-6A @ 100µ DFT/coat + 1 coat of F-2 @ 40 Microns DFT/coat; (2x100+40=240)	305-315	
17.2	For internal surfaces of CS/MS Items: Bio-sludge sump, Filter feed sump, Process sump, Sanitary sump, Transfer sump, Sludge, Slop oil tank, and scrapping mechanism in Clarifier					
17.2.1	-14 to 80	SSPC-SP-10	1 coat of F-9 @ 65-75µ DFT/coat	3 coats of F-6A @100µ DFT/coat (3x100=300)	365-375	Note : 1
17.3	All R.C.C/ concrete surfaces exposed to effluent water /liquid such as tanks, structures, drains etc in Process sump, TPI separator (Process and Oil), Aeration Tank and Transfer sump etc.					
17.3.1	-14 to 80	Blast cleaning to SSPC-SP guide lines and Acid etching with 10-15% HCL acid followed by thorough water washing.	As per SMMS-EIL specification for Epoxy screed lining No.6-06-209 (latest Revision)	As per SMMS-EIL specification for Epoxy screed lining as per 6-06-209 (latest Revision)	3mm	
17.4	C.S/M.S Dual media filters (Internal), Chemical dosing tanks(internal) such as Di-ammonium Phosphate and Urea					
17.4.1	Upto 60	SSPC-SP-10	-	Rubber Lining as per SMMS-EIL Spec. 6-06-204 (Latest revision)	4.5mm	

NOTES

1. The paint/coating manufacturers shall provide their Quality control test certificate of coating materials (F-6A) for immersion service of the exposed effluent given in 17.2

18.0 PIPING COLOUR CODE:

The following colour coding system has been made based on international standards like ASME/ ANSI, BS and Indian Standard.

18.1 IDENTIFICATION

The system of colour coding consists of a ground colour and secondary colour bands superimposed over the ground colour. The ground colour identifies the basic nature of the service and secondary colour band over the ground colour distinguishes the particular service. The ground colour shall be applied over the entire length of the un-insulated pipes. For insulated lines ground colour shall be provided as per specified length and interval to identify the basic nature of service and secondary colour bands to be painted on these specified length to identify the particular service. Above colour code is applicable for both unit and offsite pipelines.

18.1.1 The following ground colour designation for identification of basic classification of various important services shall be followed:

Post Office Red	-	Fire protection materials
Off White/Aluminium	-	Steam (all pressures)
Canary Yellow	-	Chemicals and dangerous materials
Dark Admiralty Grey	-	Crude oil, lube oil
Orange	-	Volatile petroleum products (motor spirit and lighter)
Oxide red	-	Non-volatile petroleum products (kerosene and heavier, including waxy distillates and diesel, gas oil)
Black	-	Residual oils, still bottoms, slop oils and asphalts, fuel oil
Sky blue	-	Water (all purities and temperatures)
Sea green	-	Air and its components and Freon

18.1.2 Secondary colours: The narrow bands presenting the secondary colour which identifies the specific service, may be applied by painting or preferably by use of adhesive plastic tapes of the specific colour.

18.2 COLOUR BANDS AND IDENTIFICATION LETTERING

18.2.1 The following specifications of colour bands shall be followed for identifying the piping contents, size and location of bands & letters. The bandwidth and size of letters in legends will depend to some extent upon the pipe diameter. Either white or black_letters are selected to provide maximum contrast to the band colour. Bands usually are 50 mm wide and regardless of band width, are spaced 25 mm apart when two bands are employed.

Table 1.0: Colour bands and size of lettering for piping:

Outside diameter of pipe or covering in mm	Width of colour bands in mm	Size of legend letters in mm
19 to 32	200	13
38 to 51	200	19
64 to 150	300	32
200 to 250	600	64
Over 250	800	89

In addition, ground colour as per specified length should be provided on insulated piping for easy identification of nature of fluid, on which the colour bands should be painted for identification of each service. The length of the ground colour should be 3 times the width of normal band or 2 meters, whichever is suitable depending on the length of the pipe.

Size of letters stenciled/ written for equipment shall be as given below:

Column and vessel : 150 mm (Height)
Pump, compressor and other machinery : 50 mm (Height)

In addition, the contents of the pipe and/or direction of flow may be further indicated by arrows and legend. If a hazard is involved it must be identified clearly by legend.

18.2.2 Colour bands: The location and size of bands, as recommended, when used, shall be applied to the pipe:

- On both sides of the valves, tees and other fittings of importance.
- Where the pipe enters and emerges from walls and where it emerges from road & walkway overpasses, unit battery limits.
- At uniform intervals along long sections of the pipe.
- Adjacent to tanks, vessels, and pumps.

18.2.3 For piping, writing of name of service and direction of flow for all the lines shall be done at following locations:

18.2.4 The letters will be in black on pipes painted with light shade colours and white on pipes painted with dark shade colours to give good contrast.

18.2.5 Only writing of service name shall be done on stainless steel lines. Precautions_should be taken while painting by using low chloride content painting to avoid any damage to the stainless steel pipes. It is preferable to use adhesive plastic tapes to protect stainless steel pipes.

18.2.6 Colour band specification:

a) Unit Area: Bands at intervals of 6.0 meters.

Offsite Area: Bands at intervals of 10.0 meters.

b) Each pipe segment will have minimum one band indication, irrespective of length.

c) The bands shall also be displayed near walkways, both sides of culverts, tanks dykes, tanks, vessels, suction and discharge of pumps/ compressors, unit battery limit, near valves of line, etc.

18.3 For alloy steel/ stainless steel pipes and fittings in stores/ fabrication yard, color band (Minimum ½" wide) should be applied along the complete length of pipe, bends/ tees, side-curved surface (on thickness) of flanges as well as valves as per the metallurgy.

18.4 In case of camouflaging requirements of civil defence or any other location requirements, the same shall be followed accordingly.

18.5 The specification for application of the complete Piping identification colour code, including base and bands colours, are presented in the following table confirming to RAL colour shades of Dutch Standard:

RECOMMENDED RAL COLOUR CODE FOR PAINTING OF PIPING AND EQUIPMENT

SR. No.	SERVICE	RECOMMNDED COLOUR FOR PAINT SYSTEM	RAL COLOUR CODE	
			BASE COLOUR	BAND COLOUR
	HYDROCARBON LINES (UNINSULATED)			
1	CRUDE SOUR	Dark Admiralty grey with 1 orange band	7012	2011
2	CRUDE SWEET	Dark Admiralty grey with 1 red band	7012	3001
3	LUBE OILS	Dark Admiralty grey with 1 green band	7012	6010
4	FLARE LINES	Heat Resistant Aluminium	9006	
5	LPG	Orange with 1 oxide red band	2011	3009
6	PROPYLENE	Orange with 2 blue bands	2011	5013
7	NAPTHA	Orange with 1 green band	2011	6010
8	M.S.	Orange with 1 dark admiralty grey band	2011	7012
9	AV.GASOLINE (96 RON)	Orange with 1 band each of green, white and red bands	2011 | 6010	9010 | 3001
10	GASOLINE (regular, leaded)	Orange with 1 black band	2011	9005
11	GASOLINE (premium, leaded)	Orange with 1 blue band	2011	5013
12	GASOLINE (white)	Orange with 1 white band	2011	9010
13	GASOLINE (Aviation 100/130)	Orange with 1 red band	2011	3001

14	GASOLINE (Aviation 115/145)	Orange with 1 purple band	2011	4006
15	N-PENTANE	Orange with 2 blue bands	2011	5013
16	DIESEL OIL (White)	Oxide red with 1 white band	3009	9010
17	DIESEL OIL (Black)	Oxide red with 1 yellow band	3009	1023
18	KEROSENE	Oxide red with 1 green band	3009	6010
19	HY.KEROSENE	Oxide red with 2 green bands	3009	6010
20	DISUFIDE OIL (EX-MEROX)	Oxide red with 1 black band	3009	9005
21	M.T.O	Oxide red with 3 green bands	3009	6010
22	DHPPA	Oxide red with 2 white bands	3009	9010
23	FLUSHING OIL	Oxide red with 2 black bands	3009	9005
24	LAB FS	Oxide red with 2 dark admiralty grey bands	3009	7012
25	LAB RS	Oxide red with 3 dark admiralty grey bands	3009	7012
26	LAB (Off. Spec)	Oxide red with 1 light grey band	3009	7035
27	N-PARAFFIN	Oxide red with 1-blue band	3009	5013
28	HEAVY ALKYLATE	Oxide red with red band	3009	3001
29	BLOW DOWN, VAPOR LINE	Off white / Aluminum with 1-Brown band	9006	8004
30	BLOWDOWN	Off white / Aluminum with 2 brown bands	9006	8004
31	A.T.F.	Leaf brown with 1 white band	8003	9010
32	TOULENE	Leaf brown with 1 yellow band	8003	1023
33	BENZENE	Leaf brown with 1 green band	8003	6010
34	LAB PRODUCT	Leaf brown with 1 blue band	8003	5013
35	FUEL OIL	Black with 1 yellow band	9005	1023
36	FULE OIL (Aromatic rich)	Black with 2 yellow bands	9005	1023
37	ASPHALT	Black with 1 white band	9005	9010
38	SLOP AND WASTE OILS	Black with 1 orange band	9005	2011
39	SLOP AROMATICS	Black with 2 orange bands	9005	2011
	CHEMICAL LINES			
40	TRI-SODIUM PHOSPHATE	Canary yellow with 1 violet band	1012	5000
41	CAUSTIC SODA	Canary yellow with 1 black band	1012	9005
42	SODIUM CHLORIDE	Canary yellow with 1 white band	1012	9010
43	AMMONIA	Canary yellow with 1 blue band	1012	5013
44	CORROSION INHIBITOR	Canary yellow with 1 Aluminum band	1012	9006
45	HEXAMETA PHOSPHATE	Canary yellow with 2 black bands	1012	9005
46	ACID LINES	Golden Yellow with 1 red band	1004	3001
47	RICH AMINE	Canary yellow with 2 blue bands	1012	5013

48	LEAN AMINE	Canary yellow with 3 blue bands	1012	5013
49	SOLVENT	Canary yellow with 1 green band	1012	6010
50	LCS	Canary yellow with 1 smoke grey	1012	7031
	WATER LINES			
51	RAW WATER	Sky blue with 1 black band	5015	9005
52	INDUSTRIAL WATER	Sky blue with 2 signal red band	5015	3001
53	TREATED WATER	Sky blue with 1 oxide red band	5015	3009
54	DRINKING WATER	Sky blue with 1 green band	5015	6010
55	COOLING WATER	Sky blue with 1 light brown band	5015	1011
56	SERVICE WATER	Sky blue with 1 signal red brown	5015	3001
57	TEMPERED WATER	Sky blue with 2 green bands	5015	6010
58	DM WATER	Sky blue with 1 aluminum band	5015	9006
59	DM WATER ABOVE 150°F	Sky blue with 2 black bands	5015	9005
60	SOUR WATER	Sky blue with 2 yellow bands	5015	1013
61	STRIPPED WATER	Sky blue with 2 blue bands	5015	5013
62	ETP TREATED WATER	Sky blue with 2 oxide red bands	5015	3009
	FIRE PROTECTION SYSTEM (ABOVE GROUND)			
63	FIRE WATER FOAM & EXTINGUISHERS	Post office red	3002	
	AIR & OTHER GAS LINES (UNINSULATED)			
64	SERVICE AIR	Sea green with 1 signal red band	6018	3001
65	INSTRUMENT AIR	Sea green with 1 black band	6018	9005
66	NITROGEN	Sea green with 1 orange band	6018	2011
67	FREON	Sea green with 1 yellow band	6018	1023
68	CHLORINE	Canary yellow with 1 oxide band	1012	3009
69	SO_2	Canary yellow with 2 white bands	1012	9010
70	H_2S	Orange with 2 red oxide bands	2011	3009
71	GAS (Fuel)	Orange with 1 aluminum band	2011	9006
72	GAS (Sour)	Orange with 2 aluminum bands	2011	9006
73	GAS (Sweet)	Orange with 2 signal red band	2011	3001
74	HYDROGEN	Orange with 1 light green band	2011	6021
	STEAM AND CONDENSATE LINES (UNINSULATED)			
75	HP STEAM	Off white / Aluminum with 1 yellow band	9006	1023
76	MP STEAM	Off white / Aluminum with 1 red band	9006	3001

77	MLP STEAM	Off white / Aluminum with 1 orange band	9006	2011
78	LP STEAM	Off white / Aluminum with 1 light green band	9006	6021
79	CONDENSATE	Sky blue with 1 white band	5015	9010
80	CONDENSATE ABOVE 150°F	Sky blue with 3 oxide red band	5015	3009
81	BFW	Sky blue with 2 red bands	5015	3001
Note: For all insulated steam lines, the colour coding shall be follow as given for un-insulated lines with the specified length of color bands.				
INSULATED HYDROCARBON PIPING				
82	IFO SUPPLY	1Black ground colour with 1 yellow band in centre	9005	1023
83	IFO RETURN	Black ground colour with 1 green band in centre	9005	6010
84	HPS	Black ground colour with 1 red band in centre	9005	3001
85	BITUMEN	Black ground colour with 2 red bands in centre	9005	3001
86	CLO	Black ground colour with 1 brown band in centre	9005	8004
87	VB TAR	Black ground colour with 2 brown bands in centre	9005	8004
88	VR AM (BITUMEN / VBU FEED)	1 Black ground colour with 1 blue band in centre	9005	5013
89	VR BH	1 Black ground colour with 2 blue bands in centre	9005	5013
90	VAC. SLOP	1 Black ground colour with 1 white band in centre	9005	9010
91	SLOP	1 Black ground colour with 1 orange band in centre	9005	2011
92	CRUDE SWEET	1 Dark admiralty grey ground colour with 1 red band in centre	7012	3001
93	CRUDE OUR	1 Dark admiralty grey ground colour with 1 orange band in centre	7012	2011
94	VGO / HCU	1 Oxide red ground colour with 2 steel grey bands in centre	3009	7011
95	OHCU BOTOM / FCCU FEED	1 Oxide red ground colour with 2 steel grey bands in centre	3009	7011
UNINSULATED EQUIPMENTS, TANKS AND STRUCTURES				
96	HEATER STRUCTURE	Steel grey	7011	
97	HEATER CASING	Heat resistant aluminium	9006	
98	VESSELS & COLUMNS	Aluminium	9006	
99	HYDROGEN BULLETS	Pink	3014	

100	LPG VESSELS	Oxide red	3009	
101	SO_2 VESSEL	Canary yellow	1012	
102	HEAT EXCHANGER	Heat resistant aluminium	9006	
103	FO TANK AND HOT TANKS	Black	9005	
104	ALL OTHER TANKS	Aluminum / Off white	9006	
105	CAUSTIC / AMINE / ACID TANKS	Golden yellow	1004	
106	SOUR WATER	Sky Blue	5015	
107	OUTER SURFACE IN BOILER HOUSE	Heat resistant aluminum	9006	
108	COMPRESSORS AND BLOWERS	Dark admiralty grey	7012	
109	PUMPS	Navy blue	5014	
110	MOTORS & SWITCH GEAR	Bluish green	5024	
111	HAND RAILING	Signal red	3001	
112	STAIRCASE, LADDER AND WALKWAYS	Black	9005	
113	LOAD LIFTING EQUIPMENT AND MONORAILS ETC	Leaf brown	8003	
114	GENERAL STRUCTURE	Black	9005	
	PIPES AND FITTINGS OF ALLOY STEEL AND SS MATERIAL IN STORE			
115	IBR	Signal red	3001	
116	9Cr-1Mo	Verdigris green	6021	
117	5Cr-0.5Mo	Satin blue	5012	
118	$2_{1/4}$Cr-1 Mo	Aircraft yellow	1026	
119	$1_{1/4}$Cr-½ Mo	Traffic Yellow	1023	
120	SS-304	Dark blue grey	5008	
121	SS-316	Dark violet	4005	
122	SS-321	Navy blue	5014	
	SAFETY COLOUR SCHEMES			
123	DANGEROUS OBSTRUCTION	Black and alert orange band	9005	2008
124	DANGEROUS OR EXPOSED PARTS OF MACHINERY	Alert orange	2008	

19.0 IDENTIFICATION OF VESSELS, PIPING ETC.

19.1 Equipment number shall be stenciled in black or white on each vessel, column, equipment & machinery (insulated or uninsulated) after painting. Line number in black or white shall be stenciled on all the pipe lines of more than one location as directed by Engineer-In-Charge, Size of letter printed shall be as below :

Column & Vessels	-	150mm (high)
Pump, compressor & other machinery	-	50mm (high)
Piping	-	40-150 mm

19.2 **Identification of storage tanks:**

The storage tanks shall be marked as detailed in the drawing.

20.0 PAINTING FOR CIVIL DEFENCE REQUIREMENTS

20.1 Following items shall be painted for camouflaging if required by the client.

a. All Columns
b. All tanks in Off-sites
c. Large Vessels
d. Spheres

20.2 Two coats of selected finishing paint as per defence requirement shall be applied in a particular pattern as per 20.3 and as per the instructions of Engineer-In-Charge.

20.3 **Method of Camouflaging**

20.3.1 Disruptive painting for camouflaging shall be done in three colours in the ratio of 5:3:2 (all matt finish).

Dark Green	Light Green	Dark Medium Brown
5:	3:	2

20.3.2 The patches should be asymmetrical and irregular.

20.3.3 The patches should be inclined at 30° to 60° to the horizontal.

20.3.3 The patches should be continuous where two surfaces meet at an angle.

20.3.4 The patches should not coincide with corners.

20.3.5 Slits and holes shall be painted in dark shades.

20.3.6 Width of patches should be 1 to 2 meters.

21.0 INSPECTION AND TESTING

21.1 All painting materials including primers and thinners brought to site by contractor for application shall be procured directly from manufactures as per specifications and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates are not acceptable.

21.2 Engineer-In-Charge at his discretion, may call for tests for paint formulations. Contractor shall arrange to have such tests performed including batch-wise test of wet paints for physical & chemical analysis as per clause 24.4 of relevant ASTM test method. All costs there shall be borne by the contractor.

The contractor shall produce test reports from manufacturer regarding the quality of the particular batch of paint supplied. The Engineer-in-Charge shall have the right to test wet samples of paint at random for quality of same. Batch test reports of the manufacturer's for each batch of paints supplied shall be made available by the contractor.

21.3 The painting work shall be subject to inspection by Engineer-In-Charge at all times. In particular, following stage-wise inspection will be performed and contractor shall offer the work for inspection and approval of every stage before proceeding with the next stage. The record of inspection shall be maintained in the registers. Stages of inspection are as follows:

(a) Surface preparation
(b) Primer application
(c) Each coat of paint

In addition to above, record should include type of shop primer already applied on equipment e.g. Red oxide zinc chromate or zinc chromate or Red lead primer etc.

Any defect noticed during the various stages of inspection shall be rectified by the contractor to the entire satisfaction of Engineer-In-Charge before proceeding further. Irrespective of the inspection, repair and approval at intermediate stages of work, contractor shall be responsible for making good any defects found during final inspection/guarantee period/defect liability period as defined in general condition of contract. Dry film thickness (D F T)) shall be checked and recorded after application of each coat and extra coat of paint should be applied to make-up the DFT specified without any extra cost to owner, the extra coat should have prior approval of Engineer-in-charge.

21.4 **Primer Application**

After surface preparation, the primer should be applied to cover the crevices, corners, sharp edges etc. in the presence of inspector nominated by Engineer-In-Charge.

21.5 The shades of successive coats should be slightly different in colour in order to ensure application of individual coats, the thickness of each coat and complete coverage should be checked as per provision of this specification. This should be approved by Engineer-In-Charge before application of successive coats.

21.6 The contractor shall provide standard thickness measurement instrument with appropriate range(s) for measuring.

Dry film thickness of each coat, surface profile gauge for checking of surface profile in case of sand blasting. Holiday detectors and pinhole detector and protector whenever required for checking in case of immersion conditions.

21.7 Prior to application of paints on surfaces of chimneys, the thickness of the individual coat shall be checked by application of each coat of same paint on M.S.test panel. The thickness of paint on test panels shall be determined by using gauge such as 'Elkometer'. The thickness of each

coat shall be checked as per provision of this specification. This shall be approved by Engineer-In-Charge before application of paints on surface of chimney.

21.8 At the discretion of Engineer-In-Charge, the paint manufacturer must provide the expert technical service at site as and when required. This service should be free of cost and without any obligation to the owner, as it would be in the interest of the manufacturer to ensure that both surface preparation and application are carried out as per their recommendations. The contractor is responsible to arrange the same.

21.9 Final inspection shall include measurement of paint dry film thickness, Adhesion, Holiday detection check of finish and workmanship. The thickness should be measured at as many points/ locations as decided by Engineer-In-Charge and shall be within + 10% of the dry film thickness, specified in the specifications.

21.10 The contractor shall arrange for spot checking of paint materials for Sp.gr., glow time (ford cup) and spreading rate.

22.0 GUARANTEE

22.1 The contractor shall guarantee that the chemical and physical properties of paint materials used are in accordance with the specifications contained herein/to be provided during execution of work.

23.0 QUALIFICATION CRITERIA OF PAINTING CONTRACTOR/SUB-CONTRACTOR

Painting contractor who is awarded any job for EIL, Projects under this standard must have necessary equipments, machinery, tools and tackles for surface preparation, paint application and inspection. The contractor mush have qualified, trained and experienced surface preparator, paint applicator, inspector and supervisors. The contractor supervisor, inspector, surface preparator and paint applicator must be conversant with the standards referred in this specification.

24.0 PROCEDURE FOR APPROVAL OF NEW COATING MATERIALS AND MANUFACTURERS

Following procedure is recommended to be followed for approval of new manufacturers.

24.1 The manufacturer should arrange testing of the coating materials as per the list of tests given in para 24.4 below from one of the reputed Government laboratories.

24.2 Samples of coating materials should be submitted to the Govt. laboratory in sealed containers with batch no. and test certificate on regular format of manufacturer's testing laboratory. The sampling shall be certified and sealed by a certifying agency.

24.3 All test panels should be prepared by Govt. testing agency coloured photographs of test panels should be taken before and after the test and should be enclosed alongwith test report.

Sample batch no. and manufacturer's test certificate should be enclosed alongwith the report. Test report must contain details of observation and rusting if any, as per the testing code. Suggested Government laboratories are:

HBTI, Kanpur

DMSRDE, Kanpur
IIT, Mumbai
UICT, Matunga, Mumbai
RITES, Kolkata
PDIL, Sindri
NTH, Kolkata

24.4 Manufacturers should intimate the company, details of sample submitted for testing, name of Govt. testing agency, date, contact personnel of the govt. testing agency. At the end of the test the manufacturer should submit the test reports to the company for approval. The manufacturer(s) shall be qualified based on the results of these tests and other assessment and the company's decision in this regard shall be final and binding on the manufacturer.

Test required for evaluation of acceptance of coating materials for onshore application.

Test	ASTM Test Method
Density	D 1475
Dipping properties	D 823
Film characteristics	
Drying time	D 1640
Flexibility	D 1737/D 522
Hardness	D 3363
Adhesion	D 2197
Abrasion resistance	D 968/ D 1044
DFT/coat	AS PER SSPC GUIDELINES
Storage Stability	D 1849
Resistance to	
Humidity for 2000 hrs.	D 2247
Salt spray 2000 hrs	B 117
Accelerated Weathering	D 822
% Zn in Dry film for Inorganic Zinc Silicate primer	G 53

24.5 Coating systems for panel test shall be decided after discussion with EIL.

24.6 Clause No. 24.0 is for approval prior to award of the contract. In case any agency proposes for any fresh approval after award of work, the same shall have no time implications upon the contract.

ANNEXURE-I

LIST OF RECOMMENDED MANUFACTURERS

Indian Vendors

1. Asian Paints (I) Ltd., Mumbai
2. Berger paints Ltd., Kolkata
3. Kansai Nerolac Paints Ltd., Mumbai (including Ameron, USA Products).
4. Chugoku Marine Paints Pvt. Ltd., Mumbai
5. Shalimar Paints Ltd., Kolkata
6. Sigma Kalon Marine and Protective Coatings(India) Pvt Ltd, Mumbai.
7. CDC Carboline Ltd., Chennai
8. Premier products Ltd., Mumbai
9. Coromandel Paints & Chemicals Ltd., Visakhapatnam
10. Anupam Enterprises, Kolkata
11. Grand Polycoats, Vadodata
12. Bombay Paints Ltd., Mumbai
13. Akzo Nobel Coatings and Sealants Pvt. Ltd., Bangalore
14. Cipy Polyurethanes Pvt. Ltd., Pune
15. Gunjan Paints Ltd., Ahmedabad
16. Advance Paints Ltd., Mumbai
17. VCM Polyurethane Paints (for polyurethane paints only)
18. Jotun Paints India Pvt Ltd, Chennai(Singapore)
19. Paladin Paints and Chemicals , Mumbai
20. Chembond Chemicals Pvt Ltd , Navi Mumbai
21. Aashish Coating Technologies Pvt. Ltd, Vadodara/Mumbai

Foreign Vendors

1. Sigma Kalon Protective Coatings, Singapore
2. Ameron, USA
3. Kansai Paints, Japan
4. Hempel Paints, USA
5. Valspar Corporation, USA
6. Akzo Nobel/International Coatings, UK
7. Jotun Paints, Singapore

The following are approved for specific materials only.

1.0 Mark-chem Incorporated, Mumbai (for phosphating chemicals only).

2.0 ChemTreat India Ltd.(for Phosphating Chemical and glass flake filled coatings of M/s Atlas Chemicals Corporation, USA).

3.0 Carolina equipment and supply Co., USA.

4.0 Zinga Metall(Rozenstraat 4-Industrial Zone)-9810 EKE-Belgium, Indian Agent-Newkem, Mumbai-14 (for cold spray zinc coating)

5.0 Supplier of Desiccant type De-humidifier equipment on rental basis for controlling the RH and temperature during surface preparation , paint/coating application and curing period. M/s Technical Drying Equipment Pvt,. Ltd, Gurgaon, Haryana.

Note: The paint/coating manufacturers shall supply and apply only EIL recommended paint materials

ANNEXURE-II

LIST OF RECOMMENDED MANUFACTURERS' PRODUCTS

Sl. No	Manufacturers Name	P2 Chlorinated Rubber Zinc Ph Primer	P4 Etch Primer/ Wash Primer	P6 Epoxy Zinc Ph. Primer	F9 Inorganic Zinc Silicate Primer/ Coating
1	ASIAN PAINTS (I) LTD.	ASIOCHLOR HB.ZN.PH.PRIMER RO PC 168	APCONYL WP636 (PC335)	APCODUR HB.ZP. PC433	APCOSIL 605
2	BERGER PAINTS LTD.	LINOSOL HIGH BUILD ZP PRIMER	BISON WASH PRIMER	EPILUX 610 HB PRIMER	ZINC ANODE 304 MZS
3	AMERON PRODUCTS	-	AMERCOAT 178	AMERCOAT 71/ 385P	DIMETCOTE-9FT
4	CHEMBOND CHEMICALS	KEMCHLOR 201	KEMGALVA GRIP A1	KEMOXY 301	KEMGUARD 501
5	SHALIMAR PAINTS LTD	CHLOROKOTE ZINC PHOSPHATE PRIMER GREY	TUFFKOTE ETCH PRIMER	EPIGUARD ZINC PHOSPHATE PRIMER GREY	TUFFKOTE ZILIKATE
6	SIGMA KALON INDIA PVT LTD,	SIGMA NUCOL UNICOAT 7321	SIGMA ETCH PRIMER (7185)	SIGMA COVER 256 (7412)	SIGMAZINC- 158
7	CDC CARBOLINE LTD.	-	-	CARBOLINE 893	CARBOZINC 11
8	PREMIER PRODUCTS LTD.	-	-	P-15/3A U-16/92	U17/92 ETHYL SILICATE INORGANIC ZINC
9	CORAMANDEL PAINTS & CHEMICALS LTD.	COROCLORE CR HB.ZN.PH PRIMER	CPC WASH PRIMER	COROPEX EPOXY ZN.PH. HIGH BILD PRIMER	CPC INORGANIC ZINC SILICATE PRIMER
10	ANUPAM ENTERPRISES	ANUCHLOR ZP PRIMER	ANUPRIME-291	ANUPAM ANLICOR A-EZP-500	ANUZINC 2001 TP
11	GRAND POLYCOATS	GP CHLOROPRIME 601	GP PRIME 401	-	GP PRIME 402
12	BOMBAY PAINTS LTD.	PENTA CHLOR HB PRIMER 8632	PENTOLITE WASH PRIMER 8520	PENTADUR PRIMER 8530	ZINC-O-SIL 75
13	HEMPEL MARINE PAINTS	HEMPA TEX HIGHBUILD 4633	-	HEMPEL'S SHOP PRIMER E1530	GALVASOL 1570
14	AASHISH COATING TECH-NOLOGIES				
15	AKZO NOBEL PAINTS	-	-	INTERGARD 251	INTERZINC 12/22
16	PALADIN PAINTS	VEGCHLOR HB PRIMER 1143	VEGWASH PRIMER 1181	VEGPOX 1241ZP	THERMOSIL1362 ZINC
17	VCM POLYURETHANE PAINTS				
18	JOTUN PAINTS		JOTA ETCH TWO PACK WASH PRIMER	EPOXY CQ SPECIAL ZINC PHOSPHATE PRIMER	RESIST-86
19	KCC PRODUCTS (KOREA)				EZ 180(N)
20.	CHUGOKU MARINE PAINTS PVT. LTD.	-	-	CAMIDECK PRIMER	GALBONS HB
21.	KANSAI NEROLAC PAINTS LTD.	NEROLAC HB CR ZINC PHOSPHATE PRIMER	NEROLAC ETCH PRIMER	NEROLAC EPOXY ZINC PHOSPHATE PRIMER	NEROSIL 118

LIST OF RECOMMENDED MANUFACTURERS PRODUCTS (Cont. ...)

Sl. No	Manufacturers Name	F2 Acrylic-Polyurethane Finish Paint	F3 Chlorinated Rubber Finish Paint	F6A/B High Build Epoxy Finish Paint	F7 High Build Coal Tar Epoxy Coating
1	ASIAN PAINTS (I) LTD.	APCOTHANE CF676 (PC 1109)	ASIOCHLOR CF 621 (PC 319)	APCODUR HB COATING PC 1262	APCODUR CF 651/655(PC 131/471)
2	BERGER PAINTS LTD.	BERGER ACRYLIC PU FINISH	LINOSOL CHLORINATED RUBBER HB COATING	EPLIUX 04 AND 78 HB EPOXY COATING	EPILUX 555
3	AMERON	AMERCOAT 450GL	AMERCOAT 515	AMERCOAT 383 HS	AMERCOAT 78HB
4	CHEMBOND CHEMCIALS	KEMTHANE 411	KEMCHLOR 211	KEMOXY 324	KEMOXY 314
5	SHALIMAR PAINTS LTD	SHALITHANE FINISH	CHLORKOTE HB FINISH	EPIGARD TL FINISH POLYAMINE/ POLYAMIDE	BIPIGARD CTE ZL BLACK HB COAL TAR EPOXY COATING
6	SIGMA COATINGS.	SIGMADUR GLOSS (7528)	SIGMA NUCOL FINISH 7308	SIGMA GUARD 720	SIGMACOVER 300 (7472)
7	CDC CARBOLINE LTD.	CARBOLINE 132	-	CARBOLINE 191	CARBO-MASTIC-14
8	PREMIER PRODUCTS LTD.	U3/92 POLYURETHANE	CR-71, CR FINISH PAINT	42B/4A HIGH BUILD EPOXY	350/3A, COAL TAR EPOXY COATING
9	CORAMANDEL PAINTS & CHEMICALS LTD.	COROTHANE SUPER PU FINISH	COROCLORE CR FINISHING	COROPEX EPOXY HB COATING	COROPEX EPOXY COAL TAR COATING
10	ANUPAM ENTERPRISES	ANUTHANE ENAMEL	ANUCHLOR HB ENAMEL	DURACOAT-6000	COROGUARD
11	GRAND POLYCOATS	GP BOND 141	GP CHLOROGAURD 631	GP GUARD HP234	POLYGUARD CE
12	BOMBAY PAINTS LTD.	PENTATHANE FP 4510	PENTACHLOR FB 4635	PENTADUR HB 5540/5520	PENTADUR COALTAR EPOXY 8518/6518
13.	HEMPEL MARINE PAINTS	-	HEMPATEX HIBUILD 4633	HEMPADUR HIGH BUILD 5520	HEMPADUR 1510
14.	AASHISH COATING TECH	GA 1110 PU-UB		GA701 HB	
15	AKZO NOBEL COAITNGS	INTERTHANE 990	-	INTERGARD 966 / 410	INTERTUF 262 (TAR FREE TYPE)
16	PALADIN PAINTS	VEGTHANE (ALIPHATIC)	VEGCHLOR FP3140	VEGEPOX 3245/3562	VEGEPOX 4265
17	VCM POLYURETHANE PAINTS	PIPCOTHANE ALIPHATIC POLYURETHANE FINISH PAINT			
18	JOTUN PAINTS	HARDTOP XP		PENGUARD HB	JOTAGUARD 85
19	KCC PRODUCTS (KOREA)			KOEPOX TOPCOAT HB ET 5740	EH 173
20.	CHUKOGU MARINE PAINTS PVT LTD.	UNY MARINE	-	EPICON MARINE FINISH HB	BISCON HB 2001/ACHB
21.	KANSAI NEROLAC PAINTS	NEROTHANE ENAMEL	NEROLAC HB CHLORINATED RUBBER ENAMEL	NEROPOXY HB 262/6061	NEROLAC EPOXY COAL TAR POLYAMINE/POLY AMIDE CURED.

LIST OF RECOMMENDED MANUFACTURERS PRODUCTS (cont. ...)

Sl. No.	Manufacturers Name	F8 Epoxy Mastic Coating Surface Tolerant	F-11 Heat Resistant Synthetic Medium Aluminium Paint	F-12 Heat Resistant Silicone Aluminium Paint	F-15 Two Pack Ambient Temperature Curing Epoxy Phenolic Coating
1	ASIAN PAINTS (I) LTD.	APCODOR CF 640	ASIAN HR ALUMINIUM PAINT (PC 300)	HR SILICONE ALUMINIUM PAINT (PC 189)	
2	BERGER PAINTS LTD.	PROTECTO MASTIC	FERROTOL HR ALUMINIUM PAINT	LUMEROS HR SILICONE AL. PAINT(HR/143)	BERGER EPOXY PHENOLIC COATING
3	AMERON	AMERLOCK 400		AMERCOAT 878	
4	CHEMBOND CHEMICALS	KEMGUARD 555	KEMGUARD 250HR	-	-
5	SHALIMAR PAINTS LTD	EPIPLUS 556	HEAT RESISTING LUSTROL ALUMINIUM	LUSTOTHERM HS SILICONE ALUMINIUM	EPIGARD TL 543 HS FINISH
6	SIGMA COATINGS.	SIGMA COVER 630 (7428)	HIGH TEMPERATURE RESISTANT EPOXY SYSTEM UPTO 200°C	SIGMATHERM 540/SUPER THERMOVIT 600	SIGMA PHENGUARD 930 SYSTEM
7	CDC CARBOLINE LTD.	CARBO MASTIC-15	CARBOLINE 1248	CARBOLINE 4674	
8	PREMIER PRODUCTS LTD.	BH EPOXY MASTIC 150B/150A			
9	CORAMANDEL PAINTS & CHEMICALS LTD.	-	SILVOTOL HR ALUMINIUM PAINT	CPC SILICONE HR ALUMINIUM PAINT	
10	ANUPAM ENTERPRISES	ANU-MASTIC-102	-	ANUPAM HEAT GUARD.	
11	GRAND POLYCOATS	GP PRIME GUARD 235	-	-	
12	BOMBAY PAINTS LTD.	PENTADUR MASTIC 5515	KANGAROO HHR ALUMINIUM 4950	PENTHOLITE HRR ALUMINIUM 4951	
13.	HEMPEL MARINE PAINTS	HEMPDUR 1708			
14	AASHISH COATING TECH	GA700SPE	-	-	-
15	AKZO NOBEL COATINGS	INTERSEAL 670HS	INTERTHERM 891	INTERTHERM 50	INTERTHERM 228
16	PALADIN PAINTS	VEGEPOX MASTIC 2285	VEG HR AL PAINT	VEG HHR AL PAINT 600 DEG C	
17	VCM POLYURETHANE PAINTS	-	-	-	-
18	JOTUN PAINTS	PRIMASTIC UNIVERSAL	JOTUN AL PAINT HR 250 DEG.C	SOLVELITT AL SILICONE PAINT	TANKGUARD STORAGE
19	KCC PRODUCTS (KOREA)	EH 4158H		QT 606	
20.	CHUKOGU J&N LTD.	UMEGUARD MT/SX			
21.	KANSAI NEROLAC PAINTS LTD.	NEROMASTIC 400	NEROTHERM 250	NEROTHERM 538	

Note : This list is subject to revision based on fresh approval/ re-approval/ deletion.

सिविल, सरंचना एवं वास्तुकलाकार्यों के लिए निरीक्षण एंवपरीक्षण योजना (आईटीपी) (वर्गीकरण सहितमददर संविदा)

INSPECTION & TEST PLAN (ITP) FOR CIVIL,STRUCTURAL & ARCHITECTURAL WORKS (ITEM RATE CONTRACTS-WITH CATEGORIZATION)

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
1	30 01 2019	REVISED AND REISSUED	SKG	RK	AKK	RKT
0	14 01 2014	ISSUED AS STANDARD SPECIFICATION	SM	DJ	RKD	SC

Abbreviations:

AFC	:	Approved for Construction
BM	:	Bench Mark
CI	:	Cast Iron
CPT	:	Cone Penetration Test
GI	:	Galvanised Iron
IRC	:	Indian Road Congress
JB	:	Junction Box
MS	:	Mild Steel
MPT	:	Magnetic Particle Testing
NDT	:	Non Destructive Testing
PCC	:	Plain Cement concrete
PQR	:	Procedure Qualification Record
PT	:	Penetration Testing
PVC	:	Poly Vinyl Chloride
PWHT	:	Post Weld Heat Treatment
RCC	:	Reinforced Cement Concrete
RF	:	Reinforcement
SPT	:	Standard Penetration Test
U/G	:	Under Ground
WBM	:	Water Bound Macadam
WPS	:	Welding Procedure Specification

Construction Standards Committee

Convenor: Sh. A K Kundu, ED-I/C (Construction)

Members: Sh. Amitava Pal, GGM (Construction)
Sh. Janak Kishore, CGM (Projects)
Sh. Rajeev Jain, GM (SCM)
Sh. Udayan Chakravarty, GM (Piping)
Sh. Ravindra Kumar, GM (Construction)
Sh. S K Goel, AGM (Construction)

CONTENTS

SECTION - A

GENERAL NOTE

The enclosed ITP's shall be followed for the works to be performed by the contractor. The provisions indicated for stage wise inspection by EIL/Owner (For specific activities), which may be modified in line with EIL scope of services as per the contract between EIL and Owner. Activities for which ITP's are not given, contractor to develop and get the same approved by EIL/Owner well before start of the work. In general role of EIL has been specified in the document. The role of owner to be specified during preparation of site specific ITPs.

Contractor to submit required reporting formats and job procedures for each activity listed in ITP's and submit to EIL/Owner for approval, well before commencement of the activity. If the contractor has to deviate from the given ITP for a valid reason, he shall obtain prior written approval of EIL/Owner. Contractor to carry out 100% examination of all activities.

LEGEND

HP : Hold Point ;

A point which requires witnessing/inspection/verification and acceptance by Owner/EIL before any further processing is permitted.
The Contractor shall not process the activity/item beyond a Hold Point without written approval by Owner/EIL except where prior written permission for further processing is available.

W : Witness Point ;

An activity which requires witnessing/inspection/verification by Owner/EIL when the activity is performed.
After proper notification has been provided (notification modalities and period shall be finalized beforehand), the Contractor is not obliged to hold further processing if Owner/EIL is not available to witness the activity or does not provide comments before the date notified. Basis of acceptance shall be as per relevant technical specification.

Rw : Review of Contractor's documentation.

S : Surveillance Inspection by Owner/ EIL.
Monitoring or making observations to verify whether or not material/items or services conform to specified requirements. Surveillance activities may include audit, inspections, witness of testing, review of quality documentation & records, personnel qualifications, etc.

WC : 100% Examination by Contractor.

Responsibility for execution of the inspection/testing is with the Contractor; Owner/EIL only verifies examination or testing done by the Contractor at important stages

ITP NO.: 3101

LAND & TOPOGRAPHICAL SURVEY

Sl. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Boundary markings and submission of drgs./sketches	WC	S	Yes
2.	a) Review of calibration certificates of instruments/ testing equipments	WC	HP	Yes/ Format C1
	b) Field calibration, if any	WC	W	Yes
3.	Block levels, contour plans, establishing permanent bench marks with ref. to Survey of India B.Ms. by check levels and submission of relevant drgs. & records	WC	W	Format C2
4.	Protection of control points, permanent bench marks and regular rechecking	WC	S	-
5.	Submission of Master plan showing monuments, structures exposed rocks, weirs, water works, ponds, underground services if crossing that area, etc.	WC	S	Yes
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Yes

ITP NO.: 3102

SOIL INVESTIGATION

Sl. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Positioning of test location	WC	S	-
2.	a) Review of calibration certificates of instruments/ testing equipments	WC	HP	Yes /Format C1
	b) Field calibration, if any	WC	W	Yes
3.	Boring & sampling	WC	S	-
4.	In-situ testing (SPT, CPT, Plate load test, Soil Resistivity, Block vibration test, etc.)	WC	S/Rw	Yes
5.	Lab testing (as applicable)	WC	W/Rw	Yes
6.	Monitoring of water level	WC	S	-
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Yes

ITP NO.: 3103

SITE GRADING

Sl. No.	Activity	Contractor	EIL		Records to be submitted/ Format No.
			CAT A	CAT B	
1.	Clearing and stripping of soil including disposal of unsuitable material	WC	S	-	-
2	a) Review of calibration certificates of instruments/ testing equipments	WC	HP	HP	Yes/Format C1
	b) Field calibration, if any	WC	S	-	Yes
3.	Taking and plotting of initial levels at specified intervals for cutting as well as filling areas	WC	HP	HP	Yes
4.	Classification (Levels of strata) and testing of filling soil for suitability including preparation of Lead Charts to filling/disposal areas.	WC	W/ Rw	-	Yes
5.	Proper warning of explosions, misfires and storage of explosive materials (As applicable).	WC	-	S	-
6.	Breaking up of clods, lumps, etc. at the time of filling and compaction.	WC	S	-	-
7.	Identification and suitability of borrow areas for filling soil/murrum including verification of payments for royalty, etc.	WC	S/Rw	-	Yes
8.	Compaction test for earth filling in specified layers including finished areas.	WC	W/Rw	-	Format C3
9.	Verification of final finished grade levels.	WC	HP	HP	Yes
10.	Computation of Earth works.	WC	Rw	Rw	Yes
11.	a) Record of tree cuttings	WC	W	W	
	b) Stacking of blasted rocks and other quarry materials including handing over to Owner	WC	S	S	Yes
12.	Preparation of "As built drawings	WC	Rw	Rw	Yes
13.	Removal of Surplus earth/excavated material and leveling in disposal areas.	WC	S	-	-
14.	Resolutions of obstacles/hindrances	WC	S	-	-
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Yes

CAT A: All fillings
CAT B: All cuttings.

ITP NO.: 3104

EXCAVATION

Sl. No.	Activity	Contractor	EIL		Records to be submitted/ Format No.
			CAT A	CAT B	
1.	a) Review of calibration certificates of instruments/ testing equipments	WC	HP	HP	Yes
	b) Field calibration, if any	WC	W	W	Yes/Format C1
2.	Layout checking	WC	S	S	Format C2
3.	Taking initial levels	WC	W	W	Yes
4.	Slopes of excavation, benching, overburden, shoring & strutting (in case of deep excavation)	WC	S	S	-
5.	Check for sub-soil water, dewatering requirements as per specifications.	WC	S	S	-
6.	Bottom level of excavation and compaction	WC	S	S	-
7.	Stacking of different type of soils separately	WC	S	S	-
8.	List of obstacles encountered (cables, pipes, conduits, etc.)	WC	S	S	Yes
9.	Barricading of excavated pits for safety & protection from rain	WC	S	S	-
	FOR HARD ROCK				
1.	Obtaining license from district authorities for undertaking blasting operations	WC	Rw	Rw	Yes
2.	Storing of explosive materials as per explosive rules	WC	S	S	-
3.	Prominent display of red flags around the area to be blasted	WC	S	S	-
4.	Check the dimensions of bore holes	WC	S	S	-
5.	Stacking of hard rock for useable/non useable including handing over to owner	WC	S	S	Yes
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Yes

CAT A: Equipment foundations, Plant buildings, Technological structures, pipe racks, etc.
CAT B : Non Plant buildings, Boundary walls, wing walls, manholes, drains, pipe culverts, bridges, etc.

ITP NO.: 3105

BACK FILLING

Sl. No.	Activity	Contractor	EIL		Records to be submitted/ Format No.
			CAT A	CAT B	
1.	Selection of materials/selected earth	WC	W	S	Format C4, C5
2.	Check for treatment of soil, if any	WC	S	S	Yes
3.	a) Review of calibration certificates of instruments/ testing equipments	WC	HP	HP	Yes /Format C1
	b) Field calibration, if any	WC	W	W	Yes
4.	Filling in specified layers, consolidating, watering.	WC	S	S	-
5.	Compaction tests for layers	WC	W/Rw	S/Rw	Format C3
6.	Filling to required levels	WC	S	S	-
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Yes

CAT A : Equipment foundations, Plant buildings, Technological structure, pipe racks, etc.

CAT B : Non Plant buildings, pipe racks, Boundary walls, wing walls, manholes, drains, pipe culverts, bridges etc.

ITP NO.: 3106

UNDERGROUND PIPING (RCC/ CI)

Sl. No.	Activity	Contractor	EIL		Records to be submitted/ Format No.
			CAT A	CAT B	
1.	Incoming Material a) Owner's supply	Contractor to check all free issue materials and maintain records of MIV for material issued by owner/EIL			
	b) Contractor's supply	WC	Note -1		
2.	Adequate slope, benching in excavation for safety purposes (if required)	WC	S	-	-
3.	a) Review of calibration certificates of instruments/ testing equipments	WC	Rw	Rw	Yes/ Format C1
	b) Field calibration, if any	WC	W	W	Yes
4.	Layout, line & level	WC	S	S	Format C2
5.	Laying & jointing, grouting at manholes/chambers	WC	S	-	-
6.	Check for supports/ firm bed/ sub soil water level	WC	S	-	-
7.	Testing for leakages by blocking pipe ends	WC	W	W	-
8.	Hydro-testing and other tests, Removal of blockages, Cleaning & flushing of system	WC	HP	HP	Format C6
9.	Backfilling in layers	WC	Rw	Rw	Format C3
10.	Check for MS rungs in proper position, inlet/outlet pipe levels in manholes	WC	S	S	-
11.	Preparation of "As-built drawings"	WC	Rw	Rw	Yes
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Yes

NOTE: 1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A: Main plant buildings, Utilities, offsites, etc.

CAT B: Non plant buildings, technological buildings admn. Buildings, Gate house, security rooms, etc.

ITP NO.: 3107A

WBM ROADS

Sl. No.	Activity	Contractor	EIL		Records to be submitted/ Format No.
			CAT A	CAT B	
1.	a) Review of calibration certificates of instruments/ testing equipments	WC	HP	Rw	Yes /Format C1
	b) Field calibration, if any	WC	W	W	Yes
2.	Layout checking including Road crossings and taking initial levels	WC	W	W	Yes
3.	Approval of source & checking/testing of materials (wherever required)	WC	Note 1	Note 1	Format C4 Format C5
4.	Filling (if any), compaction, providing cambers in sub-base including levels	WC	W/Rw	W/Rw	Format C3
5.	Spreading metal to required thickness, line & levels, dry rolling including spreading of screening material	WC	S	-	Yes
6.	Check for camber and levels over metalling	WC	S	S	-
7.	Spreading murrum/ sand, watering and rolling	WC	S	-	-
8.	Checking thickness after each layer and rectification thereof (if any)	WC	S	S	Yes
9.	Checking quantity of aggregate by excavation of trial pits as per IRC Code	WC	W	W	Yes
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Yes

NOTE :1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A: Roads subjected to heavy loading, connected to main highway, main plant roads, etc.

CAT B: Balance Roads

ITP NO: 3107 B

WMM for Roads

SL. NO.	ACTIVITY	CONTRACTOR	EIL		Records to be submitted/ Format No.
			CAT A	CAT B	
1.	a.) Review of calibration certificates of instruments/testing equipments.	WC	HP	Rw	Yes /Format C1
	b) Field calibration, if any.	WC	W	W	
2.	Layout Checking including Road Crossing & taking initial levels.	WC	W	W	
3.	Approval of source & checking /testing of materials (wherever required)	WC	Note 1	Note 1	Format C4 Format C5
4.	Filling (if any), compaction, providing chambers in sub-base including levels.	WC	W/Rw	W/Rw	Format C3
5.	Spreading metal to required thickness, line & levels, dry rolling including spreading of screening material.	WC	S	-	
6.	Check for camber levels.	WC	S	S	
7.	Spreading, watering & rolling.	WC	S	-	
8.	Checking thickness after each layer and rectification thereof (if any).	WC	S	S	
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Yes

NOTE :1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A - Roads subjected to heavy loading connected to main High way, main plant roads etc.

CAT B - Balance roads

ITP NO.: 3108

BLACK TOPPING (PREMIX CARPETING) & BITUMINOUS MACADAM (BM)

Sl. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Approval of source of materials (aggregate, bitumen, etc.)	WC	Note 1	Format C4
2.	a) Review of calibration certificates of instruments/ testing equipments	WC	HP	Yes /Format C1
	b) Field calibration, if any	WC	S	Yes
3.	Surface preparation & check for camber/level	WC	S	-
4.	Checking/ testing of material wherever required	WC	W	Format C5, Yes
5.	Tack coat application	WC	S	-
6.	Laying of Premix carpeting/ BM including rolling	WC	S	Yes
7.	Application of Seal coat	WC	S	Yes
8.	Check for camber and levels	WC	S	-
9.	Check for bitumen temperature and consumption	WC	S	-
10.	Thickness check (random) of Premix carpet/ BM	WC	W	Yes
11.	Removal of surplus earth	WC	-	-
12.	Berm preparation	WC	-	-
13.	Final Inspection	WC	W	Yes
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Yes

NOTE :1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT B: All works.

ITP NO.: 3109

TANK PADS

Sl. No.	Activity	Contractor	EIL		Records to be submitted/ Format No.
			CAT A	CAT B	
1.	Approval of source of materials (aggregate, bitumen etc.)	WC	Note 1	Note 1	Format C4
2.	Stripping the area	WC	-	-	-
3.	a) Review of calibration certificates of instruments/ testing equipments	WC	HP	Rw	Yes/ Format C1
	b) Field calibration, if any	WC	W	S	Yes
4.	Layout and marking of ground level	WC	S	-	Format C2
5.	Excavation to required level, compaction of sub-base	WC	W	S	-
6.	Checking/ testing of materials	WC	W	S	Format C5
7.	Filling selected materials in specified layers, rolling, watering	WC	S	-	-
8.	Compaction tests	WC	W/Rw	Rw	Format C3
9.	Gravel filling under annular ring with compaction and adding graded filler material (As applicable)	WC	W	S	Yes
10.	Anti-corrosive layer, consolidation	WC	S	-	-
11.	Premix carpeting on side slopes	WC	S	S	-
12.	Preparation of "As-built drawing" for erection	WC	Rw	Rw	Yes
13.	Check for settlement of pads during hydro testing of tanks	WC	W	S	Yes
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Yes

NOTE :1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A: All Site fabricated steel storage tanks for process fluid /Hydrocarbon, floating roof tanks having capacity more than 600cum or 10m dia and 8 m height.

CAT B: Site fabricated steel storage tanks for Raw water, Fire water, waste water, DM water, etc. and all tanks not covered under "CAT A".

ITP NO.: 3110

MICRO GRADING

Sl. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	a) Review of calibration certificates of instruments/ testing equipments	WC	RW	Yes/ Format C1
	b) Field calibration, if any	WC	-	Yes
2.	Taking initial levels	WC	S	Yes
3.	Clearing/ Removal of extra soil, debris, etc. from site by transportation	WC	S	Yes
4.	Taking final levels	WC	S	Yes
5.	Verification of gradient of ground	WC	S	-
6.	Finishing of ground surface by hand compactor/ Roller (As applicable)	WC	S	-
7.	Final inspection	WC	W	Yes
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Yes

CAT B: All works

ITP NO.: 3140

FOR UNDERGROUND PIPING (CARBON STEEL/ SS) (Sheet 1 of 6)

Sl. No	Activity	Contractor	EIL		Records to be submitted/ Format No.
			CAT A	CAT B	
A.	**PRIOR TO FABRICATION**				
1	Incoming Material a) Owner's supply	Contractor to check all free issue materials and maintain records of MIV for material issued by owner/EIL			
	b) Contractor's supply	WC	Note -1		
2.	Welding Filler Material Approval/Qualification				
	i) Review of Manufacturer's Test Certificates/ other documents	WC	Rw	Rw	Yes
	ii) Testing, if any	WC	Rw	Rw	Yes
3.	WPS/PQR				
	i) Review of proposed Procedure	WC	HP	HP	Yes
	ii) Testing	WC	HP	HP	Yes
	iii) Approval of Final WPS/PQR	WC	HP	HP	Yes
4.	Welder Performance Qualification Test	WC	W	W	Yes
4a.	Certification & approval of welders	WC	W	W	Yes
5.	NDT Procedure Qualification				
	i) Review of proposed Procedure	WC	Rw	Rw	Yes
	ii) Testing	WC	Rw	Rw	Yes
	iii) Approval of NDT procedure	WC	HP	HP	Yes
6.	Preparation of sketches from General Arrangement drawings	WC	Rw	-	Yes
7.	Joint numbering	WC	Rw	-	Yes
8.	Approval of colour coding scheme	WC	Rw	-	Std spec
9.	Monitoring of colour coding on pipes & fittings	WC	S	-	
B.	**FABRICATION (SHOP & FIELD)**				
1.	Material as per piping class (check w.r.t. approved colour coding procedure)	WC	W		Format P1
	i) Fit-up check ii) Dimensional check	WC WC	S S	Rw Rw	

ITP NO.: 3140

FOR UNDERGROUND PIPING (CARBON STEEL/ SS) (Sheet 2 of 6)

Sl. No	Activity	Contractor	EIL		Records to be submitted/ Format No.
			CAT A	CAT B	
2.	Pre-heat (if any)	WC	S	-	Yes
3	Check for purity of purging/shielding Gas (if any)	WC	S		
4.	Purging (if any)	WC	S		
5.	Shielding rate (if any)	WC	S	-	--
6.	Baking of Electrodes	WC	S	-	Yes
7.	Inter-pass cleaning & Temperature check.	WC	S		--
8.	Visual check of completed welds - For welds with Random Radiography	WC	W	-	Format P2
	- For welds with 100% Radiography	WC	S	S	Format P2
9.	PT/MPT	WC	S	-	Yes
10.	Radiography marking (for Random Radiography)	WC	W	W	Format P3
11.	Radiography Interpretation	WC	W	W	Format P4
C.	**HYDROSTATIC/ PNEUMATIC TESTING**				
1.	Procedure Review	WC	Rw	Rw	Yes
2.	Correctness of Testing arrangements	WC	S	-	---
3.	Calibration of Pressure Gauges	WC	-	-	Format C1
4.	R.F. Pad testing, if any	WC	W	W	--
5.	Scrutiny of test packs for Mechanical & NDT Clearance (Refer **Annexure-1**)	WC	HP	HP	Annex-1, Format P5, UG1
6.	Air/Water Flushing (preliminary)	WC	S	S	-
6a.	Addition of corrosion inhibitors, if required – Approval of make & quality	WC	S	S	Yes

ITP NO.: 3140

FOR UNDERGROUND PIPING (CARBON STEEL / SS) (Sheet 3 of 6)

Sl. No	Activity	Contractor	EIL		Records to be submitted/ Format No.
			CAT A	CAT B	
7.	Pneumatic/ Hydrostatic testing	WC	W	W	Format P6
8.	Draining of water & Air drying	WC	S	S	Format P6
D.	**LAYING**				
1.	Trench excavation and levels	WC	S	-	Yes
2.	Cleaning of pipe surface	WC	S	-	-
3.	Approval of wrapping/coating material manufacturers	WC	Note 1	Note 1	Yes
4.	Approval of agency for wrapping & coating	WC	Rw	Rw	Yes
5.	Sample test of coating materials in approved laboratory	WC	Rw	Rw	Yes
6.	Procedure qualification for wrapping & coating	WC	HP	HP	Yes
7.	Application of primer	WC	S	S	--
8.	Coal tar temperature	WC	S	-	---
9.	Coating & wrapping	WC	S	S	---
10.	Check Thickness of coating (if applicable)	WC	S	-	Yes
11.	Calibration of Holiday tester	WC	Rw	Rw	Format C1
12.	Holiday testing	WC	W	W	Yes
13.	Peel test	WC	W	S/Rw	Yes

NOTE :1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A: All pressure lines, Fire Water line, Cooling Water line, CB & ABD.
CAT B: Balance Works.

ITP NO.: 3140

FOR UNDERGROUND PIPING (CARBON STEEL / SS) (Sheet 4 of 6)

Sl. No	Activity	Contractor	EIL		Records to be submitted/ Format No.
			CAT A	CAT B	
14.	Lifting arrangement	WC	S	-	Yes
15.	Lowering (levels & orientation of branches)	WC	S	-	--
16.	Checking of wrapping & coating for damages during lowering, their repair, Holiday Testing, etc.	WC	W	W	--
17.	Back filling & compaction	WC	S	-	Yes
18.	Location, Brickwork, plaster of valve pit	WC	-	-	Yes
19.	Top cover & Finish of valve pit	WC	S	S	--
E.	**SYSTEM COMPLETION**				
1.	Tie in joints (Refer **Annexure-2**)	WC	Annex-2	Annex-2	
2.	Scrutiny of test packs for system testing (Refer **Annexure-1**)	WC	Annex-1	Annex-1	
3.	System testing	WC	W	S/Rw	Format UG2
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Yes

CAT A: All pressure lines, Fire Water line, Cooling Water line, etc.
CAT B: Balance Works.

ITP NO.: 3140

FOR UNDERGROUND PIPING (CARBON STEEL / SS) (Sheet 5 of 6)

ANNEXURE – 1

Sl. No.	Activity	Contractor	EIL	
			CAT A	CAT B
F.	**MECHANICAL COMPLETION RECORD (U/G Piping)**			
1.	Clearance for flushing & testing	WC	Rw	Rw
1a.	Mechanical clearance			
	- Conformity with drawing	WC	Rw	Rw
	- Material as per Specification	WC	Rw	Rw
1b.	Welding & NDT clearance			
	- Material as per Specification	WC	Rw	Rw
	- Fit-up check record	WC	Rw	Rw
	- Visual check of completed welds	WC	Rw	-
	- PT/MPT	WC	Rw	Rw
	- Radiography	WC	Rw	Rw
	- PWHT & Hardness	WC	Rw	Rw
	- RF pad testing	WC	Rw	Rw
2.	Flushing & Pressure testing	WC	Rw	Rw
3.	Coating & wrapping			
	- Surface preparation	WC	Rw	-
	- Primer application	WC	Rw	Rw
	- Coating, wrapping & peel test	WC	Rw	-
	- Holiday check	WC	Rw	Rw
4.	Laying			
	- Trench leveling	WC	Rw	Rw
	- Lowering & checking for damages in wrapping & coating, their repair, Holiday testing, etc.	WC	Rw	Rw
	- Backfilling	WC	Rw	Rw

CAT B: All pressure lines, Fire Water line, Cooling Water line, etc.

CAT C: Balance works.

ITP NO.: 3140

FOR UNDERGROUND PIPING (CARBON STEEL / SS) **(Sheet 6 of 6)**

ANNEXURE – 2

TIE-IN

Sl. No.	Activity	Contractor	EIL
A.	FIT UP	WC	W
B.	ROOT RUN DP	WC	W
C.	FINAL RUN DP	WC	W
D.	RADIOGRAPH REVIEW	WC	HP
E.	PWHT HARDNESS	WC	Rw
F.	RF PAD TESTING	WC	HP
G.	CLEANING & PRIMING	WC	S
H.	COATING, WRAPPING	WC	W
I.	PEEL TEST	WC	HP
J.	HOLIDAY TESTING	WC	HP
K.	CHECKING FOR ANY DAMAGE IN WRAPPING & COATING AFTER LOWERING, THEIR REPAIR HOLIDAY TESTING, ETC.	WC	W
L	BACK FILLING	WC	S

For CAT A as well as CAT B

ITP NO: 3141

PLAIN CEMENT CONCRETE

Sl. No.	Activity	Contractor	EIL	Records to be submitted/ format no.
1.	a) Review of calibration certificates of instruments/ testing equipments	WC	Rw	Yes /Format C1
	b) Field calibration, if any	WC	S/Rw	Yes
2.	Checking of layout and materials, compaction of sub -grade	WC	S	Format C2, C3, C5, C7
3.	Mix proportion	WC	S	-
4.	Check for shuttering, dewatering if any.	WC	-	Yes
5.	Concreting with proper compaction	WC	-	-
6.	Checking of top level of PCC	WC	Rw	Yes
7.	Curing	WC	-	-
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Yes

ITP NO: 3142

REINFORCED CEMENT CONCRETE (SUB-STRUCTURE)

Sl. No.	Activity	Contractor	EIL		Records to be submitted/ Format No.
			CAT A	CAT B	
1.	Approval of source of materials	WC	HP	HP	Format C4
2.	Approval of agency for providing Ready Mixed Concrete (RMC), as applicable	WC	HP	HP	Yes
3.	a) Review of calibration certificates of instruments/ testing equipments	WC	HP	HP	Yes /Format C1
	b) Field calibration, if any	WC	W	W	Yes
4.	Checking of layout & condition of PCC/ leveling course	WC	S	S	Yes
5.	Incoming material checking	WC	Note 1	Note 1	Format C5 , C7
6.	Design of mix & establishment of strength at site by trial mix	WC	HP	HP	Yes
7.	Check for line & level of shuttering including its condition, quality and rigidity.	WC	S	S	
8.	Check for sub-soil water & dewatering arrangement, if any	WC	S	S	-
9.	Reinforcement & covers to reinforcement	WC	S	S	Yes
10.	Inserts, Anchor bolts and pipe sleeves, pockets, dowels, etc.	WC	S	S	-
11.	Pour Card	WC	W	W	Format C8, C9
12.	Check for obstacles encountered (Electrical conduits, pipe lines, etc.)	WC	S	S	Yes
13.	Concreting, compaction & finishing	WC	W	S/Rw	Yes
14.	Casting of cubes/Slump	WC	S	S	Yes
15.	Curing	WC	S	S	
16.	Testing of cubes- 7 days	WC	S/Rw	S/Rw	Format C10
17.	Testing of cubes- 28 days	WC	W	W	Format C10
18.	Removal of shuttering	WC	S	-	-
19.	Check for water tightness, rendering, if any	WC	W	W	-
20.	Preparation of As-built drawings	WC	Rw	Rw	Yes
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Yes

NOTE :1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A: Critical foundations of equipments i.e. compressors, reactors, columns, stacks, Unit Pipe racks, plant buildings and other equipment foundations with RCC Quantity > 250 Cum, tank foundations.

CAT B: Non critical pipe racks (branch pipe, offsite pipe rack, etc.) non plant buildings, pipe sleepers, manhole, catch pit, pipe culverts, bridges other equipment foundations not covered in CAT A, and balance works.

ITP NO: 3143

REINFORCED CEMENT CONCRETE (SUPER STRUCTURE)

Sl. No.	Activity	Contractor	EIL		Records to be submitted/ Format No.
			CATA	CATB	
1.	Approval of source of materials	WC	HP	HP	Format C4
2.	Approval of agency for providing Ready Mixed Concrete (RMC), as applicable	WC	HP	HP	Yes
3.	a) Review of calibration certificates of instruments/ testing equipments	WC	HP	HP	Yes/ Format C1
	b) Field calibration, if any	WC	W	W	Format C1
4.	Checking of layout	WC	S	S	Yes
5.	Incoming material inspection	WC	Note 1	Note 1	Format C5, C7
6.	Design of mix & establishment of strength at site by trial mix	WC	HP	HP	Yes
7.	Check for line & level of shuttering and scaffolding/ vertical bracing including hoisting arrangements.	WC	S	S	--
8.	Reinforcement & covers to reinforcement	WC	S	S	Yes
9.	Inserts, bolts, pipe sleeves, MS rungs, concealed electrical conduits, fan hooks, dowels, etc. including welding if any	WC	S	S	Yes
10.	Pockets/ openings	WC	S	S	Yes
11.	Expansion joints, if any	WC	S	S	Yes
12.	Check for water stops, slopes, stoppers, if any	WC	S	S	Yes
13.	Pour Card	WC	W	W	Format C8, C9
14.	Quality Records of RMC like Delivery Ticket Information, if applicable	WC	Rw	Rw	Yes
15.	Concreting, testing, compaction & finishing	WC	W	S	Yes
16.	Casting of cubes/ Slumps	WC	S	S	Yes
17.	Curing	WC	S	S	-
18	Testing of cubes- 7 days	WC	S/Rw	S/Rw	Format C10
19.	Testing of cubes- 28 days	WC	W	W	Format C10
20.	Removal of formwork/ staging	WC	S	-	-
21.	Verification of dimensions viz. AFC drawings and tolerances	WC	S	S	-
22.	Check for water tightness, rendering, if any	WC	W	W	--
23.	Preparation of As built drawings.	WC	Rw	Rw	Yes
	INSPECTION & TEST DOCUMENTS				Yes
	Review Test and Inspection Documents	WC	Rw	Rw	Yes

NOTE :1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A: Super structure of foundations for Critical equipments i.e. compressors, reactors, columns, stacks, foundations, Slabs of plant and non-plant buildings, tank foundations, Unit Pipe racks, plant buildings and super structure of any other equipment, etc.

CAT B: Not covered in category A Non critical pipe racks (branch pipe, offsite pipe rack, etc) non plant buildings other than slab, catch pit and balance works, pipe sleepers, pipe culverts, bridges, manhole etc.

ITP NO: 3145

RCC PAVEMENT / FLOORING

Sl. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Approval of source of materials	WC	Rw	Format C4
2.	Approval of agency for providing Ready Mixed Concrete (RMC), as applicable	WC	HP	Yes
3.	a) Review of calibration certificates of instruments/ testing equipments	WC	HP	Yes
	b) Field calibration, if any	WC	S	Format C1
4.	Layout checking/ excavation of all new foundations	WC	-	Yes
5.	Incoming material inspection	WC	Note 1	
6.	Design of mix &establishment of strength at site by trial mix	WC	HP	Yes
7.	Check for proper back filling/compaction/ completion of sub - Structure works	WC	S	Format C3, Yes
8.	Check for edges of shuttering, alternate panels	WC	-	-
9.	Check for slopes, thickness of flooring	WC	S	-
10.	Shuttering, reinforcement (as applicable)	WC	-	-
11.	Check for expansion joints/ Construction joints	WC	S	-
12.	Check for concealed pipe embedment, earthing, if any	WC	-	-
13.	Check for dividing strips, as applicable	WC	S	-
14.	Concreting, finishing, etc.	WC	S	Format C8, C9
15.	Quality Records of RMC like Delivery Ticket Information	WC	Rw	Yes
16.	Concreting, testing, finishing, test cubes	WC	W	Yes
17.	Checking for line, levels, slopes, joints, thickness of flooring viz. AFC drawings	WC	S	-
18	Curing	WC	S	-
19.	Grinding & polishing, as applicable	WC	S	-
20.	Testing of concrete cubes (as applicable)	WC	W	Format C10
21.	Testing of vacuum dewatering flooring (as applicable)	WC	W/Rw	Yes
22.	Preparation of "As Built Drawings"	WC	Rw	Yes
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Yes

NOTE :1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT B: All works.

ITP NO: 3146

BRICK MASONARY

Sl. No.	Activity	Contractor	EIL		Records to be submitted/ Format No.
			CAT A	CAT B	
1.	a) Review of calibration certificates of instruments/ testing equipments	WC	Rw	Rw	Yes/ Format C1
	b) Field calibration, if any	WC	Rw	Rw	Yes
	c) Field testing of Materials, if any	WC	Rw	Rw	
2.	Incoming material inspection	WC	Note 1	Note 1	
3.	Cleaning of surface	WC	-	-	-
4.	Wetting/soaking of bricks	WC	S	S	-
5.	Cement mortar proportion	WC	S	S	-
6.	Staging & scaffolding	WC	-	-	-
7.	Hacking of adjacent concrete surface	WC	S	S	-
8.	Check for bond/closers, thickness of joints	WC	S	-	-
9.	Line, level & plumb	WC	S	S	-
10.	Raking out joints, keys in brick work, if any	WC	S	S	-
11.	Check for placement of Reinforcement bars in case of partition brick work	WC	S	S	-
12.	Embedment of fixtures	WC	S	S	-
13.	Curing	WC	-	-	-
14.	Preparation of 'As Built Drawings'	WC	Rw	Rw	Yes
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw		Yes

NOTE :1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A: Load bearing walls
CAT B: Balance works

ITP NO: 3147

STRUCTURAL STEEL WORKS

S. No	Activity	Contractor	EIL		Records to be submitted/ Format No.
			CAT A	CAT B	
A	**PRE – FABRICATION ACTIVITIES**				
1.	a) Review of calibration certificates of instruments/ testing equipments	WC	HP	HP	Yes/ Format C1
	b) Field calibration, if any	WC	S	S	Yes
2.	Incoming material inspection	WC	Note 1	Note 1	Yes
3.	Welding Filler material approval/ qualification				
	a) Manufacturing test certificates/ documents	WC	Rw	Rw	Yes
	b) Testing, if any	WC	W	W	Yes
4.	WPS/ PQR	WC	HP	HP	Yes
5.	Welders performance qualification	WC	W	W	Yes
6.	Layout checking	WC	S	-	Yes
7.	Welding equipment and accessories	WC	S	-	-
8.	Preparation and approval of Fabrication drawings	WC	Rw	Rw	Yes
B	**FABRICATION ACTIVITIES**				
1.	Materials as per design drawing	WC	Rw	Rw	Format C12
2.	Check straightness and non-warping of members	WC	S	S	Format C12
3.	Dimensional and fit-up checks including provision of slopes for deflection wherever required	WC	S	S	Format C12
4.	Visual check for welding	WC	S	S	Format C12
5.	Grinding including surface preparation for painting and application of primer	WC	S	S	Format C12
6.	Checking paint as per specs, shelf-life, etc.	WC	S	S	Yes
7.	Application of specified paint, painting thickness, etc.	WC	S	S	Format C12
C	**FIELD ERECTION ACTIVITIES**				
1.	Lifting arrangements including test certificates of lifting tackles	WC	S /Rw	S/Rw	Yes
2.	Correctness of location	WC	S	-	Format C12
3.	Orientation of bracing, lugs	WC	S	-	-
4.	Alignment & levels	WC	S	-	Format C12
5.	Field welding (if any)	WC	S	S	Format C12
6.	Grouting	WC	S	S	Format C12
7.	Finishing coat of paint, thickness of paint etc.	WC	S	S	Format C12
8.	Preparation of As-built drawings	WC	Rw	Rw	Yes
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Yes

NOTE :1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A: Steel structures pertaining to equipment site compressors, reactors, columns, Unit Pipe racks, stacks, Technological structures.

CAT B: Steel structures of Non critical pipe racks (branch pipe, offsite pipe rack, etc. non plant buildings, walkways, platforms, etc.

ITP NO: 3148

PILING WORKS

Sl. No.	Activity	Contractor	EIL		Records to be submitted/ Format No.
			CAT A	CAT B	
1.	Approval of source of materials	WC	Rw	Rw	Format C4
2.	Approval of agency for providing Ready Mixed Concrete (RMC), if applicable	WC	HP	HP	Yes
3.	a) Calibration certificate of measuring & testing equipments/ instruments	WC	HP	HP	Yes/ Format C1
	b) Field calibration, if any	WC	W	S	Yes
4.	Layout and ground level	WC	S	S	Yes
5.	Incoming material inspection	WC	Note 1	Note 1	
6.	Design of mix &establishment of strength at site by trial mix	WC	HP	HP	Yes
7.	Driving of piles & check for set point	WC	S	S	-
8.	Check for depth of bore and lowering of cage measuring	WC	S	-	-
9.	Check for cage reinforcement, its length, overlaps	WC	S	S	-
10.	Pour Card	WC	HP	HP	Format C8, C9
11.	Quality records of RMC like Delivery Ticket Information, if applicable	WC	Rw	Rw	Yes
12.	Concreting,	WC	W	S	Yes
13.	Casting of cubes/Slumps	WC	S	S	Format C10
14.	Testing of cubes- 7 days	WC	S/Rw	S/Rw	Format C10
15.	Testing of cubes- 28 days	WC	W	W	Format C10
16.	Check for cut off level of concreting & quantity of concrete poured	WC	S	-	Yes
17.	Lifting of casing pipe	WC	S	S	-
18.	Pile load tests (lateral/vertical/cyclic/pull out)	WC	W	Rw	Yes
19.	Submission of pile load test report	WC	Rw	Rw	Yes
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Yes

NOTE :1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A: Critical foundations of equipments i.e. compressors, reactors, columns, stacks, Technological structures, Unit Pipe racks, plant buildings and other equipment foundations.

CAT B: Non critical pipe racks (branch pipe, offsite pipe rack, etc.) non-plant buildings.

ITP NO: 3171

ANTITERMITE TREATMENT

Sl. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Testing of material & spraying devices including personal protective equipments like facemask, gloves, shoes, etc.	WC	HP & Note 1	Yes
2.	Preparation of surface for taking dosage of emulsion by ramming of each layer of soil by roding the earth at specified intervals	WC	-	-
3.	Backfilling and compaction in specified layers along with application of emulsifier along the sides of masonry & RCC structures	WC	S	Format C3
4	Compaction of top surface for taking dosage of emulsifier by roding the earth at specified intervals for the entire floor area before concreting	WC	-	-
5	Check for consumption of emulsifier utilized	WC	S	Yes
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Yes

NOTE :1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT B: All works.

ITP NO: 3172

PLASTERING

Sl. No.	Activity	Contractor	EIL		Records to be submitted/ Format No.
			CAT A	CAT B	
1.	Calibration of testing equipments	WC	Rw		Format C1
2.	Checking/ testing of materials	WC	W		Format C5, C7
3.	Check for completeness of all hidden jobs like piping, conduiting, etc.	WC	-	-	-
4.	Check for grading of sand, Mix proportion	WC	S	S	-
5.	Sample preparation for finish and its approval	WC	W	S	-
6.	Neeru application on plaster (as applicable)	WC	S	-	-
7.	Hacking and cleaning the surface, removing loose particles, wetting the surface	WC	-	-	-
8.	Checking of plaster thickness, plumb & even surface	WC	S	-	Yes
9.	Check for grooves, openings, rounding off the corners, hollowness in plaster	WC	-	-	-
10.	Curing	WC	S	S	-
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw		Yes

CAT A: Area requiring special finish

CAT B: Balance works.

ITP NO.: 3173

DOORS, WINDOWS AND VENTILATORS

Sl. No.	Activity	Contractor	EIL		Records to be submitted/ Format No.
			CAT A	CAT B	
1.	Incoming material inspection	WC	Note 1	Note 1	
2.	Calibration of testing equipments	WC	HP	HP	Yes
3.	Check for sections & dimensions	WC	S	-	Yes
4.	Line, level & plumb	WC	-	-	-
5.	Section joinery details	WC	Rw	-	-
6.	Grouting with lugs/ dash fasteners	WC	-		-
7.	Check for fixtures & fittings	WC	S	S	Yes
8.	Check for thickness & type of glazing	WC	-	-	Yes
9.	Check for rubber gasket, anodizing (as applicable)	WC	-	-	-
10.	Brand/ shade of paints, no. of coats including surface preparation	WC	S	Rw	-
11.	Final inspection	WC	HP	HP	Yes
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Yes

NOTE :1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A: Main plant buildings.

CAT B: Balance works.

ITP NO.: 3174

PAINTING (BUILDING WORKS)

Sl. No.	Activity	Contractor	EIL		Records to be submitted/ Format No.
			CAT A	CAT B	
1.	Completion of surface preparation	WC	-	-	-
2.	Incoming material inspection	WC	Note 1	Note 1	
3.	Confirmation of colour, shade & brand	WC	HP	HP	-
4.	Check for number of coats	WC	S	S	Yes
5.	Curing, if any	WC	S	-	-
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Yes

NOTE :1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A: Main plant buildings, Major non-plant building (viz: Administrative building, Training center etc.

CAT B: Balance works.

ITP NO. : 3175

SANITARY FITTINGS

Sl. No.	Activity	Contractor	EIL		Records to be submitted/ Format No.
			CAT A	CAT B	
1.	Incoming material inspection	WC	Note 1	Note 1	
2.	Checking of sample (as applicable)	WC	S	-	Yes
3.	Check completeness of finishing works w.r.t. line, level & position	WC	S	-	-
4.	Check proper fixing of the sanitary fittings to give aesthetic appeal	WC	S	-	-
5.	Check for leakage	WC	S	Rw	-
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Yes

NOTE :1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A: Main plant buildings, Major non-plant building (viz: Administrative building, Training center etc.)

CAT B: Balance works.

ITP NO. : 3176

WATER PROOFING (ROOF)

Sl. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Approval of materials	WC	HP	Format C4
2.	a) Calibration certificate of measuring & testing equipments/application instruments (if applicable)	WC	HP	Yes/ Format C1
	b) Field calibration, if any	WC	W	Yes
3	Surface preparation for screeding/ water proof plastering	WC	W	-
4.	Mix proportion, thickness of screeding/ plastering & slope towards rain water pipes	WC	S	Yes
5.	Formation of groove at specified height on parapet wall	WC	-	-
6.	Incoming material inspection, no. of coats, application procedure and consumption.	WC	Note 1	Yes
7.	Termination of material in groove on vertical plane	WC	S	-
8.	Check for hollowness, bubbles in water proofing, if any	WC	S	-
9.	Conducting a sample of water proofing test by flooding the area for specified interval (as applicable)	WC	W	
10.	Cleaning of surface	WC	-	--
11.	Submission of Guarantee in the requisite Performa	WC	Rw	Yes
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Yes

NOTE :1) For Incoming material Inspection please refer ITP no: 6-82-1010

ITP NO: 3177

FALSE FLOORING AND FALSE CEILING

Sl. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
	FALSE FLOORING			
1.	Manufacturers Test Certificate	WC	Rw	Yes
2.	Incoming material inspection	WC	Note 1	Yes
3.	Cleaning base floor	WC	-	-
4.	Painting base floor with Polyurethane based paint (as specified)	WC	S	Yes
5.	Check for installation of grid framework	WC	S	-
6.	Proper line, level & layout	WC	S	-
7.	Final inspection	WC	HP	Yes
	FALSE CEILING			
1.	Manufacturers Test Certificate	WC	Rw	Yes
2.	Incoming material inspection	WC	Note 1	Yes
3.	Surface preparation of panel boards	WC	-	-
4.	Proper line, level & cut-outs	WC	S	-
5.	Painting of panel boards	WC	S	Yes
6.	Final inspection	WC	HP	Yes
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Yes

NOTE :1) For Incoming material Inspection please refer ITP no: 6-82-1010

ITP NO.: 3178

UNDER DECK INSULATION

Sl. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Incoming material checking including density	WC	Note 1	Yes
2.	Checking of adhesive, fasteners for anchorage	WC	S	Yes
3.	Fixing of scaffolding, ladders, platforms	WC	S	-
4.	Fixing of under-deck insulation with adhesive	WC	-	-
5.	Fixing of dash fasteners at defined spacing	WC	-	-
6.	Finishing	WC	S	-
7.	Final inspection	WC	W	Yes
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Yes

NOTE :1) For Incoming material Inspection please refer ITP no: 6-82-1010

ITP NO.: 3179

ROOFING ACCESSORIES

Sl. No.	Activity	Contractor	EIL		Records to be submitted/ Format No.
			CAT A	CAT B	
1.	Incoming material inspection	WC	HP/ Note 1	HP/ Note 1	Yes
2.	Ensure proper sequence of sheeting	WC	W		
3.	Check for mitring, overhang, laps, etc.	WC	S	-	-
4.	Slopes line, level of sheets, barge boards, ridges & gutters, overhang of sheets	WC	S	-	-
5	Bolting by drilling only, length of bolts, nos., anodizing and type of washers	WC	S	-	-
6	Check for slopes of rain gutters, down take pipes, north lighting curves/ supports for gutters	WC	S	-	-
7	Check for leakage/ passing of light	WC	S	-	-
8.	Final inspection	WC	W	W	Yes
	INSPECTION & TEST DOCUMENTS				-
	Review Test and Inspection Documents	WC	Rw	Rw	Yes

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

2) Fixing arrangement need to be reviewed with respect to contract specifications.

CAT A: Important structures (e.g. Compressor House, Warehouse, Workshop and Pump House etc.), main plant buildings, etc.

CAT B: Balance works.

ITP NO.: 3199

LIGHTING WORKS (NON PLANT BUILDINGS)

Sl. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Prepare detailed conduit layout diagram as per the approved electrical drawing	WC	W	Yes
2.	Provide GJ/PVC sleeves in columns/beams at identified locations to facilitate laying of conduit on later date.	WC	S	-
3.	Incoming material inspection	WC	Note 1	Yes
4.	Ensure that the conduit is laid in line with execution drawings & provide pull-wires as per requirement.	WC	S	-
5.	Check correctness of drop/JB locations	WC	S	-
6.	Check threaded joints are proper	WC	S	-
7.	Ensure all JB/Fan box are properly stuffed with jute	WC	S	-
8.	Ensure conduits are properly tied to reinforcement bars to prevent floating during concrete	WC	S	-
9.	Ensure proper supporting of conduit lengths wherever required	WC	S	-
10.	Ensure adequate chasing depth for conduit portion coming inside brick walls	WC	S	-
11.	Check workmanship towards joints and presence of any foreign material inside the conduits	WC	S	-
12.	Ensure wiring material is inspected at site before use	WC	W	Yes
13.	Ensure correctness of lighting wire size and no. of wires as per the drawing in each conduit portion	WC	S	-
14.	Preparation of "As Built" drgs.	WC	Rw	Yes
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Yes

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

SECTION - B

FORMATS

FOR

CIVIL, STRUCTURAL &

ARCHITECTURAL WORKS

CONTENTS

FORMAT NO.: C1

RECORD OF CALIBRATION OF MEASURING / TESTING EQUIPMENTS

Project :
Client :
Name of Work :

Job No. :
Contractor :

Sl. No.	Name of Equipment/Apparatus	Model No.	Certificate No.	Calibrated By	Calibration Date	Next Calibration Due on	Remarks	Accepted	
								Contractor	EIL
	Theodolite								
	Levels								
	Steel measurement tapes								
	Cross staff								
	Distomat								
	All balances								
	Weigh Batcher								
	Cube testing Machine								
	Pressure Gauges								
	Dial gauges								
	Dead weight tester								
	Vernier caliper/ screw gauge								
	Holiday tester								
	Universal Testing Machine								
	Charpy V-notch Impact testing machine								
	Hardness Testing Machine								
	Various Digital and Analog meters								
	Variable current, voltage and resistance generators								
	Temperature/ Pressure Recorders								
	Temperature gauges including RTDs								
	Thermocouples								
	Vibration probes								
	Decibel-meter								
	Any other								

FORMAT NO.: C2

SURVEYING AND LAYOUT RECORD

Project :

Job No :

Client :

Contractor :

Name of Work :

1. Reference Drawing :

2. Reference Grid Pillars :

3. Reference Bench Mark/Reduced Level :

4. Co-ordinates :

5. Reduced Level :

6. Closing error, if any :

7. Layout Sketch :

_____ _____ _____

(CONTRACTOR) (EIL) (CLIENT)

Date :

FORMAT NO. : C3

TEST REPORT FOR DETERMINATION OF DRY DENSITY & MOISTURE CONTENT OF SAND/SOIL

Project :

Job No :

Client :

Contractor :

Name of Work :

Location :

Layer No :

S. No.	Description	Relation	Test Nos:						Remarks
			1	2	3	4	5	6	
1.	Wt. of mould + wt. of wet soil/sand	W_1 gm							
2.	Wt. of mould	W_2 gm							
3.	Wt. of wet soil/sand	$(W_1 - W_2)$ gm							
4.	Volume of mould	V cc							
5.	Density of wet soil/sand	$Dw = (W_1 - W_2)/V$ gm/cc							
6.	Wt. of wet sample taken	Ww gm							
7.	Wt. of sample after drying	Wd gm							
8.	Moisture Content (or directly by moisture meter)	$Mc = (Ww - Wd)/wdx100\%$							
9.	Dry density	$Dd = Dw/(1+Mc)$ gm/CC							
10.	Laboratory Max dry density	gm/cc							
11.	Degree of Compaction	%							
12.	Required degree of compaction	%							
13.	Optimum Moisture Content (OMC)	%							

(TESTED BY/LAB-IN-CHARGE)

(CONTRACTOR)

(EIL)

Date :

FORMAT NO. : C4

RECORD OF APPROVAL OF SOURCE(S) FOR AGGREGATES, SOIL

Project : Job No :

Client : Contractor :

Name of Work :

1. Reference :
2. Material :
3. Location of Source :
4. Approx. distance from the site :
5. Physical Properties
   - a) Colour (as applicable) :
   - b) Shape (as applicable) : Rounded/Irregular
   - c) Texture (as applicable) : Glossy/Smooth/Granular
6. Tests conducted at :
7. Code of Conformance :
8. Test Report Reviewed : Satisfactory/Un-satisfactory
9. Remarks : The source is approved/not approved
10. Explanation if any :

Enclosures :
- a) Reviewed Test Reports
- b) Request of contractor, if available

COMMITTEE MEMBERS :

APPROVED :
- i) EIL :
- ii) Client :

Signature of the contractor :

Date :

Place :

FORMAT NO. : C5

SIEVE ANALYSIS REPORT

Project : Job No : Name of Work :
Client : Date : Contractor :
Wt. of Sample taken : Date on which sample taken :

FINE AGGREGATE

S. No.	Sieve Size	Weight Retained (gm)	Percentage Retained	Cumulative % Retained	% Passing	Fineness Modulus	Zone (As per IS:383)	Remarks
1.	4.75 mm							
2.	2.36 mm							
3.	1.18 mm							
4.	600 u							
5.	300 u							
6.	150 u							
7.	Pan							

COARSE AGGREGATE/ROAD METAL					Wt. of Sample taken :		Passed/ Failed (As per IS:383/EIL Spec 6-65-0018)	Remarks
1.	125 mm							
2.	90 mm							
3.	80 mm							90-45 (Gr-I), 63-45 (Gr-II), 13.2 mm (screening) for road work
4.	63 mm							
5.	53 mm							
6.	45 mm							
7.	40 mm							
8.	22.4 mm							
9.	20 mm							
10.	16 mm							40 mm down for PCC
11.	13.2 mm							
12.	12.5 mm							20 mm down for RCC
13.	11.2 mm							
14.	10 mm							
15.	5.6 mm							
16.	4.75 mm							
17.	2.36 mm							
18.	180 u							

(TEST BY/LAB-IN-CHARGE) (CONTRACTOR) (EIL)

FORMAT NO. : C6

UNDERGROUND PIPING-TEST REPORT (RCC / CI)

Project :
Client :
Name of Work :

Job No :
Contractor :

1. Reference Drawing :
2. Location :
3. Line Designation :
4. Type of Pipe & System :
5. Specification :
6. Dia of Pipe :
7. Gradient :
8. Type of Manhole :
9. Test (s) Conducted :
10. Date of Testing :
11. Remarks, if any :

CONTRACTOR EIL CLIENT

Date :

FORMAT NO. : C7

CEMENT TESTING RESULT REPORT

Project :
Client :
Name of Work :
Brand of Cement :
Wt. of sample taken :
Room Temperature :

Job No :
Contractor :
Consignment No. :
Sample Collected on :

A. CONSISTENCY

Trial No.	Wt. of Cement (gm)	Wt. of Water Added (gm)	% of Water	Reading on Indicator (mm)	Consistency	Remarks

B. SETTING TIME

Trial No.	Wt. of Cement (gm)	Wt. of Water Added (gm)	W/C Ratio	Time Recorded When Water Added	Time Recorded At set	Initial Set	Final Set	Setting Time	Remarks

C. FINENESS

Trial No.	Wt. of Cement *Sample Used*	Retained on 90 μ IS sieve in gm	% Retained	Remarks

D. COMPRESSIVE STRENGTH

Cube Size : 7.06X7.06X7.06 cm

Trial No.	Mix Proportion	Date of		Age of Specimen	Crushing Surface Area (Cm^2)	Crushing Load (Kg)	Crushing Strength (Kg/Cm^2)	Remarks
		Casting	Testing					

(TESTED BY)/LAB-IN-CHARGE (CONTRACTOR) (EIL)

Date :

FORMAT NO. : C8

POUR CARD-I (PROGRAMME OF CONCRETING)

Contractor :				***Client :***	
Name of work :					
1.	Reference document :				
2.	Type of structure :		Location :		
3.	Levels	From :	To :		
4.	Grade of concrete/ Approved Design Mix				
5.	Brand name, Grade and Consignment no. of cement				
6.	Estimated volume of concrete :				
7.	Quantity of cement required :				
8.	***Reinforcement checking details*** :				
		No.	Dia.	Length	
	a) Laps				
	b) Separators				
	c) Chairs				
	d) Any other				
	Remarks				
9.	**Pre pour inspection details**			**Checked**	**NA**
	a) Survey Layout				
	b) Sub soil compaction				
	c) Completion of underground works				
	d) Cleanliness				
	e) Cover to reinforcement				
	f) Anchor bolts/Insert plates				
	g) Sleeves/ packers				
	h) Water stops				
	i) Formwork				
	j) Slopes				
	k) Construction/ Expansion joints				
	l) Admixtures				
	m) Any other				
	Remarks				
10.	Clearance for Electrical/ Mechanical works required/ not required :	***Electrical***		***Mechanical***	
11.	The above structure is finally inspected on at AM/PM and found/ not found satisfactory for concreting.				
	Remarks, if any				

(Contractor)	**(EIL)**	**(Client/ Owner)**
Name	Name	Name
Designation	Designation	Designation
Date	Date	Date

FORMAT NO. : C9

POUR CARD-II (OBSERVATIONS DURING CONCRETING)

Contractor :				***Client :***	
Name of work :					
1.	a) Quality of coarse aggregates	Satisfactory ☐	Not satisfactory ☐		
	b) Quality of fine aggregates	Satisfactory ☐	Not satisfactory ☐		
	c) Bulkage of sand taken into account	Yes ☐	No ☐		
2.	Quality of water	Satisfactory ☐	Not satisfactory ☐		
3.	***Machinery mobilization***			***Nos.***	***Stand by***
	a) Mixture machine				
	b) Ready mixed concrete dumpers				
	c) Vibrators				
	d) Pumps				
	e) Hoists				
4.	Pour start time :	AM/PM,	Date :		
5.	Slump				
6.	W/C Ratio				
8.	Type of weather	Normal ☐	Abnormal ☐		
	Details of abnormality (Precautions taken for <5°C and >40°C, rainy season)				
10.	Number of cubes taken & Cube identification number/mark				
11.	Quantity of concrete poured				
12.	Pour completion time:	AM/PM:	Date:		
13.	Curing method				
	☐ Traditional	☐ Curing compound			
	☐ Blanket/ foils/ gunny bags	☐ Others (specify)			
14.	Period for removal of form work :				
15.	Any defect(s) observed during concreting :				

(Contractor)	**(EIL)**	**(Client/ Owner)**
Name	Name	Name
Designation	Designation	Designation
Date	Date	Date

FORMAT NO. : C10

CRUSHING STRENGTH TESTING RESULTS OF CONCRETE CUBES

Project :

Job No :

Client :

Contractor :

Name of Work :

Grade of Concrete :

Type of Cement :

W/C Ratio :

Max. size of Aggregate :

Cube No.	Id. Mark on cube	Type & Location of Structure	Date of		Age (days)	Dimensions of Cube			Vol. of Cube (m^3)	Wt. of Cube (Kg)	Unit WT. (Kg/m^3)	Surface Area (Cm^2)	Crushing Load (Kg)	Crushing Strength (Kg/Cm^2)	Remarks
			Casting	Testing		L (Cm)	B (Cm)	H (Cm)							

(TESTED BY)/LAB-IN-CHARGE

(CONTRACTOR)

(EIL)

FORMAT NO. : C11

DIMENSIONAL, WATER ABSORPTION, CRUSHING STRENGTH & EFFLORESCENCE TESTING RESULTS OF BRICKS

Project :

Job No :

Client :

Contractor :

Name of Work :

S. No.	Frog Mark	Wt. of oven *Dried Brick* (gm)	Absorption Period (hr)	Wt. of wet Brick (gm)	% of Water Absorption	Efflorescence Observed After Drying	Size of Brick (L X B X H) Cm	Crushing Surface Area (Cm^2)	Crushing Load (Kg)	Crushing Strength (Kg/Cm^2)	Remarks

NOTE : i) Water absorption shall not be more than 20% by its dry weight. Bricks should be soaked in cold water for 24 hrs.
ii) Code of conformance shall be IS:3495 (for conducting tests) and IS:5454 (for collecting samples)

(TESTED BY/LAB-IN-CHARGE) CONTRACTOR EIL

Date :

FORMAT NO. : C12

STRUCTURE FABRICATION & ERECTION SHEET

Project :

Job No :

Client :

Contractor :

Name of Work :

Reference Drawing :

Location/Coordinates/Grids :

Layout Clearance obtained : Yes/ No

S. No.	Item No.	Material & Dimensional clearance	Shop Fit up		Shop welding		Cleaning & primer painting		Erection Fit up		Alignment & leveling		Field welding		Grouting clearance		Final Painting & thickness		Remarks
			Con	EIL	Con	EIL	Con	EIL	Con	EIL	Con	EIL	Con	EIL	Con	EIL	Con	EIL	

Abbreviations:
Con : Contractor's signature with date

SECTION - C

FORMATS

FOR

UNDERGROUND PIPING WORKS

CONTENTS

FORMAT NO. : P1

DAILY FIT UP INSPECTION & TRACEABILITY REPORT

Project :
Client :
Name of Work:
Report No. :

Job No :
Contractor :
Date :

Sl. No.	Service/Line No.	Dia.	Joint No.	*Type*	Inch Mtr.	Manufacturers Heat No.	Clearance	Remarks
	TOTAL INCH DIA.				**TOTAL INCH MTR.**			

Total Inch	Previous	Till Date
Diameter		
Meter		

G – Butt Weld	S – Socket Weld	B – Branch Weld	M – Mitre Weld

(CONTRACTOR) (EIL)

FORMAT NO. : P2

WELD VISUAL INSPECTION REPORT

Project : Job No :

Client : Contractor :

Name of Work :

Report No. : Date :

WPS No. :

Sl. No.	Service/Line No.	Dia.	Joint No.	Type	Welder No.	Visual Inspection Clearance	*Remarks*
	Total inch Dia						

WORK LOAD =
PREVIOUS =
TILL DATE =
% PROGRESS =

G - BUTT WELD
S - SOCKET WELD
B - BRANCH WELD
M - MITRE WELD

CONTRACTOR EIL

FORMAT NO. : P3

RADIOGRAPHY OFFERING REPORT

Project : Job No :

Client : Contractor :

Name of Work :

Report No. : Date :

Sl. No.	Service/Line No.	Dia.	Joint No.	Welder No.	Radiography No.	Accepted Date	R.A. Bill No.

CONTRACTOR EIL

FORMAT NO. : P4

RADIOGRAPHY INTERPRETATION REPORT

Project : Job No :

Client : Contractor :

Name of Work :

Radiography Technique : SWSI/DWSI/DWDI

Source : Ir192 ☐ , X-Ray ☐ , Cobalt 60 ☐

Film Type & Make :

IQI : Date :

Radiography Procedure No. :

Sl. No.	Service/ Line No.	Dia.	Joint No.	Welder No.	Radiography No.	Segment	Results	Joint Status A/R/H

SWSI - SINGLE WALL SINGLE IMAGE
DWSI - DOUBLE WALL SINGLE IMAGE
DWDI - DOUBLE WALL DOUBLE IMAGE

A - ACCEPTED
R - REPAIR
H - HOLD
S/C - SURFACE CHECK
RT - RETAKE

CONTRACTOR EIL

FORMAT NO. : P5

PIPING HYDROSTATIC TEST RELEASE RECORD

Project : Job No :

Client : Contractor :

Name of Work :

Plan : _____	Date : _____
Loop No : _____	Area : _____
	REF P & ID No. : _____
	INCH MTR : _____
	From _____ To _____

		Line No. (s)		Isometric No. (s)	P&ID No. (s)	

Test Medium :	Test Duration :	Design/Test Pressure :

Test Pressure Gauge No.	Range	Calibration Certificate No.:	Gauge Calibration Date:

Items to check		Accept	Witness	
		Contractor	EIL	
	Field Installation Checklist Prior to Hydrostatic test Signed			
	Punch list Prepared	Yes ☐	No ☐	
	Pre – Hydrostatic test Punch items Cleared			
	Accessibility to Inspection/Witness Locations			
	Capacity of pressurizing pump checked			
	Cordon off area for high pressure testing, as required			
	Pre-hydrostatic test flushing carried out			
	IBR/Others test Witnessing Required Yes No			
System Released for Pressure Testing :				

Contractor :	**EIL:**
Sign : Name :	Sign : Name :
Date :	Date :
Designation :	Designation:

FORMAT NO. : P6

PIPING HYDROSTATIC TEST ACCEPTANCE RECORD

ACTIVITY	Date	Time
Water Filling and Venting started at		
Water Filling Completed		
Vents Closed		
Isolation of Pressurizing pump		
Test completed at :		
- Water drained		
- Air		
- Temp Blinds Removed		
- Checked for reinstallation of a. Valves b. Others		
- Cold setting of spring supports carried out		

Contractor :	EIL :
Sign :	Sign:
Date :	Date:
Name : Designation	Name: Designation:
	Reviewed by EIL Area Coordinator :
	Sign:
	Date:
	Name: Designation:

FORMAT NO. : UG1

LINEWISE RECORD

Project :

Job No :

Client :

Contractor :

Name of Work:

Plant :

% Radiography :

Loop No. :

Sl. No.	Dia.	Jt. No	Type	Fit-up Clearance Date	Welder No.	Date of Welding	Radiography		Stress Relieve Chart No.	Hardness	Hydrostatic test Date	Clearance date for					Remarks
							No.	Result & Date				Cleaning & Priming	Coating & Wrapping	Trench Level Checking	Holiday Checking	Lowering Back-Filling	

CONTRACTOR

Date :

EIL

FORMAT NO. : UG2

U/G PIPING SYSTEM TESTING RECORD

ACTIVITY	Date	Time
Air/Water Filling and Venting started at		
Water Filling Completed/Air pressure achieved		
Vents Closed (for water testing)		
Isolation of Pressurizing pump/compressor		
Visual Test/Soap Bubble check completed at :		
- Water drained/Air depressurized		
- Drying, if applicable		
- Temp Blinds Removed		
- Checked for reinstallation of a. Valves b. Others		

Contractor :	EIL :
Sign :	Sign:
Date :	Date:
Name : Designation	Name: Designation:
	Reviewed by EIL Area Coordinator :
	Sign:
	Date:
	Name: Designation:

बोलीकर्ता से गुणवत्ता प्रबंधन प्रणाली अपेक्षाओं हेतु विनिर्देश

SPECIFICATION FOR QUALITY MANAGEMENT SYSTEM REQUIREMENTS FROM BIDDERS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convener	Standards Bureau Chairman
					Approved by	
2	12.06.20	General Revision	QMS Standards Committee	QMS Standards Committee	SKB	SKS
1	12.03.15	General Revision	QMS Standards Committee	QMS Standards Committee	MPJ	SC
0	04.06.09	Issued as Standard Specification	QMS Standards Committee	QMS Standards Committee	SCT	ND

Abbreviations:

ISO	-	International Organization for Standardization
MR	-	Material Requisition
PO	-	Purchase Order
PR	-	Purchase Requisition
QMS	-	Quality Management System

QMS Standards Committee

Convener: Mr. S.K. Badlani

Members: Mr. Sanjay Mazumdar (Engg.)
Mr. R.K. Singh (SCM)
Mr. B. Biswas (SCM)
Mr. Ravindra Kumar (Const.)
Mr. Vinod Kumar (CQA)
Mr. Swapnil Vaishnav (Projects)

CONTENTS

1.0 SCOPE

This specification establishes the Quality Management System requirements to be met by BIDDER for following purpose:

- QMS requirements to be met by suppliers / contractors after award of work / during contract execution.

2.0 DEFINITIONS

2.1 Bidder

For the purpose of this specification, the word "BIDDER" means the person(s), firm, company or organization who is under the process of being contracted by EIL / Owner for delivery of some products (including service). The word is considered synonymous to supplier, contractor or vendor.

2.2 Project Quality Plan

Document tailored from Standard Quality Management System Manual of BIDDER, specifying how the quality requirements of the project will be met.

2.3 Owner

Owner means the owner of the project for which services / products are being purchased and includes their representatives, successors and assignees.

3.0 REFERENCE DOCUMENTS

6-78-0002	Specification for Documentation Requirements from Contractors
6-78-0003	Specification for Documentation Requirements from Suppliers

4.0 QUALITY MANAGEMENT SYSTEM – GENERAL

Unless otherwise agreed with EIL / Owner, the BIDDER proposed quality system shall fully satisfy all relevant requirements of ISO 9001 "Quality Management Systems – Requirements." Evidence of compliance shall be current certificate of quality system registration to ISO 9001 or a recent compliance audit recommending registration from a certification agency. The quality system shall provide the planned and systematic control of all quality related activities for execution of contract. Implementation of the system shall be in accordance with BIDDER'S Quality Manual and PROJECT specific Quality Plan.

5.0 QUALITY SYSTEM REQUIREMENTS

5.1 BIDDER shall prepare and submit for review / record, Project Quality Plan / Quality Assurance Plan for contracted scope / job. The BIDDER'S Quality Plan shall address all of the applicable elements of ISO 9001, identify responsible parties within BIDDER'S organization, for the implementation / control of each area, reference the applicable procedures used to control / assure each area, and verify the documents produced for each area. The Project Quality Plan shall necessarily define control or make reference to the relevant procedures, for design and engineering, purchase, documentation, record control, bid evaluation, inspection, production / manufacturing, preservation, packaging and storage, quality control at construction site, pre-commissioning, commissioning and handing over (as applicable) in line with contract requirement and scope of work.

5.2 BIDDER shall identify all specified or implied statutory and regulatory requirements and communicate the same to all concerned in his organization and his sub contractor's organization for compliance.

5.3 BIDDER shall deploy competent and trained personnel for various activities for fulfillment of PO / contract. BIDDER shall arrange adequate infrastructure and work environment to ensure that the specification and quality of the deliverable are maintained.

5.4 BIDDER shall do the quality planning for all activities involved in delivery of order. The quality planning shall cover as minimum the following:

- Resources
- Product / deliverable characteristics to be controlled.
- Process characteristics to ensure the identified product characteristics are realized
- Identification of any measurement requirements, acceptance criteria
- Records to be generated
- Need for any documented procedure

The quality planning shall result into the quality assurance plan, inspection and test plans (ITPs) and job procedures for the project activities in the scope of bidder. These documents shall be submitted to EIL / Owner for review / approval, before commencement of work.

5.5 Requirements for sub-ordering of outsourced items / sub-contracting / purchasing of services specified in MR / contract / tender shall be adhered to. In general all outsourced items will be from approved vendors of EIL. Wherever requirements are not specified, or approved sub vendors do not exist, the sub-contractor shall establish and maintain a system for purchasing / sub-contracting to ensure that purchased product / service conforms to specified requirements in concurrence with EIL / Owner. Criteria for selection of sub-contractor, evaluation, re-evaluation, maintenance of purchasing data and verification of purchased product (sub-contractor services), constitute important components of this requirement.

5.6 BIDDER shall plan and carry production and service provision under controlled conditions. Controlled conditions shall include, as applicable

a) the availability of information that describes the characteristics of the product
b) the availability of work instructions
c) the use of suitable equipment
d) the availability and use of monitoring and measuring devices
e) the implementation of monitoring and measurement
f) the implementation of release, delivery and post-delivery activities

5.7 BIDDER shall validate any processes for production and service provision where resulting output cannot be verified by subsequent monitoring and measurement. This includes any process where deficiencies become apparent only after the product is in use or service has been delivered.

5.8 BIDDER shall establish a system for identification and traceability of product / deliverable throughout product realization. Product status with respect to inspection and testing requirements shall be identified.

5.9 BIDDER shall identify, verify, protect and safeguard EIL / Owner property (material / document) provided for use or incorporation into the product. If any Owner / EIL property is lost, damaged or otherwise found to be unsuitable for use, this shall be reported to the EIL / Owner.

5.10 BIDDER shall ensure the conformity of product / deliverable during internal processing and delivery to the intended destination. Requirements mentioned in the MR/ tender shall be adhered to.

5.11 BIDDER shall establish system to ensure that inspection and testing activities are carried out in line with requirements. Where necessary, measuring equipment shall be calibrated at specified frequency, against national or international measurement standards; where no such standard exists, the basis used for calibration shall be recorded. The measuring equipment shall be protected from damage during handling, maintenance and storage.

5.12 BIDDER shall ensure effective monitoring, using suitable methods, of the processes involved in production and other related processes for delivery of the scope of contract.

5.13 BIDDER shall monitor and measure the characteristics of the product / deliverable to verify that product requirement has been met. The inspection (stage as well as final) by BIDDER and EIL / Owner personnel shall be carried out strictly as per the approved ITPs or ITPs forming part of the contract. Product release or service delivery shall not proceed until the planned arrangements have been satisfactorily completed, unless otherwise approved by relevant authority and where applicable by Owner / EIL.

5.14 BIDDER shall establish and maintain a documented procedure to ensure that the product which does not conform to requirements is identified and controlled to prevent its unintended use or delivery

5.15 All non-conformities (NCs) / deficiencies found by the BIDDER'S inspection / surveillance staff shall be duly recorded, including their disposal action shall be recorded and resolved suitably. Effective corrective actions shall be implemented by the BIDDER so that similar NCs including deficiencies do not recur. The BIDDER shall take appropriate actions to address the Risks and Opportunities in the project.

5.16 All deficiencies noticed and reported by EIL / Owner shall be analyzed by the BIDDER and appropriate corrective actions shall be implemented. BIDDER shall intimate EIL / Owner of all such corrective action implemented by him.

5.17 BIDDER should follow the standards, specifications and approved drawings. Concessions / Deviations shall be allowed only in case of unavoidable circumstances. In such situations Concession / deviation request must be made by the BIDDER through online system of EIL eDMS. URL of EIL eDMS is http://edocx.eil.co.in/vportal.

5.18 BIDDER shall have documented procedure for control of documents.

5.19 All project records shall be carefully kept, maintained and protected for any damage or loss until the project completion, then handed over to EIL / Owner as per contract requirement (Refer Specification Nos. 6-78-0002 - Specification for Documentation Requirements from Contractors and 6-78-0003 - Specification for Documentation Requirements from Suppliers), or disposed as per relevant project procedure.

6.0 AUDITS

BIDDER shall plan and carry out the QMS audit for the job. Quality audit programme shall cover design, procurement, construction management and commissioning as applicable including activities carried out by sub-vendors and sub-contractors. This shall be additional to the certification body surveillance audits carried out under BIDDER'S own ISO 9001 certification scheme.

The audit programmes and audit reports shall be available with bidder for scrutiny by EIL / Owner. EIL or Owner's representative reserves the right to attend, as a witness, any audit conducted during the execution of the WORKS.

In addition to above, EIL, Owner and third party appointed by EIL / Owner may also perform Quality and Technical compliance audits. BIDDER shall provide assistance and access to their systems and sub-contractor / vendor systems as required for this purpose. Any deficiencies noted shall be immediately rectified by BIDDER.

7.0 DOCUMENTATION REQUIREMENTS

BIDDER shall submit following QMS documents immediately after award of work (Within one week) for record / review by EIL / Owner/ TPIA, as applicable.

- Organization chart (for complete organization structure and for the project)
- Project Quality Plan / Quality Assurance Plan
- Job specific Inspection Test Plans, if not attached with PR
- Job Procedures
- Inspection / Test Formats

In addition to above QMS documents, following documentation shall be maintained by the BIDDER for submission to EIL / Owner on demand at any point of time during execution of the project.

- Quality Manual
- Certificate of approval for compliance to ISO: 9001 standard
- Procedure for Control of Non-conforming Product
- Procedure for Control of Documents
- Sample audit report of the QMS internal and external audits conducted during last one year
- Customer satisfaction reports from at least 2 customers,
- Project QMS audit report
- Technical audit reports for the project
- Corrective action report on the audits

Documents as specified above are minimum requirements. BIDDER shall submit any other document / data required for completion of the job as per EIL / Owner instructions.

ठेकेदारों से प्रलेखन अपेक्षाओं हेतु विनिर्देश

SPECIFICATION FOR DOCUMENTATION REQUIREMENTS FROM CONTRACTORS

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by: Standards Committee Convener	Approved by: Standards Bureau Chairman
2	12.06..20	General Revision	QMS Standards Committee	QMS Standards Committee	SKB	SKS
1	12.03.15	General Revision	QMS Standards Committee	QMS Standards Committee	MPJ	SC
0	04.06.09	Issued as Standard Specification	QMS Standards Committee	QMS Standards Committee	SCT	ND

Abbreviations:

DCI	-	Document Control Index
FOA	-	Fax of Acceptance
IC	-	Inspection Certificate
IRN	-	Inspection Release Note
ITP	-	Inspection and Test Plan
LOA	-	Letter of Acceptance
QMS	-	Quality Management System
URL	-	Universal Resource Locator
V Portal	-	Vendor Portal

QMS Standards Committee

Convener: Mr. S.K. Badlani

Members:
Mr. Sanjay Mazumdar (Engg.)
Mr. R.K. Singh (SCM)
Mr. B. Biswas (SCM)
Mr. Ravindra Kumar (Const.)
Mr. Vinod Kumar (CQA)
Mr. Swapnil Vaishnav (Projects)

CONTENTS

Attachments

1.0 SCOPE

This specification establishes the Documentation Requirements from Contractors

All documents / data against the Tender / Contract shall be developed and submitted to EIL / Owner by the contractor for review / records, in line with this specification.

2.0 DEFINITIONS

2.1 Contractor

For the purpose of this specification, the word "CONTRACTOR" means the person(s), firm, company or organization who has entered into a contract with EIL / Owner for delivery of some products and services. The word is considered synonymous to bidder, supplier or vendor.

2.2 Owner

Owner means the owner of the project for which services / products are being purchased and includes their representatives, successors and assignees.

3.0 REFERENCE DOCUMENTS

6-78-0001	Specification for Quality Management System Requirements from Bidders

4.0 DOCUMENTATION AND DATA REQUIREMENTS

4.1 Order Acknowledgement and Assigning Project Manager

After placement of order, Contractor shall acknowledge order through V-Portal within 7 days of receipt of FOA / PO. Contractor shall assign a Project Manager for that order though online portal and provide requisite details. Project Manager details shall include e-mail address, mailing address, mobile / telephone nos., fax nos. and name of Project Manager. All the system generated emails pertaining to that order shall be sent to the assigned Project Manager.

4.2 Documents / Data to be submitted by the Contractor

4.2.1 The contractor shall submit the documents and data against the Tender / Contract as per the list specified in respective Tender / Contract.

4.2.2 Review of the contractor drawings / Documents by EIL would be only to review the compatibility with basic designs and concepts and in no way absolve the contractor of his responsibility / contractual obligation to comply with Tender / Contract requirements, applicable codes, specifications and statutory rules / regulations. Any error / deficiency noticed during any stage of manufacturing / execution / inspection / installation shall be promptly corrected by the contractor without any extra cost or time, whether or not comments on the same were received from EIL during the drawing review / inspection stage.

4.2.3 Unless otherwise specified, submission of documents for Review / Records shall commence as follows from the date of Fax of Intent / Letter of Intent/ Fax of Acceptance (FOA) / Letter of Acceptance (LOA):

QMS	- 1 week
Document Control Index	- 2 weeks
Other Documents/Drawings	- As per approved Document Control Index

4.2.4 Documents as specified in Tender / Contract are minimum requirements. Contractor shall submit any other document / data required for completion of the job as per EIL / Owner instructions.

4.3 Style and Formatting

4.3.1 All Documents shall be in ENGLISH language and in M.K.S System of units.

4.3.2 Before submitting the drawings and documents, contractor shall ensure that the following information are properly entered in each drawing:

Tender Number
Name of Equipment / Package
Equipment / Package Tag No.
Name of Project
Owner
Main Contractor (if work is sub-contracted)
Drawing / Document Title
Drawing / Document No.
Drawing / Document Revision No. and Date

4.4 Review and Approval of Documents by Contractor

4.4.1 The Drawing / Documents shall be reviewed, checked, approved and duly signed / stamped by contractor before submission. Revision number shall be changed during submission of the revised contractor documents and all revisions shall be highlighted by clouds. Whenever the contractor require any sub- contractor drawings to be reviewed by EIL, the same shall be submitted by the contractor duly reviewed, approved and stamped by the contractor. Direct submission of sub- contractor's drawings without contractor's approval shall not be entertained.

4.5 Document Category

4.5.1 **Review Category**

Following review codes shall be used for review of contractor Drawings / Documents:

Review Code 1	-	No comments. Proceed with Manufacture / Fabrication / Construction as per the document.
Review Code 2	-	Proceed with Manufacture / Fabrication / Construction as per commented document. Revised document required.
Review Code 3	-	Document does not conform to basic requirements as marked. Resubmit for review.
R	-	Document is retained for Records. Proceed with Manufacturing / fabrication as per Tender/ Contract Requirement.
V	-	Void

4.6 Methodology for Submission of Documents to EIL / Owner

4.6.1 Document Control Index (DCI)

Contractor shall create and submit Document Control Index (DCI) for review based on PO / PR / MR along with schedule date of submission of each drawing / document on EIL Vendor Portal. The DCI shall be specific with regard to drawing / document no. and the exact title. Proper sequencing of the drawings / documents should be ensured in schedule date of submission.

4.6.2 Submission of Drawings / Documents / Data

Drawings / documents, data and DCI shall be uploaded on the EIL Vendor Portal. The detail guidelines for uploading documents on EIL Vendor Portal are available on following URL

http://edocx.eil.co.in/vportal

4.6.3 Statutory Approvals

Wherever approval by any statutory body is required to be taken by Contractor, the Contractor shall submit copy of approval by the authority to EIL.

4.6.4 Schedule and Progress Reporting

Contractor shall submit monthly progress report (MPR) and updated procurement, engineering and manufacturing status (schedule vs. actual) and highlight constraints, if any, along with action plan for mitigation, to the EIL / Owner by 1st week of every month. One month Look-ahead schedule including the mobilization plan shall be submitted within 2 weeks from FOA / LOA. In case of exigencies, EIL / Owner can ask for report submission as required on weekly / fortnightly / adhoc basis depending upon supply status and contractor shall furnish such reports promptly without any price implication. Format for progress report shall be submitted by the contractor during kick off meeting or within one week of receiving FOA / LOA, whichever is earlier.

4.6.5 Quality Assurance Plan / Inspection and Test Plan

Inspection and test plans attached if any, to the tender are generic and indicative only. Immediately after receipt of the order, contractor shall submit within one week of receiving FOA / LOA, job specific ITPs based on the indicative ITPs. Further, contractor shall also submit Quality Assurance Plan for project activities in the scope of contract, starting from manufacturing to handing over / commissioning, these plans shall cover / identify the activities, relevant procedure, if any, code of conformance, resources for performance and checking / monitoring, approval requirements and authority, records to be generated and audit scope by EIL/Owner.

For EPCC / LSTK / Package contracts, the contractor shall prepare a list of items / equipment and their inspection categorization plans for all items included in the scope of supply immediately after receipt of order and obtain approval for the same from EIL. The items shall be categorized into different categories depending upon their criticality for the scope of inspection of TPIA and / or EIL.

4.6.6 Inspection Release Note (IRN)/ Inspection Certificate (IC)

Contractor shall ensure that all documents viz. documents reviewed, manufacture's test certificate etc., mentioned in Inspection Release Note (IRN), issued by EIL / third party against the materials supplied by contractor, are sent to EIL along with the IRN.

IRN / IC shall be issued by EIL Inspector / third party inspection agency only after all the drawings/documents as per DCI are submitted and are accepted under review code-1 & code R. Material / Equipment dispatch from contractor's / sub vendor's works shall not commence till above condition is met.

Note 1: Non fulfilling above requirement shall result into appropriate penalty or with- holding of payment as per conditions of Tender / Contract.

Note 2: For items where IRN/IC is issued by TPIA, supplier to ensure that following as a minimum must be mentioned by TPIA in IRN/IC

a) Tender document number
b) List of drawings / documents with EIL approval code
c) Tests witnessed, documents reviewed
d) Compliance statement by TPIA that product meets the requirement as specified in EIL standard specifications, Inspection Test Plan / QAP and approved documents.

4.6.7 **Pre Commissioning & Commissioning Activities Management System (PCAMS)**

Pre Commissioning & Commissioning activities management system software shall be followed for Mechanical completion, check listing of loops, punch points, hydro test and issue of Formats during the Pre Commissioning and Commissioning activities and the same can be accessed on following URL

https://pcams.eil.co.in/

4.7 Final Documentation

4.7.1 As built Drawings

Minor Shop / Site changes made by contractor after approval of drawings under 'Code 1' by EIL and deviations granted through online system , if any, shall be marked in hard copies of drawings which shall then be stamped 'As-built' by the contractor. These 'As-built' drawings shall be reviewed and stamped by EIL Inspector / Site engineer / TPIA also, as the case may be. Format for completeness of final documents (Format No. 3-78-0004) is attached with this specification. Contractor shall prepare scanned images files of all marked – up 'As – built' drawings. Simultaneously contractor shall incorporate the shop / site changes in the native soft files of the drawings also.

4.7.2 As built Final Documents

As built final documents shall be submitted as listed in Tender / Contract

4.7.3 Packing / Presentation of Final Documents

Final Documents shall be legible photocopies in A4, A3 size only. Drawings will be inserted in plastic pockets (both sides transparent, sheet thickness minimum 0.1 mm) with an extra strip of 12 mm wide for punching so that drawings are well placed.

Final Documentation shall be bound in hard board plastic folder(s) of size 265 mm x 315 mm ($10^1/_2$ inch x $12^1/_2$ inch) and shall not be more that 75 mm thick. It may be of several volumes and each volume shall have a volume number, index of volumes and index of contents of that particular volume. Where numbers of volumes are more, 90mm thickness can be used. Each volume shall have top PVC sheet of minimum 0.15 mm thick duly fixed and pressed on folder cover and will have 2 lever clips. In case of imported items documents, 4 lever clip shall also be accepted. All four corners of folders shall be properly metal clamped. Indexing of contents with page numbering must be incorporated by contractor. Spiral / Spico bound documents shall not be acceptable. As mentioned above, books should be in hard board plastic folders with sheets punched and having 2/4 lever clips arrangement.

Each volume shall contain on cover a title block indicating Tender No., name of project, name of customer, package equipment tag no. & name (if applicable). Each volume will have hard front cover and a reinforced spine to fit thickness of book. These spines will also have the title printed on them. Title shall include also volume number (say 11 of 15) etc.

4.7.4 **Submission of Soft copies**

Contractor shall submit to EIL, the scanned images files as well as the native files of drawings / documents, along with proper index.

In addition to hard copies, contractor shall submit soft copies of all the final drawings and documents in pen drive or any other specified medium with proper identification tag, all text documents prepared on computer, scanned images of all important documents (not available as soft files), all relevant catalogues, manuals available as soft files (editable copies of drawings / text documents, while for catalogues / manuals / proprietary information and data PDF files can be furnished).

All the above documents shall also be uploaded on the EIL Vendor Portal and if applicable on Client Server also.

4.7.5 **Completeness of Final Documentation**

Contractor shall get the completeness of final documentation verified by EIL / TPIA and attach the Format for Completeness of Final Documentation (Format No. 3-78-0004) duly signed by EIL or TPIA as applicable to the final document folder.

COMPLETENESS OF FINAL DOCUMENTATION

Name of Supplier/Contractor	:	
Customer	:	
Project	:	
EIL's Job No.	:	
Purchase Order No./ Contract No.	:	
Purchase Requisition No./ Tender No.	:	Rev. No. :
Name of the Work/ Equipment	:	
Tag. No.	:	
Supplier's / Contractor's Works Order No.	:	

Certified that the Engineering Documents / Manufacturing & Test Certificates submitted by the supplier (as per Index sheet mentioned in Annexure-1) are complete in accordance with the Vendor Data Requirements of Purchase Requisition / Tender.

Signature	: …….	Signature	: …….
Date	: …….	Date	: …….
Name	: ……..	Name	: ……..
Designation	: ……	Designation	: ……
Department	: ……	Department	: ……
Supplier / Contractor		EIL / TPIA	

Annexure-1

Final Documentation Index Sheet			
PR/PO/Tender No.		Rev. No.	
Serial No.	Document Title	Page/ Folder No.	No. of Pages

Signature	: …….	Signature	: …….
Date	: …….	Date	: …….
Name	: ……..	Name	: ……..
Designation	: ……	Designation	: ……
Department	: ……	Department	: ……

Supplier / Contractor

EIL / TPIA

आपूर्तिकर्ताओं से प्रलेखन अपेक्षाओं हेतु विनिर्देश

SPECIFICATION FOR DOCUMENTATION REQUIREMENTS FROM SUPPLIERS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committe Convener	Standards Bureau Chairman
					Approved by	
2	12.06.20	General Revision	QMS Standards Committee	QMS Standards Committee	SKB	SKS
1	12.03.15	General Revision	QMS Standards Committee	QMS Standards Committee	MPJ	SC
0	04.06.09	Issued as Standard Specification	QMS Standards Committee	QMS Standards Committee	SCT	ND

Abbreviations:

DCI	-	Document Control Index
eDMS	-	Electronic Document Management System
FOA	-	Fax of Acceptance
IC	-	Inspection Certificate
IRN	-	Inspection Release Note
ITP	-	Inspection and Test Plan
LOA	-	Letter of Acceptance
MR	-	Material Requisition
PO	-	Purchase Order
PR	-	Purchase Requisition
PVC	-	Polyvinyl Chloride
QAP	-	Quality Assurance Plan
QMS	-	Quality Management System
RPO	-	Regional Procurement Office
TPIA	-	Third Party Inspection Agency
URL	-	Universal Resource Locator
V-Portal	-	Vendor Portal

QMS Standards Committee

Convener: Mr. S.K. Badlani

Members:
Mr. Sanjay Mazumdar (Engg.)
Mr. R.K. Singh (SCM)
Mr. B. Biswas (SCM)
Mr. Ravindra Kumar (Const.)
Mr. Vinod Kumar (CQA)
Mr. Swapnil Vaishnav (Projects)

CONTENTS

Attachments

1.0 SCOPE

This specification establishes the Documentation Requirements from Suppliers.

All documents / data against the PO / PR / MR shall be developed and submitted to EIL / Owner by the suppliers for review / records, in line with this specification.

2.0 DEFINITIONS

2.1 Supplier

For the purpose of this specification, the word "SUPPLIER" means the person(s), firm, company or organization who has entered into a contract with EIL / Owner for delivery of some products (including service). The word is considered synonymous to bidder, contractor or vendor.

2.2 Owner

Owner means the owner of the project for which services / products are being purchased and includes their representatives, successors and assignees.

3.0 REFERENCE DOCUMENTS

6-78-0001	Specification for Quality Management System Requirements from Bidders

4.0 DOCUMENTATION REQUIREMENTS

4.1 Order Acknowledgement and Assigning Project Manager

After placement of order, Supplier shall acknowledge order through V-Portal within 7 days of receipt of FOA / PO. Supplier shall assign a Project Manager for that order though online portal and provide requisite details. Project Manager details shall include e-mail address, mailing address, mobile/telephone nos., fax nos. and name of Project Manager. All the system generated emails pertaining to that order shall be sent to the assigned Project Manager.

4.2 Documents / Data to be submitted by the Supplier

4.2.1 The Supplier shall submit the documents and data against the PO / PR / MR as per the list given in respective PO / PR / MR.

4.2.2 Review of the supplier drawings / documents by EIL would be only to review the compatibility with basic designs and concepts and in no way absolve the supplier of his responsibility / contractual obligation to comply with PR requirements, applicable codes, specifications and statutory rules / regulations. Any error / deficiency noticed during any stage of manufacturing / execution / inspection/ installation shall be promptly corrected by the supplier without any time and cost implications, irrespective of comments on the same were received from EIL during the drawing review stage or not.

4.2.3 Unless otherwise specified, submission of documents for Review / Records shall commence as follows from the date of Fax of Intent / Letter of Intent / Fax of Acceptance (FOA) / Letter of Acceptance (LOA):

QMS	- 1 week
Document Control Index	- 2 weeks
Other Documents / Drawings	- As per approved Document Control Index

4.2.4 Documents as specified in PO / PR / MR are minimum requirements. Supplier shall submit any other document / data required for completion of the job as per EIL / Owner instructions.

4.3 Style and Formatting

4.3.1 All Documents shall be in ENGLISH language and in M.K.S System of units.

4.3.2 Before forwarding the drawings and documents, contractor shall ensure that the following information are properly mentioned in each drawing:

Purchase Requisition Number
Name of Equipment / Package
Equipment / Package Tag No.
Name of Project
Client
Drawing / Document Title
Drawing / Document No.
Drawing / Document Revision No. and Date

4.4 Review and Approval of Documents by Supplier

4.4.1 The Drawing / Documents shall be reviewed, checked, approved and duly signed / stamped by supplier before submission. Revision number shall be changed during submission of the revised supplier documents and all revisions shall be highlighted by clouds. Whenever the supplier require any sub-supplier drawings to be reviewed by EIL, the same shall be submitted by the supplier duly reviewed, approved and stamped by the supplier. Direct submission of sub-supplier's drawings without contractor's / suppliers' approval shall not be entertained.

4.5 Document Category

4.5.1 **Review Category**

Following review codes shall be used for review of supplier Drawings / Documents:

Review Code 1	-	No comments. Proceed with Manufacture / Fabrication as per the document.
Review Code 2	-	Proceed with Manufacture / Fabrication as per commented document. Revised document required.
Review Code 3	-	Document does not conform to basic requirements as marked. Resubmit for review.
R	-	Document is retained for Records. Proceed with Manufacturing / Fabrication as per PR / Tender requirements.
V	-	Void

4.6 Methodology for Submission of Documents to EIL/Owner

4.6.1 Document Control Index (DCI)

Supplier shall create and submit Document Control Index (DCI) for review based on PO / PR / MR along with schedule date of submission of each drawing / document on EIL Vendor Portal. The DCI shall be specific with regard to drawing / document no. and the exact title. Proper sequencing of the drawings / documents should be ensured in schedule date of submission.

4.6.2 Submission of Drawings / Documents / Data

Drawings / documents, data and DCI shall be uploaded on the EIL Vendor Portal as per approved DCI. The detailed guidelines for uploading documents on EIL Vendor Portal are available on following URL

http://edocx.eil.co.in/vportal

4.6.3 Statutory Approvals

Wherever approval by any statutory body is required to be taken by Supplier, the Supplier shall submit copy of approval by the authority to EIL.

4.6.4 Manufacturing Schedule

Supplier shall prepare manufacturing schedule for the order, with key milestone activities (such as document submission, sub ordering, manufacturing, Inspection, dispatches, etc) to meet delivery as per FOA / PO terms. Supplier shall submit manufacturing schedule to concerned Regional Procurement Office (RPO) of EIL / Owner for review within 2 weeks from date of FOA / PO.

4.6.5 Schedule and Progress Reporting

Supplier shall submit monthly progress (MPR) report and updated procurement, engineering, manufacturing status, Inspection and dispatch status (schedule vs. actual) and highlight constraints, if any, along with action plan for mitigation, to the concerned Regional Procurement Office (RPO) of EIL / Owner by 1st week of every month., First MPR shall be submitted within 2 weeks from FOA / LOA. In case of exigencies, EIL / Owner can ask for report submission as required on weekly / fortnightly / adhoc basis depending upon supply status and supplier shall furnish such reports promptly without any price implication. Format for progress report shall be submitted by the Supplier during kick off meeting or within 2 weeks of receiving FOA / LOA, whichever is earlier.

4.7 Inspection and Testing

4.7.1 Quality Assurance Plan / Inspection and Test Plan

If Inspection and test plans (ITP) are attached with MR / PR same shall be followed along with additional tests requirement (if any) mentioned in MR/ PR. However for cases wherein EIL Standard ITPs not available / have not been attached with MR / PR, Supplier shall submit within one week of receiving FOA / LOA, the Quality Assurance Plan for inspection & testing at various stages of production, quality control records for critical bought out items / materials and site assembly & testing as may be applicable to the specific order and obtain approval from concerned Regional procurement Office of EIL / third party inspection agency, as applicable.

For Package equipment contracts, the supplier shall prepare a list of items / equipment and their inspection categorization plan for all items included in the scope of supply immediately after receipt of order and obtains approval for the same from EIL. The items shall be categorized into different categories depending upon their criticality for the scope of inspection of TPIA and / or EIL.

4.7.2 **Inspection Requisition:**

Supplier shall perform internal inspection as per ITP/ approved QAP at their works based on approved documents / drawings. Upon satisfactory internal inspection, supplier shall raise inspection call to concerned Regional Procurement Office (RPO) of EIL / TPIA / Owner with advance notice as per contract along with Internal test reports.

All changes w.r.t. PR shall be recorded through agreed variations or Concessions & Deviations. Conflict, if any, between PR / Job specifications and approved drawings, shall be brought to the notice of EIL / owner by the supplier / contractor. Decision of EIL / owner will be binding on the supplier and to be complied without time and cost implications.

Identified bought out items/ raw material shall be procured under TPIA as per ITP.

4.7.3 **Inspection Release Note (IRN)/ Inspection Certificate (IC)**

IRN / IC shall be issued by EIL Inspector / third party inspection agency on successful inspection, review of test reports / certificates as per specifications & ITP / agreed quality plan (as applicable) and only after all the drawings / documents as per DCI are submitted and are accepted under review code-1 or code R. Supplier shall ensure that necessary documents / manufacturing and test certificates are made available to EIL / TPIA as and when desired.

Note 1: Non fulfilling above requirement shall result into appropriate penalty or with- holding of payment as per conditions of PO / PR / MR.

Note 2: For items where IRN/IC is issued by TPIA, supplier to ensure that following as a minimum must be mentioned by TPIA in IRN / IC

a) PR document number
b) List of drawings / documents with EIL approval code
c) Tests witnessed, documents reviewed
d) Compliance statement by TPIA that product meets the requirement as specified in EIL PR, standard specifications, Inspection Test Plan / QAP and approved documents.

4.8 Transportation Plan

Transportation Plan for Over Dimensional Consignments (ODC), if any, shall be submitted within 2 weeks of receiving FOA / LOA, for approval. Consignment with parameters greater than following shall be considered as over dimensional.

Dimensions: 4 meters width x 4 meters height x 20 meters length

Weight : 32 MT

Dimensions and weight provided above are inclusive of all nozzles, attachments, transportation saddles etc.

Physical Rout survey for ODC movement shall be submitted to EIL within 8 weeks of receiving FOA / LOA.

4.9 Dispatch Details

Upon receipt of IRN / IC from EIL inspector / TPIA, supplier shall dispatch items within 2 days. Supplier shall submit dispatch details to concerned RPO of EIL / Owner within a day of dispatch. Dispatch details shall include Lorry Receipt (LR) number / Dispatch Number, Transporter Name, Date of dispatch, Packing list, Invoice copy etc.

4.10 Final Documentation

4.10.1 Supplier shall prepare final documents in line with VDR (Vendor Document Requirements) attached with PR/Tender. A copy of final document along with filled in Format for Completeness of Final Documentation (Format No. 3-78-0004) to be submitted to EIL Inspector / TPIA for review & approval within 2 weeks from dispatch. Upon receipt of EIL/TPIA endorsement on Completeness of Final Documents, supplier shall submit soft / hard copies of Final documents to EIL / Owner in requisite quantity as per PO / PR details, along with covering letter. A copy of covering letter to be submitted to the concerned Regional Procurement Office (RPO) of EIL/Owner.

4.10.2 **As Built Drawings**

Minor Shop changes made by Supplier after approval of drawings under 'Code 1' by EIL and deviations granted through online system ,if any, shall be marked in hard copies of drawings which shall then be stamped 'As-built' by the supplier. These 'As-built' drawings shall be reviewed and stamped by EIL Inspector / TPIA. Supplier shall prepare scanned images files of all marked – up 'As – built' drawings. Simultaneously Supplier shall incorporate the shop changes in the native soft files of the drawings also.

4.10.3 **Packing / Presentation of Final Documents**

Final Documents shall be legible photocopies in A4, A3 size only. Drawings will be inserted in plastic pockets (both sides transparent, sheet thickness minimum 0.1 mm) with an extra strip of 12 mm wide for punching so that drawings are well placed.

Final Documentation shall be bound in Hard board Plastic folder(s) of size 265 mm x 315 mm ($10^1/_2$ inch x $12^1/_2$ inch) and shall not be more that 75 mm thick. It may be of several volumes and each volume shall have a volume number, index of volumes and index of contents of that particular volume. Where number of volumes are more, 90mm thickness can be used. Each volume shall have top PVC sheet of minimum 0.15 mm thick duly fixed and pressed on folder cover and will have 2 lever clip. In case of imported items documents, 4 lever clip shall also be accepted. All four corners of folders shall be properly metal clamped. Indexing of contents with page numbering must be incorporated by supplier. Spiral/Spico bound documents shall not be acceptable. As mentioned above, books should be in hard board plastic folders with sheets punched and having 2/4 lever clips arrangement.

Each volume shall contain on cover a Title Block indicating package Equipment Tag No. & Name, PO / Purchase Requisition No., Name of Project and Name of Customer. Each volume will have hard front cover and a reinforced spine to fit thickness of book. These spines will also have the title printed on them. Title shall include also volume number (say 11 of 15) etc.

4.10.4 **Submission of Soft Copies**

Supplier shall submit to EIL, the scanned images files as well as the native files of drawings / documents, along with proper index.

In addition to hard copies, Supplier shall submit soft copies of all the final drawings and documents in pen drive or any other specified medium with proper identification tag, all text documents prepared on computer, scanned images of all important documents (not available

as soft files), all relevant catalogues, manuals available as soft files (editable copies of drawings/text documents, while for catalogues / manuals / proprietary information and data, PDF files can be furnished).

All the above documents shall also be uploaded on the EIL Vendor Portal and if applicable on Client Server also.

4.10.5 **Completeness of Final Documentation**

Supplier shall get the completeness of final documentation verified by EIL / TPIA, as applicable, and attach the Format for Completeness of Final Documentation (Format No. 3-78-0004) duly signed by EIL Inspector or TPIA as applicable to the final document folder.

COMPLETENESS OF FINAL DOCUMENTATION

Name of Supplier/Contractor	:	
Customer	:	
Project	:	
EIL's Job No.	:	
Purchase Order No./ Contract No.	:	
Purchase Requisition No./ Tender No.	:	Rev. No. :
Name of the Work/ Equipment	:	
Tag. No.	:	
Supplier's / Contractor's Works Order No.	:	

Certified that the Engineering Documents / Manufacturing & Test Certificates submitted by the supplier (as per Index sheet mentioned in Annexure-1) are complete in accordance with the Vendor Data Requirements of Purchase Requisition / Tender.

Signature	: …….	Signature	: …….
Date	: …….	Date	: …….
Name	: ……..	Name	: ……..
Designation	: ……	Designation	: ……
Department	: ……	Department	: ……
Supplier / Contractor		EIL / TPIA	

Annexure-1

Final Documentation Index Sheet			
PR/PO/Tender No.		Rev. No.	
Serial No.	Document Title	Page/ Folder No.	No. of Pages

Signature	: …….	Signature	: …….
Date	: …….	Date	: …….
Name	: ……..	Name	: ……..
Designation	: ……	Designation	: ……
Department	: ……	Department	: ……

Supplier / Contractor

EIL / TPIA

COMPLETENESS OF FINAL DOCUMENTATION

Name of Supplier/Contractor	:	
Customer	:	
Project	:	
EIL's Job No.	:	
Purchase Order No./ Contract No.	:	
Purchase Requisition No./ Tender No.	:	Rev. No. :
Name of the Work/ Equipment	:	
Tag. No.	:	
Supplier's / Contractor's Works Order No.	:	

Certified that the Engineering Documents / Manufacturing & Test Certificates submitted by the supplier (as per Index sheet mentioned in Annexure-1) are complete in accordance with the Vendor Data Requirements of Purchase Requisition / Tender.

Signature	: …….	Signature	: …….
Date	: …….	Date	: …….
Name	: ……..	Name	: ……..
Designation	: ……	Designation	: ……
Department	: ……	Department	: ……
	Supplier / Contractor		EIL / TPIA

Annexure-1

Final Documentation Index Sheet			
PR/PO/Tender No.		Rev. No.	
Serial No.	Document Title	Page/ Folder No.	No. of Pages

Signature	: …….	Signature	: …….
Date	: …….	Date	: …….
Name	: ……..	Name	: ……..
Designation	: ……	Designation	: ……
Department	: ……	Department	: ……

Supplier / Contractor

EIL / TPIA

निर्माण स्थल पर स्वास्थ्य, सुरक्षा एवं पर्यावरण प्रबंधन हेतु मानक विनिर्देश

STANDARD SPECIFICATION FOR HEALTH, SAFETY & ENVIRONMENTAL MANAGEMENT AT CONSTRUCTION SITES

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
2	18/04/2023	REVISED & UPDATED	BT	RK	JPV	SM
1	07/06/2022	REVISED & UPDATED	BT	RK	JPV	SM
0	23/12/2020	REVISED & UPDATED	BT	RK	AKK	S Mazumdar

Abbreviations:

AERB	:	Atomic Energy Regulatory Board
ANSI	:	American National Standards Institute
BARC	:	Bhabha Atomic Research Centre
BS	:	British Standard
BOCW	:	Building and other construction workers
BOO/BOOT	:	Build, Own, Operate/Build, Own, Operate, Transfer
EIL	:	Engineers India Limited
EIC	:	Engineer In charge
ELCB	:	Earth Leakage Circuit Breaker
EPC	:	Engineering, Procurement and Construction
EPCC	:	Engineering, Procurement, Construction and Commissioning
ESI	:	Employee State Insurance
GCC	:	General Conditions of Contract
GM	:	General Manager
GTAW	:	Gas Tungsten Arc Welding
HOD	:	Head of Department
HSE	:	Health, Safety & Environment
HIRAC	:	Hazard, Identification Risk Assessment & Control
HMV	:	Heavy Motor Vehicle
HV	:	High Voltage
IS	:	Indian Standard
ISO	:	International Organization for Standardization
IE	:	Indian Electricity
LTI	:	Lost Time Injuries
LMV	:	Light Motor Vehicle
LOTO	:	Lock Out & Tag Out
LPG	:	Liquefied Petroleum Gas
LSTK	:	Lump Sum Turn Key
MV	:	Medium Voltage
OH&S	:	Occupational Health and Safety
OISD	:	Oil Industry Safety Directorate
PPE	:	Personal Protective Equipment
PUC	:	Pollution Under Control
RC	:	Registration Certificate
RCCB	:	Residual Current Circuit Breaker
RCM	:	Resident Construction Manager or Site-in-Charge, as applicable
SCC	:	Special Conditions of Contract
SLI	:	Safe Load Indicator
SWL	:	Safe Working Load
TPI	:	Third Party Inspection
TBT	:	Tool Box Talks

Construction Standards Committee

Convenor: Sh John Paul V, ED(Construction)

Members: Sh.Janak Kishore, ED (Projects)
Sh.Biswajit Mandal, CGM (SCM)
Sh. Udayan Chakravarty, Sr.GM (Piping)
Sh.Ravindra Kumar, Sr.GM (Construction)
Sh.Debasish Ghosal, GM(Construction)
Sh. Pankaj Kumar Rai, DGM (Construction)

CONTENTS

1.0 SCOPE

This specification establishes the Health, Safety and Environment (HSE) management requirement to be complied by Contractors/Vendors including their sub-contractors/sub vendors during construction.

This specification is not intended to replace the necessary professional judgment needed to design & implement an effective HSE system for construction activities and the contractor is expected to fulfill HSE requirements in this specification as a minimum. It is expected that contractor shall implement best HSE practices beyond whatever are mentioned in this specification.

Requirements stipulated in this specification shall supplement the requirements of HSE Management given in relevant Act(s)/ Legislations, General Conditions of Contract (GCC), Special Conditions of Contract (SCC) and Job (Technical) Specifications. Where different documents stipulate different requirements, the most stringent shall apply.

2.0 REFERENCES

The document should be read in conjunction with following:

- General Conditions of Contract (GCC)
- Special Conditions of Contract (SCC)
- Building and other construction workers Act, (Refer Appendix-D)
- Indian Factories Act,(Refer Appendix-D)
- Job (Technical) specifications
- Relevant International/ National Codes (refer Appendix-A for standards/codes on HSE)
- Relevant State & National Statutory requirements.
- Operating Manuals Recommendation of Manufacturer of various construction Machineries
- Occupation Health and Safety Management System (OHSAS 18001:2007/ISO 45001) and Environmental Management System (ISO 14001:2015)

3.0 REQUIREMENTS OF HEALTH, SAFETY & ENVIRONMENTAL (HSE) MANAGEMENT SYSTEM TO BE COMPLIED BY BIDDERS

3.1 Management Responsibility

3.1.1 HSE Policy & Objectives

The Contractor should have a documented and duly approved HSE policy &objectives to demonstrate commitment of their organization to ensure health, safety and environmental aspects in their line of operations.
The Contractor's senior management shall provide strong visible leadership and continuously demonstrate commitment to develop, operate and maintain, review and continually improve a HSE culture at site which empowers individuals to take responsibility for their safety and embrace and accept nothing but responsible HSE behaviour.
Contractor shall refer in clause No. 3.3.23 for Key Performance Indicator (KPI).

3.1.2 Management System

The HSE management system of the Contractor shall cover the HSE requirements & commitments to fulfill them, including but not limited to what have been specified under clauses 1.0 and 2.0 above. The Contractor shall obtain the approval of its site specific HSE Plan from EIL/ Owner prior to commencement of any site works. Corporate as well as Site management of the Contractor shall ensure compliance of their HSE Plan at work sites in its entirety in true spirit.

3.1.3 Indemnification

Contractor shall indemnify & hold harmless, Owner/EIL & their representatives, free from any and all liabilities arising out of non-fulfillment of HSE requirements or its consequences.

3.1.4 **Deployment &Qualifications of Safety Personnel**

The Contractor shall designate/deploy various categories of HSE personnel at site as indicated below insufficient number. In no case, deployment of safety Supervisor / Safety Steward shall substitute deployment of Safety Officer / Safety Engineer what is indicated in relevant statute of BOCW Act i.e. deployment of safety officer/Safety Engineer is compulsory at project site. The Safety supervisors, Safety stewards/Observer etc. would facilitate the HSE tasks at grass root level for construction sites and shall assist Safety Officer /Engineers.

Contractor shall appoint safety personnel as given below for every work shift:

(i) Safety Observer/Steward: Contractor shall depute one Safety Observer/Steward for every 100 workers or part thereof

(ii) Safety Supervisor: In addition to above(i), contractor shall depute one Safety Supervisor for every 250 workers or part thereof

(iii) Safety Engineer: In addition to above (i&ii), one safety engineer/ officer for every 1000 workers or part thereof.

Contractor shall intimate/obtain prior permission from EIC before demobilizing any safety personnel. The Contractor shall mobilize suitable safety personnel as replacement.

a) Safety Steward/Observer

As a minimum, he shall possess class XII pass certificate and trained in fire-fighting as well as in safety/occupational health related subjects, with minimum two year of practical experience in construction work environment and should have adequate knowledge of the local language spoken by majority of the workers at the construction site.

b) Safety Supervisor

As a minimum, he shall possess a recognized graduation Degree in Science (with Physics & Chemistry) or a Diploma in Engg. Or Tech. with minimum Two years of practical experience in construction work environment and should possess requisite skills to deal with construction safety & fire related day-to-day issues.

c) Safety Officer / Safety Engineer

Safety Officer/Engineer should possess following qualification & experience:

(i) Recognized degree in any branch of Engg. or Tech. or Architecture with practical experience of working in a building or other construction work in supervisory capacity for a period of not less than two years, **or** possessing recognized diploma in any branch of Engg. or Tech with practical experience of working in a building or other construction work in supervisory capacity for a period of not less than five years.

(ii) Recognized degree or one year diploma in Industrial safety(from any Indian Institutes recognized by AICTE or State Council of Tech. Education of any Indian State/Union territory) with at least one paper in construction safety (as an elective subject).

(iii) Preferably have adequate knowledge of the language spoken by majority of the workers at the construction site.

Alternately

(i) Person possessing Graduation Degree in Science with Physics **or** Chemistry and degree or one year diploma in Industrial Safety (from any Indian institutes recognized by AICTE or State Council of Tech. Education of any Indian State/ Union Territory) with practical experience of working in a building, plant or other construction works (as Safety Officer, in line with Indian Factories Act, 1948) for a period of not less than five years, may be considered as Safety Officer.

d) HSE In-Charge

In case there is more than one Safety Officer at any project construction site, one of them, who is senior most by experience (in HSE discipline), may be designated as HSE In-Charge. Duties & responsibilities of such person shall be commensurate with that of relevant statute and primarily to coordinate with top management of EIL/Client and contractors.

In case the statutory requirements i.e. State or Central Acts and / or Rules as applicable like the Building and Other Construction Workers' Regulation of Employment and Conditions of Service- Act,1996 or State Rules (wherever notified), the Factories Act, 1948 or Rules (wherever notified), etc. are more stringent than above clarifications, the same shall be followed.

Contractors shall ensure physical availability of safety personnel at the place of specific work location, where Hot Work Permit is required/granted. No work shall be started at any of the project sites until above safety personnel & concerned Site Engineer of Contractor are physically deployed at site. The Contractor shall submit a HSE Organogram clearly indicating the lines of responsibility and reporting system and elaborate the responsibilities of safety personnel in their HSE Plan.

Upon fulfilling the basic requirement of qualification and relevant experiences, the performance of contractor HSE personnel's is to be monitored.

The good performing contractor's HSE personnel at site shall be rewarded upon assessment of performance by EIL/Owner. The non-performing HSE personnel shall be counselled by EIL/Owner & suitable action may be taken for suspension from site for 3-6 days. Contractor shall arrange training for non performing HSE personnel.

HSE In –Charge of the contractor shall be given the status at par with the other heads of department and shall report to Head of Project.

The Contractor shall verify & authenticate credentials of such safety personnel and furnish Bio-Data/Resume/Curriculum Vitae of the safety personnel as above for EIL/Owner's approval, at least 1 month before the mobilization. The Contractor, whenever required, shall arrange submission of original testimonials/certificates of their Safety personnel, to EIL/Owner (for verification/scrutiny, etc.)

Imposition/ Realization of penalty shall not absolve the Contractor from his/her responsibility of deploying competent safety officer at site.

Adequate planning and deployment of safety personnel shall be ensured by the Contractor so that field activities do not get affected because of non-deployment of competent & qualified safety personnel in appropriate numbers.

3.1.5 **Implementation, Inspection/Monitoring**

a) The Contractor shall be fully responsible for planning, reporting, implementing and monitoring all HSE requirements and compliance of all laws & statutory requirements.

b) The Contractor shall also ensure that the HSE requirements are clearly understood & implemented conscientiously by their site personnel at all levels at site.

c) The Contractor shall ensure physical presence of their field engineers / supervisors, during the continuation of their contract works / site activities including all material transportation activities. Physical absence of experienced field engineers / supervisors of Contractor at critical work spot during the course of work may invite halting / stoppage of work.

d) The Contractor shall regularly review inspection report internally and implement all practical steps / actions for improving the status continuously.

e) Contractor skilled workmen like riggers, scaffold erectors, welders, crane operators etc. should have sufficient past experience and skill on the relevant job.

f) The Contractor shall ensure important safety checks right from beginning of works at every work site locations and to this effect format No. HSE-10 "Daily Safety Check List" shall be prepared by field engineer & duly checked by safety personnel for conformance.

g) The Contractor shall carry out inspection to identify various unsafe conditions of work sites/machinery/equipment's as well as unsafe acts on the part of workmen/supervisor/engineer while carrying out different project related works.

h) Adequate records for all inspections shall be maintained by the Contractor and the same shall be furnished to EIL/Owner, whenever sought.

i) To demonstrate involvement/commitment of site management of Contractor, at least one Monthly Safety Walk through in a month shall be carried out by Contractor's head of site (along with his area manager/field engineers)and a report shall be furnished to EIL/Owner as per format No: HSE-1" Safety walk through report" followed by compliance for unsatisfactory remarks.

j) As a general practice lifting tools/tackles, machinery, accessories etc. shall be inspected, tested and examined by competent person(approved by concerned State authorities) before being used at site and also at periodical interval (e.g. during replacement, extension, modification, elongation/reduction of machine/parts, etc.) as per relevant statutes. Hydraulic Mobile Crane, cranes, lifting machinery, mobile equipment's/ machinery/ vehicles, etc. shall be inspected regularly by only competent / experienced personnel at site and requisite records for such inspections shall be maintained by contractor. Contractor shall also maintain records of maintenance of all other site machinery (e.g. generators, rectifiers, compressors, cutters, etc.) & portable tools/equipment's being used at project related works (e.g. drills, abrasive wheels, punches, chisels, spanners, etc.).The Contractor shall not make use of arbitrarily fabricated 'derricks' at project site for lifting/ lowering of construction materials.

k) Site facilities /temporary. installations, e.g. batching plant, cement godown, DG-room, temporary electrical panels/distribution boards, shot-blasting booth, fabrication yards, etc. and site welfare facilities, like labour colonies, canteen/pantry, rest-shelters, motor cycle/bicycle-shed, First-aid centers, urinals/toilets, etc. should be periodically inspected by Contractor (preferably utilizing HR/Admin. personnel to inspect site welfare facilities) and records to be maintained.

3.1.6 **Behaviour Based Safety**

a) The contractor shall develop a system to implement Behavior-Based Safety (BBS) through which work groups can identify, measure and change the behaviors of employees and workers towards construction safety aspects.

b) The BBS process shall include the following:
- Identify the behaviors critical to achieve required safety performance.
- Communicate the behaviors and how they are performed correctly byall
- Observe the work force and record safe/at risk behaviors. Intervene with workers to give positive reinforcement when unsafe behaviors are observed. Provide coaching/correction when at risk behaviors are observed
- Collect and record observation data
- Summarize and analyze observation data
- Communicate observation data and analysis results to all employees
- Provide recognition or celebrate when safe behavior improvements occur
- Change behaviors to be observed or change activators or change consequences as appropriate.
- Communicate any changes to workforce

c) Contractor through its own HSE committee shall implement the above process.

d) The necessary procedures and Monthly reporting formats shall be developed by the contractor for approval by EIL/Owner.

e) The HSE committee of contractor shall observe individual's behavior for safe practices adapted for utilization/execution of work for followings a minimum:-
- PPE
- Tools & equipment's
- Hazard Identification & control
- House keeping
- Confined space entry
- Hot works
- Excavation
- Loading & unloading
- Work at height
- Stacking & storage
- Ergonomics

f) EIL/Owner and Contractor's site staff at all levels shall monitor the behavior of contractor employees that create and/or contribute to the unsafe situations at work place.

g) Contractor shall arrange Behavior Based safety (BBS) training of their employees at site on yearly basis.

3.1.7 **Awareness and Motivation**

a) The Contractor shall promote and develop awareness on Health, Safety and Environmental protection among all personnel working for the Contractor.

b) The contractor shall display safety statistics board at all prominent location .Also shall provide dedicated notice board for displaying of safety alerts or any other safety related notices for awareness site workforces.

c) Regular awareness programs and fabrication shop/work site meetings at least on monthly basis shall be arranged on HSE activities to cover hazards/risks involved in various operations during construction.

d) Contractor's workmen & supervisory staff shall participate in common Tool Box Meeting as & when organized/required at site to avoid any incident/accident or occupational disease arising out of multidisciplinary jobs/activities being performed by various contracting agencies in the same location at different elevation.

e) Contractor to motivate & encourage the workmen & supervisory staff by issuing/ awarding them with tokens/ gifts/ mementos/ monetary incentives/ certificates etc. The motivational program shall be organized on regular basis.
f) Contractor shall assess & recognize the behavioral change of its site engineers / supervisors periodically and constantly motivate / encourage them to implement HSE practices at project works
g) Life Saving Rules (refer Appendix-I for details) are to be displayed at prominent location of site.

3.1.8 **Fire Prevention & First-Aid**

The Contractor shall deploy First aider & suitable First-aid measures such as First Aid Box (Refer Appendix-B for details), stand-by Emergency Vehicle. Additionally separate ambulance with trained personnel/male or female nurse to administer First Aid shall be provided by the Contractor beyond deployment of 500 workmen during day/night working hours.

a) The Contractor shall arrange installation of fire protection measures such as adequate number of steel buckets with sand & water and adequate number of appropriate portable fire extinguishers (Refer Appendix-C for details) to the satisfaction of EIL/Owner.
b) The Contractor shall arrange EMERGENCY MOCK DRILL like fire, bomb threat, gas leakage, earth quake, etc. at each site at least once in three months, involving site workmen and site supervisory personnel & engineers. The Contractor shall maintain record of such mock drills at project site.
c) The contractor shall require to tie-up with the hospitals located in the neighborhood for attending medical emergency.

3.1.9 **Documentation**

The Contractor shall evolve a comprehensive, planned and documented system covering the following as a minimum for implementation and monitoring of the HSE requirements and the same shall be submitted for approval by owner/EIL.

- HSE Organogram
- Site specific HSE Plan
- Safety Procedures, forms and Checklist. Indicative list of HSE procedures is attached as Appendix :H
- Inspections and Test Plan
- Risk Assessment & HIRAC for critical works.
- HIRAC Register as per Format no: HSE-19 to identify, assess, analyze & mitigate the construction hazards& incorporate relevant control measures before actually executing site works.
- Environmental Aspect Impact Register as per Format no: HSE-18 (identify, assess, analyze & mitigate the environmental impact & incorporate relevant control measures).
- Legal Register to identify and comply to all applicable HSE related legal requirements.

The monitoring for implementation shall be done by regular inspections and compliance of the observations thereof. The Contractor shall get similar HSE requirements implemented at his sub-contractor(s) work site/office, if applicable. However, compliance of HSE requirements shall be the responsibility of the Contractor. Any review/approval by EIL/Owner shall not absolve contractor of his responsibility/liability in relation to fulfilling all HSE requirements.

3.1.10 **Audit**

Safety Audit shall be conducted at initial stage by EIL/Owner to understand the readiness to start the job after mobilization of contractor's RCM at site& Suitable action shall be taken by contractor to comply the audit observation(s).

The Contractor shall submit an Audit Plan to EIL/Owner indicating the type of audits covering following as minimum:

a) Internal HSE audits regularly on six monthly basis by engaging internal qualified auditors (viz. safety officers/Construction personnel having 5years experience in construction safety and Lead Auditor Course: OHSAS 18001/ISO 45001 certification).However, minimum two internal HSE audit will have to be conducted irrespective of time period of the contract.

b) External HSE audits regularly on yearly basis by engaging authorized auditing agencies (viz. National Safety Council etc.)or qualified external auditors (viz safety officers/Construction personnel having 10years experience in construction safety and Lead Auditor Course: OHSAS 18001/ISO 45001certification). However, minimum one external HSE audit will have to be conducted irrespective of time period of the contract.

c) EIL/Owner may participate in Opening and closing meeting of external audits and provide inputs to the external auditor. Outcome of external audit shall be discussed during HSE Meeting with EIL/Owner.

All HSE shortfalls/ non-conformances on HSE matters brought out during review/audit, shall be resolved forthwith(generally within a week) by Contractor& compliance report shall be submitted to EIL/Owner.

In addition to above audits by contractor, the contractor's work shall be subjected to HSE audit by EIL/Owner at any point of time during the pendency of contract. The Contractor shall take all actions required to comply with the findings of the Audit Report and issue regular Compliance Reports for the same to OWNER/ EIL till all the findings of the Audit Report are fully complied.

Failure to carry-out HSE Audits& its compliance (internal & external) by Contractor, shall invite penalization.

3.1.11 **Meetings**

i. The Contractor shall ensure participation of his top most executive at site (viz. Resident Construction Manager / Resident Engineer/ Project Manager / Site-in-Charge) along with safety officer in Safety Committee/HSE Committee meetings arranged by EIL/Owner usually on monthly basis or as and when called for. In case Contractor's top most executive at site is not in a position to attend such meeting, he shall inform EIL/Owner in writing before the commencement of such meeting indicating reasons of his absence and nominate his representative – failure to do so may invite very stringent penalization against the specific Contractor, as deemed fit as per Contract. The obligation of compliance of any observations during the meeting shall be always time bound. The Contractor shall always assist EIL/Owner to achieve the targets set by them on HSE management during the project implementation.

ii. In addition, the Contractor shall also arrange internal HSE meetings chaired by his top most executive at site on fortnightly basis and maintain records. Such internal HSE meetings shall essentially be attended by field engineers / supervisors including safety personnel of the Contractor and its associates. Records of such internal HSE meetings shall be maintained by the Contractor for review by EIL/Owner or for any HSE Audits.

iii. Agenda of internal HSE meeting should broadly cover: -

a) Confirmation of record notes /minutes of previous meeting
b) Discussion on outstanding subjects of previous points / subjects, if any
c) Incidents / Accidents (of all types) at project site, if any
d) Current topics related to site activities / subjects of discussion
e) House keeping
f) Behavioral Safety
g) Information / views / deliberations of members / site sub-contractors
h) Report from Owner / Client
i) Status of Safety awareness, Induction programs & Training programs

The time frame for such HSE meeting shall be religiously maintained by one and all.

3.1.12 **Intoxicating drinks & drugs and smoking**

a) The Contractor shall ensure that his staff members & workers (permanent as well casual) shall not be in a state of intoxication during working hours and shall abide by any law relating to consumption & possession of intoxicating drinks or drugs in force.

b) The Contractor shall not allow any workman to commence any work at any locations of project activity who is/are influenced / effected with the intake of alcohol, drugs or any other intoxicating items being consumed prior to start of work or working day.

c) Awareness about local laws on this issue shall form part of the Induction Training and compulsory work-site discipline.

d) The Contractor shall ensure that all personnel working for him comply with "No-Smoking" requirements of the Owner as notified from time to time. Cigarettes, lighters, auto ignition tools or appliances as well as intoxicating drugs, dry tobacco powder, etc. shall not be allowed inside the project / plant complex.

e) Smoking shall be permitted only inside smoking booths, if any, exclusively designated & authorized by the Owner/EIL.

3.1.13 **Penalty**

The Contractor shall adhere consistently to all provisions of HSE requirements. In case of non-compliances and also for repeated failure in implementation of any of the HSE provisions, EIL/Owner may impose stoppage of work without any cost & time implication to the Owner and/or impose a suitable penalty.

The amount of penalty to be levied against defaulted Contractor shall be up to a cumulative limit of

2.0% (Two percent) of the contract value for Item Rate or Composite contracts with an overall ceiling of 1,00,00,000(Rupees One Crore).

0.5% (Zero decimal five percent) of the contract value for LSTK, OBE, EPC,BOO/BOOT, EPCC or Package contracts with an overall ceiling of 10,00,00,000(Rupees Ten Crores.)

This penalty shall be in addition to all other penalties specified elsewhere in the contract. The decision of imposing stop-work-instruction and imposition of penalty shall rest with EIL/Owner. The same shall be binding on the Contractor. Imposition of penalty does not make the Contractor eligible to continue the work in unsafe manner.
The amount of penalty applicable for the Contractor on different types of HSE violations is specified below:

Sl. No.	Violation of HSE Norms	Penalty Amount
1.	For not using personal protective equipment like Helmet, Safety Shoes, and other safety gadgets as applicable as per nature of work.	Rs.500/- per day/Item / Person
2.	Working without Work Permit/Clearance	Rs.20,000/- per occasion
3	Execution of work without deployment of requisite field engineer / supervisor at work spot	Rs.5,000/- per violation per day
4.	Unsafe electrical practices (not installing ELCB, using poor joints of cables, using naked wire without top plug into socket, laying wire/cables on the roads, electrical jobs by incompetent person, etc.)	Rs.10,000/- per item per day

Sl. No.	Violation of HSE Norms	Penalty Amount
5.	Working at height without full body harness, using non-standard/ rejected scaffolding and not arranging fall protection arrangement as required, like hand-rails, life-lines, Safety Nets etc.	Rs.10,000/- per case per day
6.	Unsafe handling of compressed gas cylinders (No trolley, jubilee clips double gauge regulator, and not keeping cylinders vertical during storage/handling, not using safety cap of cylinder).	Rs.1,000/- per item per day
7.	Use of domestic LPG for cutting purpose / not using flash back arresters on both the hoses/tubes on both ends.	Rs.5,000/-per occasion
8.	No fencing/barricading of excavated areas / trenches.	Rs.5,000/- per occasion
9.	Not providing shoring/strutting/proper slope and not keeping the excavated earth at least 1.5M away from excavated area.	Rs.5,000/-per occasion
10.	Non display of scaffold tags, caution boards on erected scaffolds.	Rs.1,000/- per occasion per day
11.	Traffic rules violations like over speeding of vehicles, rash driving, talking on mobile phones during vehicle driving, wrong parking, not using seat belts, vehicles not fitted with reverse horn / warning alarms / flicker lamps during foggy weather.	Rs.3,000/-per occasion per day
12.	Absence of Contractor's RCM/SIC or his nominated representative (prior approval must be taken for each meeting for nomination) from site HSE meetings whenever called by EIL/Owner& failure to nominate his immediate deputy for such HSE meetings.	Rs.10,000/- per meeting
13.	Failure to maintain HSE records by Contractor Safety personnel, in line with approved HSE Plan/Procedures/Contract specifications.	Rs.10,000/- per month
14.	Failure to conduct daily site safety inspection (by Contractor's Site Engineer &safety officer), internal HSE meeting, internal HSE Awareness/Motivation Program and Site HSE Training at predefined frequencies (as approved in HSE Plan).	Rs.10,000/- per occasion
15.	Failure to fill online/submit the monthly HSE report by 5th of subsequent month to Engineer-in-Charge/ Owner	Rs10,000/-per occasion and Rs.1,000/-per day of further delay
16.	Poor House Keeping	Rs.5,000 /- per occasion per subject
17.	Failure to report &follow-up accident (including Near Miss) reporting system within specific time-frame.	Rs.20,000/- per occasion
18.	Degradation of environment (not confining toxic spills, spilling oil/lubricants onto ground)	Rs.10,000/- per occasion

Sl. No.	Violation of HSE Norms	Penalty Amount
19.	Not medically examining the workers before allowing them to work at height / to work in confined space / to work in shot-blasting / to work for painting / to work in bitumen or asphalt works, not providing ear muffs while allowing them to work in noise polluted areas, made them to work in air polluted areas without respiratory protective devices, etc.	Rs.5,000/- per occasion per worker
20.	Violation of any other safety condition as per job HSE plan / work permit and HSE conditions of contract (e.g.using crowbar on cable trenches, improper welding booth, not keeping fire extinguisher ready at hot work site, unsafe rigging practices, non-availability of First-Aid box at site, not providing dead man handle switch for blasting, whiplash arrestor for the compressor line, not using hood with respiratory devices by blaster for shot//grit blasting, etc.)	Rs.5,000/- per occasion
21.	Penalty for non-deployment of ambulance in case of man-power more than 500 or not providing dedicated emergency vehicle in case of man-power less than 500.	Rs.3,000 per day
22.	Failure to carry-out Safety audit in time (internal & external),close-out of identified shortfalls of Observations of Safety Aspects(OSA),etc.	Rs.20,000/- per occasion (for internal audit &OSA). Rs.30,000/-per occasion for external audit
23.	Carrying out sand blasting instead of grit/shot blasting	Rs.50,000/- per day
24.	Failure to deploy adequately qualified and competent Safety Officer	Rs.10,000/- per day per Officer
25.	Utilization of Hydraulic Mobile Crane /back-hoe loader for material shifting or any other unauthorized /unsafe lifting works	Rs.25,000/- per occasion
26.	Any Fatal Accident	Rs.10,00,000/-per fatality
27.	Any violation not covered above	To be decided by EIL/Owner.

Note: Penalty amount deducted from the contractor shall be utilized by owner/EIC for the promotion of the safety during the currency of the project.

The Contractor shall make his field engineers/supervisors fully aware of the fact that they keep track with the site workmen for their behavior and compliance of various HSE requirements. Safety lapses / defects of project construction site shall be attributable to the concerned job supervisor / engineer of the Contractor, (who remains directly responsible for safely executing field works). For repeated HSE violations, concerned job supervisor / engineer shall be reprimanded or appropriate action, as deemed fit, shall be initiated (with information to EIL & Owner) by the concerned Contractor.

Contractor shall initiate verbal warning shall be given to the worker/employee during his first HSE violation. A written warning shall be issued on second violation and specific training shall be arranged / provided by the Contractor to enhance HSE awareness/skill including feedback on the mistakes/ flaws. Any further violation of HSE stipulations by the erring individuals shall call

for his forthright debar from the specific construction site. A record of warnings for each worker/employee shall be maintained by the Contractor, like by punching their cards / Gate passes or by displaying their names at the Project entry gate. Warnings, penalizations, appreciations etc. shall be discussed in HSE Committee meetings by site Head of the Contractor.

3.1.14 **Accident/ Incident investigation**

All accidents/incidents shall be informed to EIL/Owner at least telephonically by Contractor immediately and in writing within 24 hours on Format No. HSE-2 as applicable, by Contractor. Thereafter, a Supplementary Accident/Incident investigation Report on Format No. HSE-3 shall be submitted to EIL/Owner within 72 hours. Near Miss incident(s), Dangerous accidents/incident shall also be reported on Format No. HSE-4 within24 hours. The accident/ incident shall be investigated by a team of Contractor's senior Site personnel (involving Site-in-Charge or at least by his deputy) for establishing root-cause and recommending corrective & preventive actions. Findings shall be documented and suitable actions taken to avoid recurrences shall be communicated to EIL/Owner. Owner/EIL shall have the liberty to independently investigate such occurrences and the Contractor shall extend all necessary help and cooperation in this regard. EIL/Owner shall have the right to share the content of this report with the outside world.

3.2 House Keeping

The Contractor shall ensure that a high degree of housekeeping is maintained and shall ensure inter-alia; the followings:

a) All surplus earth and debris are removed/disposed-off from the working areas to designated location(s).

b) Unused/surplus cables, steel items and steel scrap lying scattered at different places within the working areas are removed to identify location(s).

c) All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from work place to identified location(s).

d) Roads shall be kept clear and materials like pipes, steel, sand, boulders, concrete, chips and bricks etc. shall not be allowed on the roads to obstruct free movement of men & machineries.

e) Fabricated steel structural, pipes & piping materials shall be stacked properly.

f) Water logging on roads shall not be allowed.

g) No parking of trucks/trolleys, cranes and trailers etc. shall be allowed on roads, which may obstruct the traffic movement.

h) Utmost care shall be taken to ensure over all cleanliness and proper upkeep of the working areas.

i) Protective measures to be ensured with projected rebar by suitable means.

j) Trucks carrying sand, earth and pulverized materials etc. shall be covered while moving within the plant area/ or these materials shall be transported with top surface wet.

k) The contractor shall ensure that the atmosphere in plant area and on roads is free from particulate matter like dust, sand, etc. by keeping the top surface wet for ease in breathing.

l) At least two exits for any unit area shall be assured at all times – same arrangement is preferable for digging pits/ trench excavation/ elevated work platforms/ confined spaces etc.

m) Welding cables and the power cable must be segregated and properly stored and used. The same shall be laid away from the area of movement and shall be free from obstruction.

n) Upkeep/cleaning of site to be carried out on regular basis by the contractor. Contractor shall earmark the area for waste/scrap disposal and ensure that all waste/scrap arising out of the day's work is properly disposed to the earmarked area.

o) Hazardous waste shall be segregated and shall be kept separately at designated place.

p) Contractor shall present the status of housekeeping in HSE meeting.

The Contractor shall carry-out regular checks (minimum one per fortnight) as per format No. HSE-11 for maintaining high standard of housekeeping and maintain records for the same. The Contractor shall provide supervisor for housekeeping exclusively for management of day-to-day housekeeping activities.

3.3 HSE Measures

3.3.1 Construction Hazards

The Contractor shall ensure identification of all Occupational Health, Safety & Environmental hazards in the type of work he is going to undertake and enlist mitigation measures. Contractor shall carry out HIRAC specifically for high risk jobs/critical jobs like

a) Working at height (+2.0 Mts height) for cold (incl. colour washing, painting, insulation etc.) & hot works.
b) Work in confined space,
c) Deep excavations &trench cutting (depth > 2.0 mts.)
d) Operation & Maintenance of Batching Plant.
e) Shuttering / concreting (in single or multiple pour) for columns, parapets & roofs.
f) Erection & maintenance of Tower Crane.
g) Erection of structural steel members / roof-trusses / pipes at height more than 2.0 Mts. with or without crane.
h) Erection of pipes (full length or fabricated) at height more than 2.0 Mts. height with Crane of 100T capacity.
i) All lifts using 100T Crane plus mechanical pulling.
j) All lifts using two cranes in unison (Tandem Lifting).
k) Any lift exceeding 80% capacity of the lifting equipment's (Hydraulic Mobile Crane, crane etc.).
l) Laying of pipes (isolated or fabricated) in deep narrow trenches – manually or mechanically.
m) Maintenance of crane / extension or reduction of crane-boom on roads or in yards.
n) Erection of any item at >2.0 Mts. height using 100T crane or of higher capacity
o) Hydrostatic test of pipes, vessels & columns and water-flushing.
p) Radiography jobs (in-plant & open field)
q) Work in Live Electrical installations / circuits
r) Handling of explosives &Blasting operations
s) Demolishing/ dismantling activities
t) Welding/ gas cutting jobs at height (+2.0 Mts.)
u) Lifting/placing roof-girders at height(+2.0 Mts.)
v) Lifting & laying of metallic / non-metallic sheet over roof/structures.
w) Lifting of pipes, gratings, equipment's/vessels at heights (+2.0 Mts.) with & without using cranes
x) Calibration of equipment, instruments and functional tests at yards / work-sites.
y) Operability test of Pump, Motors (after coupling) & Compressors.
z) Cold or Hot works inside Confined Space.
aa) Transportation & shifting of ODC consignments into project areas.
bb) Working in "Charged/Live" elect. Panels
cc) Stress Relieving works (Electrically or by Gas-burners).
dd) Pneumatic Tests
ee) Card board blasting
ff) Grit Blasting activity
gg) Catalyst loading/unloading
hh) Erection/dismantling of scaffolding
ii) Chemical cleaning

The necessary HSE measures devised shall be put in place, prior to start of an activity &also shall be maintained during the course of works, by the Contractor. Copies of such HIRAC shall be kept available at work sites by the Contractor to enable all concerned carrying out checks / verification.

A list of typical construction hazards along with their effects & preventive measures is given in **Appendix-E.**

3.3.2 **Accessibility**

h) The Contractor shall provide safe means of access(in sufficient numbers)& efficient exit to any working place including provisions of suitable and sufficient scaffolding at various stages during all operations of the work for the safety of his workmen and EIL/Owner.

i) The Contractor shall implement use of all measures including use of "life line", "fall-arresters", "retractable fall arresters", "safety nets" etc. during the course of using all safe accesses& exits, so that in no case any individual remains at risk of slip & fall during their travel.

j) A ladder or step- ladder must have a level and firm footing, in case of use of fixed ladders, sufficient foot hold and hand hold to be provided.

k) The access to operating plant / project complex shall be strictly regulated. Any person or vehicle entering such complex shall undergo identification check, as per the procedures in force / requirement of EIL/Owner.

l) Accessibility to 'confined space' shall be governed by specific system / regulation, as established at project site.

3.3.3 **Personal Protective Equipment (PPEs)**

a) The Contractor workmen shall be permitted entry inside the project premises only with proper PPEs.

b) The Contractor shall ensure that all their staff, workers and visitors including their sub-contractor(s) have been issued (records to be kept) & wear appropriate PPEs like nape strap type safety helmets preferably with head &sweat band with ¾" cotton chin strap (made of industrial HDPE), High ankle safety shoes with steel toe cap and antiskid sole, Coverall, full body harness (CE marked and conforming to EN361), protective goggles, gloves, ear muffs, respiratory protective devices, etc. All these gadgets shall conform to applicable IS Specifications/CE or other applicable international standards. The Contractor shall implement a regular regime of inspecting physical conditions of the PPEs being issued / used by the workmen of their own & also its sub-agencies and the damaged / unserviceable PPEs shall be replaced forthwith.

c) Owner/EIL may issue a comprehensive color scheme for helmets to be used by various agencies. The Contractor shall follow the scheme issued by the owner/EIL and shall choose colour other than white (for Owner) or blue (for EIL). All HSE personnel shall preferably wear dark green band on their helmet or green color safety helmet so that workmen can approach them for guidance during emergencies.HSE personnel shall preferably wear such dresses with fluorescent stripes, which are noticeable during night, when light falls on them.

d) Florescent jackets with respective company logo to be worn by the contractor workmen with different color coding for categories like supervisor and workmen.

e) Workers required using or handling alkalies, acid or other similar corrosive substance at site shall be provided with appropriate protective equipment, in accordance with MSDS.

f) For shot blasting, the usage of protective face shield and helmets, gauntlet and protective clothing is mandatory. Such protective clothing should conform relevant IS Specification.

g) For off-shore jobs/contracts, contractor shall provide PPEs (new) of all types to EIL & Owner's personnel, at his (contractor's) cost. All personnel shall wear life jacket at all time.

h) An indicative list of HSE standards/codes is given under **Appendix-A**.

i) Contractor shall ensure procurement & usage of following safety equipment's/ accessories (conforming to applicable IS mark / CE standard) by their staff, workmen & visitors including their subcontractors all through the span of project construction / pre-commissioning/ Commissioning:-

i. PPEs (Helmet with company name/logo, Safety Goggles, Coverall, Ear-muff, Face Shield, Hand Gloves, High Ankle Safety Shoes, Gum Boot etc.)
ii. Barricading tape / warning signs
iii. Rechargeable Safety torch (flame-proof)
iv. Safety nets (with tie-chords)
v. Fall arresters
vi. Emergency Man-basket/rescue kit for height works
vii. Portable ladders (varying lengths)
viii. Life-lines (steel wire-rope, dia. not less than 8.0 mm)
ix. Full body double lanyard Safety harness with Rebar/ladder hook or scaffolding hook.
x. Lanyard
xi. Karabiner
xii. Retractable fall arresters (various length)
xiii. Portable fire extinguishers (DCP type) – 5 kg&10 kg capacity
xiv. Portable Multi Gas detector
xv. Sound level meter
xvi. Digital lux meter
xvii. Fire hoses & flow nozzles
xviii. Fire blankets/ Fire retardant cloth (with eyelets)
xix. Flame retardant/Flame resistant coverall-based on hazard identification & risk assessment, if required.

3.3.4 **Working at height**

a) The Contractor shall issue permit for working (PFW) at height after verifying and certifying the checkpoints as specified in the attached permit (Format No. HSE-6). He shall also undertake to ensure compliance to the conditions of the permit during the currency of the permit including adherence of personal protective equipment's. Contractor's Safety Officer shall verify compliance status of the items of permit document after implementation of action is completed by Contractor's execution / field engineers at work site. HIRAC for specific works at height duly commented by EIL/Owner, shall be kept attached with particular Permit for Work (PFW) at site for ready reference & follow-up.

b) Such PFW shall be initially issued for one single shift or expected duration of normal work and extended further for balance duration, if required. EIL/Owner can devise block-permit system at any specific area, in consultation with project specific HSE Committee to specify the time-period of validity of such PFW or its renewal. This permit shall be applicable in areas where specific clearance from Owner's operation Deptt./Safety Deptt. is not required. EIL / Owner's field Engineers/Safety Officers/Area Coordinators may verify and counter sign this permit (as an evidence of verification) during the execution of the job.

c) All personnel shall be medically examined & certified by registered doctor, confirming their 'medical fitness(Vertigo or epilepsy must be covered under test report)for working at height. Contractor shall develop the model for conducting vertigo test. The fitness examination shall be done once in six months. Sticker for "PASS FOR HEIGHT WORK" shall be pasted on the safety helmet of the site personnel.

d) In case work is undertaken without taking sufficient precautions as given in the permit, EIL/Owner Engineers may exercise their authority to cancel such permit and stop the work till satisfactory compliance/rectification is arranged made. Contractors are expected to maintain a register for issuance of permit and extensions thereof including preserving the

used permits for verification during audits etc.

e) The Contractor shall arrange (at his cost) and ensure use of Fall Arrester Systems by his workers. Fall arresters are to be used while climbing/descending tall structures or vessels / columns etc. These arresters should lock automatically against the anchorage line, restricting free fall of the user. The device is to be provided with a double security opening system to ensure safe attachment or release of the user at any point of rope. In order to avoid shock, the system should be capable of keeping the person in vertical position in case of a fall. All the fall arrest systems should be cleaned after use and stored in a clean &dry area. Defective Safety Harness, lanyards & life line must be discarded from workplace and record to be maintained.

f) The Contractor shall ensure that Full body harnesses with double lanyards conforming EN361 and having authorized CE marking is used by all personnel while working at height. The lanyards and life lines should have enough tensile strength to take the load of the worker in case of a fall. One end of the lanyard shall be firmly tied with the harnesses and the other end with life line. The harness should be capable of keeping the workman vertical in case of a fall, enabling him to rescue himself.

g) The Contractor shall provide Roof Top Walk Ladders for carrying out activities on sloping roofs in order to reduce the chances of slippages and falls.

h) The Contractor shall ensure that a proper Safety Net System is used wherever the hazard of fall from height is present. The safety net, preferably a knotted one with mesh ropes conforming to IS 5175/ ISO 1140 shall have a border rope & tie cord of minimum 12mm dia. The Safety Net shall be located not more than 6.0 meters below the working surface extending on either side upto. sufficient margin to arrest fall of persons working at different heights.

i) In case of accidental fall of person on such Safety Net, the bottom most portion of Safety Net should not touch any structure, object or ground.

j) Grade separators shall be provided in Pipe-rack/Tech-structures to arrest falling objects like welding spatters, welding rods, nuts, bolts, tools etc. and to facilitate U/G and A/G works simultaneously.

k) Beam Clamps may be used for construction of localized temporary working platforms sheds for welding booths etc. at height in all types of steel structure due to faster installation and requirement of less scaffolding materials.

l) Hanging Platform, manufactured by Standard HSE equipment vendors must be encouraged for painting of Buildings etc.

m) All the tools used at height (like spanner, screw driver etc.) shall be provided with securing arrangement like back-pack/waist pouch to prevent accidental slippage from worker hand.

n) The Contractor shall install temporary lightening arrester in tall structures during construction to save human life and to avoid damage to equipment's& machineries. During the possibility of a thunderstorm, all the work at height where a person can be exposed to lightning shall be stopped.

o) To the extent possible use Roller arrangement to shift overhead pipes from one end to other in Pipe Racks Area.

p) Providing of steel scaffold stair tower system with landings at regular intervals as and when required for height work.

q) The Contractor shall ensure positive isolation while working at different levels like in the pipe rack areas. The working platforms with toe boards & hand rails shall be sufficiently strong & shall have sufficient space to hold the workmen and tools& tackles including the equipment's required for executing the job. Such working platforms shall have mid-rails, to enable people work safely in sitting posture.

3.3.5 Scaffoldings& Barricading

a) Suitable steel scaffoldings only shall be provided to workmen for all works that cannot be safely done from the ground or from solid construction except such short period work that

can be safely done using ladders or certified (by 3rd party competent person) man-basket. When a ladder is used, an extra workman shall always be engaged for holding the ladder. The ladder shall be inspected before use for cracked or split stiles, missing, broken, loose or damaged rungs & splinters. The ladder shall be of adequate length to enable it to extend to at least 1.0m above the landing place or working point. Metallic ladders shall be only used as access.

b) The Contractor shall ensure that the scaffolds used during construction activities shall be strong enough to take the designed load. Main Contractor shall always furnish duly approved construction-design details of scaffold &SWL (from competent designers) free of charge, before they are being installed/ constructed at site. Owner/EIL reserves the right to ask the Contractor to submit certification and or design calculations from his Head Office/ Design/Engineering expert regarding load carrying capacity of the scaffoldings. All steel tubing, couplers and fittings used for scaffolding shall conform to IS 3696 or an acceptable equivalent. Only metallic scaffold boards shall be allowed to use. Steel tubes shall be free from cracks, splits. Surface flaws & other defects. All couplers & fittings shall be properly oiled and maintained. Nuts shall have a free running fit on their bolts. Bolts with worn or damaged thread shall be replaced.

c) All scaffolds shall be inspected by a competent Scaffolding Inspector (person with scaffolding related experience in construction field and having a training of scaffolding supervisor from a institute/agency like National Safety Council etc.). He shall paste a GREEN tag (duly signed by competent Scaffolding Inspector) on each scaffold found safe and a RED tag (duly signed by competent Scaffolding Inspector) on each scaffold found unsafe. Scaffolds with GREEN tag only shall be permitted to be used and Scaffolds with RED ones shall immediately be made inaccessible. Work being found continuing on scaffolds with RED tag shall be considered unauthorized work by Contractor and may invite penalization from EIL/Owner. For every 120-125 m^2 /m^3 area / volume or its parts thereof minimum one TAG shall be provided.

d) The Contractor shall ensure positive barricading (indicative as well as protective) of the excavated, radiography, heavy lift, high pressure hydrostatic & pneumatic testing and other such areas. Sufficient warning signs shall be displayed along the barricading areas.

e) Scaffolding shall be constructed using foot seals or base plates only. Base plates shall be used below each standard on surface .Sole plate of timber shall be used beneath the base plate to achieve greater load distribution.

3.3.6 **Electrical installations**

a) All electrical installations/ connections shall be carried out as per the provisions of latest revision of following codes/standards, in addition to the requirements of Statutory Authorities and IE/applicable international rules& regulations:

- OISD STD 173 : Fire prevention & protection system for electrical installations
- SP 30 (BIS) : National Electric Code

b) All electrical installations shall be approved by the concerned statutory authorities.

c) All temporary electrical installations / facilities shall be regularly checked by the licensed/competent electricians of the Contractor and appropriate records shall be maintained in format no: HSE-12" Inspection of temporary electrical booth/installation at project construction site". Such inspection records are to be made available to EIL/Owner, whenever asked for.

3.3.6.1 The Contractor shall meet the following requirements:

a. Shall make Single Line Diagram (SLD) for providing connection to each equipment's & machinery and the same (duly approved by EIL/Owner) shall be pasted on the front face of DBs (distribution boards) or JBs (Junction boxes) at every site.(A typical Switch Board Sketch is attached as Appendix -G)

b. Ensure that electrical systems and equipment including tools & tackles used during construction phase are properly selected, installed, used and maintained as per provisions of the latest revision of the Indian Electrical/ applicable international regulations.

c. Shall deploy qualified & licensed electricians for proper & safe installation and for regular inspection of construction power distribution system/points including their earthing. A copy of the license shall be submitted to EIL / Owner for records. Availability of at least one competent (ITI qualified) / licensed electrician (by State Elec. authorities) shall be ensured at site round the clock to attend to the normal/emergency jobs.

d. All switchboards / welding machines shall be kept in well-ventilated & covered shed/ with rain shed protection. The shed shall be elevated from the existing ground level to avoid water logging inside the shed. Installation of electrical switch board must be done taking care of the prevention of shock and safety of machine.

e. No flammable materials shall be used for constructing the shed. Also flammable materials shall not be stored in and around electrical equipment / switchboard. Adequate clearances and operational space shall be provided around the equipment.

f. Fire extinguishers and insulating mats shall be provided in all power distribution centers.

g. Temporary electrical equipment shall not be employed in hazardous area without obtaining safety permit.

h. Proper housekeeping shall be done around the electrical installations.

i. All temporary installations shall be tested before energizing, to ensure proper earthing, bonding, suitability of protection system, adequacy of feeders/cables etc.

j. All welders shall use hand gloves irrespective of holder voltage.

k. Multilingual (Hindi, English and local language) caution boards, shock treatment charts and instruction plate containing location of isolation point for incoming supply, name & telephone No. of contact person in emergency shall be provided in substations and near all distribution boards / local panels.

l. ELCB tester /test meter shall be used for testing the ELCBs operation. ELCBs testing shall be carried out by using ELCB tester on monthly basis but in specific cases like heavy rain as decided by owner/EIC. Record of the testing shall be maintained.

m. Regular inspection of all installations at least once in a month. (**Ref. Format HSE-12**).

3.3.6.2 The following features shall also be ensured for all electrical installations during construction phase by the contractor:

a. Each installation shall have a main switch with a protective device, installed in an enclosure adjacent to the metering point. The operating height of the main switch shall not exceed 1.5 M. The main switch shall be connected to the point of supply by means of armoured cable.

b. The outgoing feeders shall be double or triple pole switches with fuses / MCBs. Loads in a three phase circuit shall be balanced as far as possible and load on neutral should not exceed 20% of load in the phase.

c. The installation shall be adequately protected against overload, short circuit and earth leakage by the use of suitable protective devices. Fuses wherever used shall be HRC type. Use of rewirable fuses shall be strictly prohibited. ELCB/RCCB (Residual Current Circuit Breaker) must be fitted with all Electrical installation. The earth leakage devices shall have an operating current not exceeding 30 mA.

d. All connections to the hand tools / welding receptacles shall be taken through proper switches, sockets and plugs.

e. All single phase sockets shall be minimum 3 pin type only. All unused sockets shall be provided with socket caps.

f. Only 3 core (P+N+E) overall sheathed flexible cables with minimum conductor size of 1.5 mm^2 copper shall be used for all single phase hand tools.

g. Only metallic distribution boxes with double earthing shall be used at site. No wooden boxes shall be used.

h. All power cables shall be terminated with compression type cable glands. Tinned copper lugs shall be used for multi-strand wires / cables.

i. Cables shall be free from any insulation damage.

j. Minimum depth of cable trench shall be 750 mm for MV & control cables and 900 mm for HV cables. These cables shall be laid over a sand layer and covered with sand, brick & soil for ensuring mechanical protection. Cables shall not be laid in waterlogged area as far as practicable. Cable route markers shall be provided at every 25 M of buried trench route.

When laid above ground, cables shall be properly cleated or supported on rigid poles of atleast 2.1 M high. Minimum head clearance of 6 meters shall be provided at road crossings.

k. Underground road crossings for cables shall be avoided to the extent feasible. In any case no underground power cable shall be allowed to cross the roads without pipe sleeve.

l. All cable joints shall be done with proper jointing kit. No taped/temporary joints shall be used.

m. An independent earthing facility should preferably be established within the temporary installation premises. All appliances and equipment shall be adequately earthed. In case of armored cables, the armour shall be bonded to the earthing system. IS: 3043 Code for earthing practices shall be followed at project site.

n. All cables(green colour) and wire rope used for earth connections shall be terminated through tinned copper lugs.

o. In case of local earthing, earth electrodes shall be buried near the supply point and earth continuity wire shall be connected to local earth plate for further distribution to various appliances. All insulated wires for earth connection shall have insulation of green colour. Periodical check tests of all electrodes should be carried out and record shall be maintained of such checks.

p. Separate core shall be provided for neutral. Earth / Structures shall not be used as a neutral in any case.

q. ON/OFF position of all switches shall be clearly designated / painted for easy isolation in emergency.

3.3.7 Welding/ Grinding/Gas cutting

a) Contractor shall ensure that flash back arrestors conforming to BS:6158 or equivalent are installed on all gas cylinders as well as at the torch end of the gas hose, while in use.

b) All cylinders shall be mounted on trolleys and provided with a closing key. Empty & filled-up gas cylinders shall be stored separately with TAG, protecting them from direct sun or rain. Minimum 2 nos. of Portable DCP type fire extinguishers (10 kg) shall be maintained at the gas cylinder stores. Stacking & storing of compressed gas cylinders shall be arranged away from DG set, hot works, Elect. Panels / Elec. boards, etc.

c) The burner and the hose placed downstream of pressure reducer shall be equipped with Flash Back Arrester/Non Return Valve device.

d) The hoses for acetylene and oxygen cylinders must be of different colours. Their connections to cylinders and burners shall be made with a safety collar.

e) At end of work, the cylinders in use shall be closed and hoses depressurized.

f) Cutting of metals using gases, other than oxygen &acetylene, shall require written concurrence from Owner.

g) Grinding activity shall not be carried out in confined spaces without a valid work permit.

h) All grinding/cutting machines shall be guarded and fitted with Dead-Man switch and this shall not be bypassed any time.

i) All welding/grinding machines shall have effective earthing at least at distinctly isolated two points.

j) In order to help maintain good housekeeping, and to reduce fire hazard, live electrode bits shall be contained safely and shall not be thrown directly on the ground.

k) The hoses of Acetylene and Oxygen shall be kept free from entanglement & away from common pathways / walkways and preferably be hanged overhead in such a manner which can avoid contact with cranes, Hydraulic Mobile Crane or other mobile construction machinery.

l) Hot spatters shall be contained / restricted appropriately (by making use of effective fire-retardant cloth/fabric) and their flying-off as well as chance of contact with near-by flammable materials shall be stopped. The Fire retardant blanket shall be woven from ceramic yarn with eyelets.

m) The Contractor shall arrange adequate systems & practices for accumulation / collection of metal & other scraps and remnant electrodes and their safe disposal at regular interval so as to maintain the fabrication and other areas satisfactorily clean & tidy.

n) All gas cylinders must have a cylinder cap on at all times when not in use.

3.3.8 Ergonomics and tools & tackles

a) The Contractor shall assign to his workmen, tasks commensurate with their qualification, experience and state of health. Competency of the crane operator to be thoroughly checked prior to engaging in crane operation.

b) All lifting tools, tackles, equipment, trailers, trucks/dumpers, accessories including cranes shall be tested periodically by statutory/competent authority for their condition and load carrying capacity. Valid test & fitness certificates from the applicable authority shall be submitted to Owner/EIL for their review/acceptance before the lifting tools, tackles,

equipment, trailers, trucks/dumpers, accessories and cranes are used. Third party inspection certificate is mandatory for all lifting tools & tackles before put into use.

c) Load testing of Cranes by competent person must be made mandatory after each modification/alteration of crane configuration/change in boom length. All heavy equipment's including cranes must be maintained in good condition &record of such maintenance shall be maintained. Routine preventive maintenance of the crane to be carried out& record to be maintained for such preventive maintenance. Healthiness of the crane to be checked by Crane Expert on regular basis as per manufacturer guidelines.

d) HIRAC/JSA for assembly/dismantling activity of the crane to be submitted for approval of EIC.

e) No one should stand/work below the mast & boom of the crane. Mast of the crane should not be used for unintended lifts.

f) Mast of the crane to be kept in right position during dismantling activity of the crane.

g) Log book of all crane to be maintained.

h) Only authorized person shall be allowed to give signal to the operator.

i) Lifting/Loading/Unloading activities shall be carried out by the trained riggers under supervision of rigging Foreman.

j) Prior to marching/movement of the crane, obstructions free access/route to be ensured.

k) Skilled Technician to be engaged for AC gas checking and refilling of refrigerant and should follow the safe operating procedure for cranes.

l) Manufacturer's instructions to be followed without any deviation.

m) The contractor shall not be allowed to use defective equipment or tools not adhering to safety norms.

n) Adequate capacity of Chain pulley blocks with valid TPI certificate to be used for lifting/lowering/dragging/erection of piping material .

o) Colour coding system for lifting tools & tackles shall be followed on quarterly basis for a particular colour as mentioned below:

Period	Colour Code
January, February, March	Blue
April,May, June	Yellow
July, August, September	Green
October, November, December	Orange
For Quarantine (Unsafe Tools & Tackles)	Red

Contractor shall arrange non-sparking tools for project construction works in operating plant areas / hydrocarbon prone areas.

i. Wherever required the Contractor shall make use of Elevated Work Platforms (EWP) or Aerial Work Platforms (mobile or stationary) to avoid ergonomical risks and workmen shall be debarred to board such elevated platform during the course of their shifting / transportation.

ii. Contractor shall ensure installation of Safe Load Indicator (SLI) on all cranes (while in use) to minimize overloading risk. SLI shall have capability to continuously monitor and display the load on the hook, and automatically compare it with the rated crane capacity at the operating condition of the crane. The system shall also provide visual and audible warnings at set capacity levels to alert the operator in case of violations.

iii. The contractor shall be responsible for safe operations of different equipments mobilized and used by him at the workplace like transport vehicles, Tower Crane, engines, cranes, mobile ladders, scaffoldings, work tools, etc. Strictly avoid standing close to Hydraulic Mobile Crane/vehicles tyres during operation.

iv. The contractor shall deploy cranes in good working condition of maximum allowable years of service from the year of manufacture as specified below: -

20 years for cranes of 50 MT & below capacity,25 years for 51 MT to 100 MT,30 years for cranes above 101 MT.

v. In general Man basket shall not be lifted by Hydraulic Mobile Crane. Generally Crane shall be used for lifting the man basket.

vi. Tower Crane, Crane, Hydraulic Mobile Crane or equivalent, Hydraulic Rig &Boom Lift shall be inspected on fortnightly basis as per Format No. HSE-20, HSE-21, HSE-22, HSE-23 & HSE-24.

vii. The Contractor shall arrange periodical training for the operators of Hydraulic Mobile Crane, crane, excavator, mobile machinery, Tower Crane, etc. at site by utilizing services from renowned manufacturers.

viii. Hydraulic Mobile Crane or equivalent having steering control mechanism shall be permitted at construction site only for the purpose of loading/unloading. However, continuous rigger availability during marching of hydraulic crane at site shall be ensured by contractor.

3.3.9 Occupational Health

a) The contractor shall identify all operations that can adversely affect the health of its workers and issue & implement mitigation measures.

b) For surface cleaning operations, sand blasting shall not be permitted even if not explicitly stated elsewhere in the contract.

c) To eliminate radiation hazard, Tungsten electrodes used for Gas Tungsten Arc Welding shall not contain Thorium.

d) Appropriate respiratory protective devices(hood with respiratory devices) shall be used to protect workmen from inhalation of air borne contaminants like silica, asbestos, gases, fumes, etc.

e) Workmen shall be made aware of correct methods for lifting, carrying, pushing & pulling of heavy loads. Wherever possible, manual handling shall be replaced by mechanical lifting equipment's.

f) Fuelling of construction equipments/Diesel Generator set shall be carried out by hand operated pump.

g) In view of the congested working environment and associated hazards, deployment of manpower/machineries shall be in staggered manner keeping adequate safe distance between two adjacent work spot.

h) For jobs like drilling/demolishing/dismantling/steam blowing/cardboard blasting etc. where noise pollution exceeds the specified limit of 85decibels, ear muffs shall be provided to the workers. The Noise level monitoring record shall be maintained.

i) To avoid work related upper limb disorders (WRULD) and backaches, Display Screen Equipments' workplace stations shall be carefully designed & used with proper sitting postures. Power driven hand-held tools shall be maintained in good working condition to minimize their vibrating effects and personnel using these tools shall be taught how to operate them safely & how to maintain good blood circulation in hands.

j) The Contractor shall arrange health check-up(by registered medical practitioner) for all the workers at the time of induction. Health check may have to be repeated if the nature of duty assigned to him is changed necessitating health check or doubt arises about his wellness. EIL/Owner reserves the right to ask the contractor to submit medical test reports. Regular health check-ups are mandatory for the workers assigned with Welding, Radiography, Blasting, Painting, Heavy Lift and Height (>2m) jobs. All the health check-ups shall be conducted by registered Medical practitioner and records are to be maintained by the Contractor.

k) The Contractor shall arrange Medical Camps at regular intervals at work sites and labor colonies to assess health condition of workers.

l) The Contractor shall ensure vaccination of all the workers including their families, during the course of entire project span.

3.3.10 **Hazardous substances**

a) Hazardous, inflammable and/or toxic materials such as solvent coating, thinners, anti-termite solutions, water proofing materials shall be stored in appropriate containers preferably with lids having spillage catchment trays and shall be stored in a good ventilated area. These containers shall be labeled with the name of the materials highlighting the hazards associated with its use and necessary precautions to be taken. Respective MSDS (Material Safety Data Sheet) shall be made available at site &may be referred whenever problem arises.

b) Where contact or exposure of hazardous materials are likely to exceed the specified limit or otherwise have harmful effects, appropriate personal protective Equipment's such as gloves, goggles/face-shields, aprons, chemical resistant clothing, respirator, etc. shall be used.

c) The work place shall be checked prior to start of activities to identify the location, type and condition of any asbestos materials which could be disturbed during the work. In case asbestos material is detected, usage of appropriate PPEs by all personnel shall be ensured and the matter shall be reported immediately to EIL/ Owner.

3.3.11 **Slips, trips & falls**

a) The contractor shall establish a regular cleaning and basic housekeeping programme that covers all aspects of the workplace to help minimize the risk of slips, trips & falls. The contractor shall take positive measures like keeping the work area tidy, storing waste in suitable containers & harmful items separately, keeping passages, stairways, entrances & exits especially emergency ones clear, cleaning up spillages immediately and replacing damaged carpet/ floor tiles, mats & rugs at once to avoid slips, trips & falls.

b) Grating removal permit system should be implemented during construction phase. So that after permanent gratings are installed on platforms and tech structure floors; removal of any gratings for whatever purpose (including for lifting piping material etc.) is required to be sanctioned by signed permit by HSE officers of both contractor and Engineer-in-charge. The spot where gratings are removed shall be hard-barricaded during course of work. The removed gratings shall be re-installed immediately after completion of work or at the time of cessation of work every day whichever is earlier and the permit shall be closed on daily basis. A register shall be maintained for recording all the grating removal permits and their closure shall be monitored on daily basis.

3.3.12 **Radiation exposure**

a) All personnel exposed to physical agents such as ionizing &non-ionizing radiation, including ultraviolet rays or similar other physical agents shall be provided with adequate shielding or protection commensurate with the type of exposure involved.

b) For Open Field Radiography works, requirements of Bhabha Atomic Research Centre (BARC)/ Atomic Energy Regulatory Board (AERB) shall be followed.

c) The Contractor shall implement an effective system of control (as described in the AERB regulations) at site for handling radiography-sources & for avoiding its misuse & theft.

d) The contractor shall generate the Format No: HSE-8 "Permit for radiation work" before start of work.

e) In case the radiography work has to be carried out at day time, suitable methodology to be used so that other works, people are not affected.

3.3.13 **Explosives/Blasting operations**

a) Blasting operations shall be carried out as per latest Explosive Rules (Indian/ International) with prior permission. The Contractor shall obtain license from Chief Controller of Explosives (CCoE) for collection, transportation, storage of explosives as well as for carrying out blasting operations.

b) The Contractor shall prepare exclusive method statement (in cognizance with statutory requirements)for rock blasting works &diffusing unfired explosives, if any, at project site before carrying out actual task. Nowhere blasting shall be carried out by the Contractor or its agency without the involvement of competent supervisor and licensed blaster.

3.3.14 **Demolition/ Dismantling**

a) The contractor shall adhere to safe demolishing/ dismantling practices at all stages of work to guard against unsafe working practices.

b) The contractor shall disconnect service lines (power, gas supply, water, etc.)/ make alternate arrangements prior to start of work and restore them, ifrequired as directed by EIL/ Owner at no extra cost.

c) Before carrying out any demolition/dismantling work, the contractor shall take prior approval of EIL/Owner and generate the Format No.HSE-9. For revamp jobs in operating plants where location of underground utilities is not known with certainty, the contractor shall depute an experienced engineer for supervision and shall make adequate arrangements for Fire-fighting& First-Aid during the execution of these activities.

d) The Contractor shall arrange approved HIRAC/ Method Statement for the specific demolition / dismantling task and corresponding action plan commensurate with hazards / risks associated therein. In no case any activity related to demolition / dismantling shall be carried out by the Contractor without engaging own supervision / field engineer.

3.3.15 **Road Safety**

a) The Contractor shall ensure adequately planned road transport safety management system.

b) The vehicles shall be fitted with reverse warning alarms & flashing lights / fog-lights and usage of seat belts shall be ensured.

c) The Contractor shall also ensure a separate pedestrian route for safety of the workers and comply with all traffic rules & regulations, including maintaining speed limit of 20 KMPH or indicated by owner for all types of vehicles / mobile machinery. The maximum allowable speed shall be adhered to.

d) In case of an alert or emergency, the Contractor must arrange clearance of all the routes, roads, access. The Contractor shall deploy sufficient number of traffic controllers at project site routes / roads/ accesses, to alert reversing movement of vehicles & machinery as well as pedestrians. Experienced drivers/operators with valid driving license (LMV/HMV)shall be allowed to drive/operate the vehicles/equipment's. The Contractor shall maintain copy of PUC,RC and Insurance etc. for all the vehicles/equipment's.

e) Dumpers, Tippers, etc. shall not be allowed to carry workers within the plant area and also to & from the labour colony to & from project sites.

f) Hydraulic Mobile Crane or equivalent)shall only be allowed for handling(loading/unloading) the materials at fabrication/ storage yards and in no case shall be allowed to transport the materials over project / plant roads.

g) The Contractor shall not deploy any such mobile machinery / Equipment's, which do not have competent operator and / or experienced banks-man/signal-man. Such machinery/equipment's shall have effective limit-switches, reverse-alarm, front& rear-end lights etc. and shall be maintained in good working order.

h) The Contractor shall not carry-out maintenance of vehicles / mobile machinery occupying space on project / plant roads and shall always arrange close supervision for such works.

i) For pipeline jobs, the contractor shall submit a comprehensive plan covering transportation, loading / unloading of pipes, movement of side booms, movement of vehicles on the ROW, etc.

j) Height barrier/Restriction to be provided on both side of the HT lines, if required.

k) Contractor's shall arrange /install visible road signs, diversion boards, caution boards, etc. on project roads for safe movement of men and machinery.

3.3.16 **Welfare measures**

Contractor shall, at the minimum, ensure the following facilities at work sites:

a) A crèche at site where 10 or more female workers are having children below the age of 6 years.

b) Adequately ventilated / illuminated rooms at labour camps & its hygienic up-keeping.

c) Reasonable canteen facilities at site and in labour camps at appropriate location depending upon site conditions. Contractor shall make use of "industrial" variety of LPG cylinder & satisfactory illumination at the canteens. Necessary arrangement for efficient disposal of wastes from canteens & urinals /toilets shall also be made and regular review shall be made to maintain the ambience satisfactorily hygienic &shall also comply with all applicable statutory requirements.

d) Adequately lighted & ventilated Rest rooms at site (separate for male workers and female workers).

e) Provision for suitable mobile toilets to be made available by Contractor for remote/scattered job locations.

f) Urinals, Toilets, drinking water, washing facilities, adequate lighting at site and labour camps, commensurate with applicable Laws/ Legislation.

g) The contractor shall ensure the test report of drinking water.

h) The contractor at periodic interval shall arrange to prevent mosquito breeding by fumigation/spraying of insecticides at workplace/fabrication yard.

3.3.17 **Environment Protection**

Contractor shall ensure proper storage and utilization methodology of materials that are detrimental to the environment. Where required, Contractor shall ensure that only the environment friendly materials are selected and emphasize on recycling of waste materials, such as metals, plastics, glass, paper, oil & solvents. The waste that cannot be minimized, reused or recovered shall be stored and disposed of safely. In no way, toxic spills shall be allowed to percolate into the ground. The contractor shall not use the empty areas for dumping the wastes.

The contractor shall ensure availability of stack emission test report of DG set. Monitoring of air quality emission of DG stack shall be carried out on yearly basis. However, air quality emission shall be monitored first time on commissioning of DG Set.

Contractor to submit Environmental Aspect Impact Register detailing the list of activities in his scope, the respective environmental impact and the actions taken to minimize the impact. Environmental Aspect Impact Register to be prepared as per Format HSE-18 and to be updated and maintained till job completion. Environmental Aspect Impact Register of the contractor shall be reviewed by EIL/Owner on half-yearly basis.

The contractor shall strive to conserve energy and water wherever feasible.

The contractor shall ensure dust free environment at workplace by sprinkling water on the ground at frequent intervals. The air quality parameters for dust, poisonous gases, toxic releases,

harmful radiations, etc. shall be checked by the contractor on daily basis and whenever need arises.

The contractor shall not be allowed to discharge chemicals, oil, silt, sewage, sullage and other waste materials directly into the controlled waters like surface drains, streams, rivers, ponds. A discharge plan suggesting the methods of treating the waste before discharging shall be submitted to EIL/Owner for approval.

For pipeline jobs, top soil shall be stacked separately while making ROW through fields. This fertile soil shall be placed back on top after backfilling.

For offshore construction barges, arrangements shall be made for safe disposal of human, food & other wastes and applicable laws in this regard shall be followed.

3.3.18 Rules & Regulations

All persons deployed at site shall be knowledgeable of and comply with the environmental laws, rules & regulations relating to the hazardous materials, substances and wastes. Contractor shall not dump, release or otherwise discharge or disposes off any such materials without the express authorization of EIL/Owner. An indicative list of Statutory Acts & Rules relating to HSE is given under Appendix-D.

3.3.19 Weather Protection

Contractor shall take appropriate measures to protect workers from severe storms, rain, solar radiations, poisonous gases, dust, etc. by ensuring proper usage of PPEs like Sun glasses, Sun screen lotions, respirators, dust masks, etc. and rearranging/ planning he construction activities to suit the weather conditions. Effective arrangement (without creating inconvenience to project facilities & permanent installations) for protecting workmen from hailstorm, drizzle in the form of temporary shelter shall be made at site.

3.3.20 Communication

All persons deployed at the work site shall have access to effective means of communication so that any untoward incident can be reported immediately and assistance sought by them.

All health & safety information shall be communicated in a simple & clear language easily understood by the local workforce.

For information to all, typical subjects that should be communicated are: -

Inside the company (Top to down)

a. Quality Policy
b. HSE Policy contents
c. Environment Policy
d. HSE Objectives
e. Safety Cardinal Rules
f. HSE Target – reached or missed
g. Praises & Warnings to personnel for HSE Management
h. Safety Walk Through Reports and safety defects / shortfalls (by management)
i. HSE Audit results
j. Revised Statutory Health & Safety provisions, if any
k. H & S publicity
l. Suggestions

Inside the Company (Bottom to up)

a. Complaints
b. Compliances on safety defects / shortfalls
c. Suggestions
d. Proposals for changes & improvements
e. HSE Reports (including near-miss reports)

3.3.21 Confined Space Entry

The contractor shall generate a work permit (Format No. HSE -7) before entering a confined space. People, who are permitted to enter into confined space, must be medically examined & certified by registered doctor, confirming their 'medical fitness for working in confined space'. All necessary precautions mentioned therein shall be adhered to. An attendant shall be positioned outside a confined space for extending help during an emergency. Effective communication shall be maintained between personnel in confined space and outside by combination of visual/voice or portable radio. Compressed gas cylinders shall not be taken into confine space. Entry Register for confined space to be maintained with the name and time of entry/exit. All appropriate PPEs and air quality parameters shall be checked before entering a confined space. It shall be ensured that the piping of the equipment which has to be opened is pressure- free by checking that blinds are in place, vents are open and volume is drained. Inside confined space works, only electrical facilities / installations of 24V shall be permitted. Contractor shall ensure usage of safe & suitable arrangement of oxygen supply for individual workmen (during the course of work in confined space), if oxygen concentration is found to be less than 19.5% (v/v) there. All persons must be made aware of the risk associated with Nitrogen &all precautionary measures shall be taken when vessel/sphere/pipelines etc. are being purged with nitrogen.
Rescue arrangement must be readily available at workplace to fulfill requirement of the emergency situation.

3.3.22 Heavy Lifts

a) The contractor shall submit detailed rigging study/ plan for EIL/ Owner approval prior to lifting equipment requiring a crane of approx. 100 MT capacity or more due to constraints of its dimensions, location of foundation height, approach & weight.
b) Contractor shall generate the format no. HSE-15 "Permit for heavy lift/critical erection"
c) The Safe Working Load (SWL) and manufacturer's serial numbers shall be clearly marked on the slings and the lifting gears, either by tagging, stamping, engraving or embossing.
d) Prior to actual lifting activities, contractor shall check the validity of the crane inspection certificate issued by statutory/ competent authority. This requirement shall also apply to all rigging equipment's utilized for the job.
e) The contractor shall, at all times, be responsible for all rigging activities.
f) The Contractor shall ensure medical fitness of all workmen who are engaged / involved in erection of equipment's, vessels etc. and such fitness checks shall be carried-out every six months interval with the help of a registered medical practitioner & record shall be maintained
g) Adequate safety measures such as positive barricading, usage of appropriate PPEs, permit to work, etc. shall be taken during all heavy or critical lifts.
h) Ground condition should be suitable to sustain the Ground Bearing Load of the Crane with full load condition.
i) For lifting any material (irrespective of shape, size or volume), at any height, it is always advisable to prepare a Plan of Erection (PoE) taking into consideration hazards & risks associated therein – this can enable people to put their own experiences of various natures & side-by-side establish a practical method for risk-free erection / lifts. The contractor shall

prepare PoE & shall document the same, when risks are identified as "medium" or "high" and the same shall be approved by its competent / qualified engineer.

3.3.23 Key Performance Indicators

The contractor shall measure an activity in both leading & trailing indicators for statistical and performance measurement. The activities pertaining to key performance indicators are covered in Monthly HSE Report (Format No. HSE-5). The contractor shall try to achieve a statistically fair record and strive for its continual improvement.

Leading Indicators viz:-:

- Number of Safety Inductions carried-out at site (for workmen & staff members)
- Number of HSE inspections carried out
- Number of "Safety Walk Through" carried-out by site-head.
- Number of HSE shortfalls / lapses identified per contractor& closed-out in time.
- Number of Safety Meetings conducted (in-house / with contractors)
- Number of HSE Audits made (internal & external) vis-à-vis non conformances raised
- Number of HSE Awareness / Motivational program conducted by contractors
- Number of HSE Trainings conducted at site for supervisors & workmen
- Study of Near miss case reported
- Encouragements / Awards / Recognitions to workmen, job supervisors & field engineers.
- Suggestions for improvement

Trailing Indicators viz:-:

- Calculation of HSE statistics viz frequency rate, severity rate, LTA free man hours etc.
- Analysis of incidents / accidents (nature, severity, types etc.)
- Study of Incident / Accident with respect to :-
    - Variety
    - Period of the year / project span
    - Timings of the incident / accident
    - Age profile of victims
    - Body parts involved
    - Penalty levied for causing incident / accident

3.3.24 Unsuitable Land Conditions

Contractor shall take appropriate measures and necessary work permits/clearances if work is to be done in or around marshy areas, river crossings, mountains, monuments, etc. The Contractor shall make right assessment and take all necessary action for developing work areas to make them safe & suitable for crane operations or other vehicular movement before carrying out any project related activity / operation. Contractor shall take all necessary actions to make the surroundings of its site establishments (site office, stores, lay-down area etc.) work-worthy safe and secure.

3.3.25 Under Water Inspection

Contractor shall ensure that boats and other means used for transportation, surveying & investigation works shall be certified seaworthy by a recognized classification society. It shall be equipped with all life saving devices like life jackets, adequate fire protection arrangement sand shall possess communication facilities like cellular phones, wireless, walkie-talkie. All divers used for seabed surveys, underwater inspections shall have required authorized license, suitable life-saving kit. Number of hours of work by divers shall be limited as per regulations. EIL/ Owner shall have the right to inspect the boat and scrutinize documents in this regard.

3.3.26 **Excavation**

The Contractor shall obtain permission from competent authorities prior to excavation wherever required.

The Contractor shall locate the position of buried utilities (water line, cable route, etc.) by referring to project / plant drawing / in consultation with EIL/Owner. The Contractor shall start digging manually to locate the exact position of buried utilities & thereafter use mechanical means.

In case of non-availability of sufficient data/drawings, underground services i.e. underground cable/ pipe shall be checked by cable detector/pipe locator by the contractor.

The Contractor shall keep soil heaps at least 1.5 M away from edge or a distance equal to depth of pit (whichever is more)

All excavated pits greater than 10 Sq.M plan area and depth more than 1.5M shall have at least two access routes for ingress and egress. Also, additional access routes shall be provided such that distance between any two access routes shall not be more than 20M.

The Contractor shall maintain sufficient "angle of repose" during excavation – shall also provide slope or suitable bench as decided by EIL / Owner.

The Contractor shall arrange "battering" or "benching" wherever required for preventing collapse of edge of excavations.

Avoid vertical wall of less than 2mtrs between two adjacent deep excavated pit/area. Further deep excavation should not be kept open for a longer duration.

The Contractor shall identify & arrange de-watering pump or well-point system to prevent earth collapse due to heavy rain / influx of underground water.

The Contractor shall arrange protective fencing/hard barricading with warning signal around excavated pits, trenches, etc. along with minimum 2 (two) entries, exits / escape ladders.

The Contractor must avoid "underpinning" / under-cutting to prevent collapse of chunk of earth during excavation.

The Contractor shall use "stoppers" to prevent over-run of vehicle wheels at the edge of excavated pits / trenches. Vehicles movement should be restricted to minimum three meters away from the excavated pit.

The Contractor shall arrange strengthening of "shoring" & "strutting" proactively to avoid collapse of earth / edges due to vehicular movement in close proximity of excavated areas / pits/ trenches, etc.

3.4 Tool Box Talks (TBT)

Contractor shall conduct daily TBT with workers prior to start of work and shall maintain proper record of the meeting. A suggested format is given below. The Job specific TBT is to be conducted by the immediate supervisor of the workers.

The Contractor shall conduct TBT before start of every morning or evening shift or night shift activities, for alerting the workers on specific hazards and their appropriate dos & don'ts. The Contractor shall provide sufficient rests to the site workmen and their foremen to avert fatigue & thereby endangering their lives during the course of site works.

TOOLBOX TALK RECORDING SHEET		
Date & Time		
Work Location		
Subject (Nature of work)		
Presenter		
Hazards involved		
Precautions to be taken		
Worker's Name	Signature	Section
Remarks, in any		

The topics during TBT shall include

- Hazards related to work assigned on that day and precautions to be taken.
- Any forthcoming HSE hazards/events/instruction/orders, etc.

The above record can be kept in local language, which workers can read. These records shall be made available to EIL/ Owner whenever demanded.

3.5 Training & Induction Programme

a) Initial induction of workers into Construction oriented activities and appraising them about the methodology of works and how to carry-out safely and the same should not be inter mixed with Tool Box Talks or HSE Training. In this regard careful action should be made& maintained for imparting HSE induction to every individual, irrespective of his task/designation/level of employment, whereas, HSE Training should be imparted to specific person/group of people who are to carry-out that specific task more than once – for example, Riggers must be trained for working at heights, welders must be trained for work in confined space, fitters/carpenters, mesons must be trained for work at heights, etc.
Contractor shall arrange suitable facilities (e.g training room/place, audio visual facilities etc.) for organizing such training on HSE.

b) Contractor shall conduct Safety induction programme on HSE for all his workers and maintain records. Sticker for "Safety Induction" shall be pasted on the safety helmet of the site personnel. The Gate Pass shall be issued only to those workers who successfully qualify the Safety induction programme. Contractor to conduct effective safety induction program at work site by making efforts to arrange Video film/Virtual Reality (VR) technology pertaining to the escape routes, assembly points, risks involved in the event of an emergency etc while imparting safety induction.

c) The Contractor brief the visitors about the HSE precautions which are required to be taken before their proceeding to site and make necessary arrangements to issue appropriate PPEs like Aprons, hard hats, ear-plugs, goggles & safety shoes etc., to his visitors. The Contractor shall always maintain relevant acknowledgement from visitor on providing him brief information on HSE actions.

d) Contractor shall submit job specific training schedule for approval of EIL/Owner &ensure that all his personnel possess appropriate training to carry out the assigned job safely. The training should be imparted in a language understood by them and should specifically be trained about

- Potential hazards to which they may be exposed at their workplace

- Measures available for prevention and elimination of these hazards

The topics during training shall cover, at the minimum: -

- Why safety should be considered during work - explanation
- Education about hazards and precautions required
- Employees' duties & responsibilities
- Emergency and evacuation plan
- HSE requirements during project activities
- Fire fighting and First-Aid
- Use of PPEs
- Occupational health issues – dos & don'ts
- Local laws on intoxicating drinks, drugs, smoking in force
- Common environmental subjects – lighting, ventilation, vibration, smoke/fumes etc.

e) Records of the training shall be kept and submitted to EIL/ Owner.

f) The Contractor shall make regular program for conducting Safety Training on various topics related to various activities & their safe-guarding utilizing experienced persons / outside agency / faculty. A program for Safety Training (indicative list as per Appendix –F) shall be furnished by the Contractor in its HSE Plan.

g) For offshore and jetty jobs, contractor shall ensure that all personnel deployed have undergone a structured sea survival training including use of lifeboats, basket landing, use of radio communication etc. from an agency acceptable to Owner/EIL.

3.6 ADDITIONAL SAFETY REQUIREMENTS FOR WORKING INSIDE A RUNNING PLANT

As a minimum, the contractor shall ensure adherence to following safety requirements while working in or in the close vicinity of an operating plant:

a) Contractor shall obtain permits for Hot work, Cold work, Excavation and Confined Space from Owner in the prescribed format.

b) The contractor shall monitor record and compile list of his workers entering the operational plant/unit each day and ensure & record their return after completing the job.

c) Contractor's workers and staff members shall use designated entrances and proceed by designated routes to work areas only assigned to them. The workers shall not be allowed to enter units' area, tanks area, pump rooms, etc. without work authorization permit.

d) Work activities shall be planned in such a way so as to minimize the disruption of other activities being carried out in an operational plant/unit and activities of other contractors.

e) The contractor shall submit a list of all chemicals/toxic substances that are intended to be used at site and shall take prior approval of the Owner.

f) Specific training on working in a hydrocarbon plant shall be imparted to the work force and mock drills shall be carried out for Rescue operations/First-Aid measures.

g) Proper barricading/cordoning of the operational units/plants shall be done before starting the construction activities. No unauthorized person shall be allowed to trespass. The height and overall design of the barricading structure shall be finalized in consultation with the Owner and shall be got approved from the Owner.

h) Care shall be taken to prevent hitting underground facilities such as electrical cables, hydrocarbon piping during execution of work.

i) Barricading with water curtain shall be arranged in specific/critical areas where hydrocarbon vapors are likely to be present such as near horton spheres or tanks. Positioning of fire tenders (from owner) shall also be ensured during execution of critical activities.

j) Emergency evacuation plan shall be worked out and all workmen shall be apprised about evacuation routes. Mock drill operations may also be conducted.

k) Flammable gas test shall be conducted prior to any hot work using appropriate measuring instruments. Sewers, drains, vents or any other gas escaping points shall be covered with flame retardant tarpaulin.

l) Respiratory devices shall be kept handy while working in confined zones where there is a danger of inhalation of poisonous gases. Constant monitoring of presence of Gas/Hydrocarbon shall be done.

m) Clearance shall be obtained from all parties before starting hot tapping, patchwork on live lines and work on corroded tank roof.

n) Positive isolation of line/equipment by blinding for welding/cutting/grinding shall be done. Closing of valve will not be considered sufficient for isolation.

o) Welding spatters shall be contained properly by using fire retardant blanket and in no case shall be allowed to fall on the ground containing oil. Similar care shall be taken during cutting operations. Fire watcher to be deployed to ensure the same.

p) The vehicles, cranes, engines, etc. shall be fitted with spark arresters on the exhaust pipe and got it approved from Safety Department of the Owner.

q) Plant air should not be used to clean any part of the body or clothing or use to blow off dirt on the floor.

r) Gas detectors should be installed in gas leakage prone areas as per requirement of Owner's plant operation personnel.

s) Flame proof electrical distribution board, plug and socket shall be used for electrical appliances.

t) Experienced full time safety personnel shall be exclusively deployed to monitor safety aspects in running plants.

3.7 Self-Assessment and Enhancement

The contractor shall develop a method of check & balance through self-assessment& enhancement techniques and shall explore the opportunities for continual improvement in the HSE system.

3.8 HSE Promotion

The contractor shall encourage his workforce to promote HSE efforts at workplace by way of organizing workshops/seminars/training programs, celebrating HSE awareness weeks &National Safety Day, conducting quizzes & essay competitions, distributing pamphlets, posters & material on HSE, providing incentives for maintaining good HSE practices and granting incentives/ bonus for completing the job without any lost time accident.

3.9 Lock Out and Tag Out(LOTO) for Isolation of Energy Source

a) Contractor shall follow the LOTO/Isolation procedure of owner for all energy source isolations installed/under purview by /of owner i.e. "Brown field"

b) For all the other energy source (not under purview of client/owner)i.e. "Green field" Contractor shall develop a system to ensure the isolation of equipments, pipelines, Vessel, electrical panels from the energy source covering following as minimum:-

- Identification of all energy source viz electrical, mechanical, hydraulic, pneumatic, chemical, thermal, gravitational, radiation and other forms of stored or kinetic energy.
- Establishing the energy isolation devices viz manually operated electrical circuit breakers, disconnection switches, blind flanges, etc.
- Installation of Lock Out devices for preventing the inadvertent release of stored energy and Tag Out devices ("Danger", "Do Not operate" or Do not Remove"tags) to indicate that testing, maintenance or servicing is underway and the device cannot be operated until the tag out device is removed.
- Lock Out and Tag out log book
- Permit for isolation and de-isolation of energy source as per format No.: HSE-16
- Availability of competent persons like experienced operators at substations, pump house, units etc. supervisors etc.

c) Contractor shall ensure that all the sources are locked out and tagged properly before giving clearance to start the job.

d) After the completion of job, contractor shall ensure all tools and tackles are removed and nobody is present in the working area and signing on LOTO log book.

e) Only on confirmation of above the contractor will remove their lock and tag from the isolation points and give instructions for energizing the same. Only the person carrying out the task shall himself carry the key for the lock in /Lock out.

4.0 DETAILS OF HSE MANAGEMENT SYSTEM BY CONTRACTOR

4.1 On Award of Contract

The Contractor shall submit a comprehensive Health, Safety and Environmental Plan or programme for approval by EIL/Owner prior to start of work. The Contractor shall participate in the pre-start meeting with EIL/Owner to finalize HSE Plans which shall including the following:

- HSE policy & Objectives
- Job procedure to be followed by the Contractor for construction activities including handling of equipment's, scaffolding, electric installations, etc. describing the risks involved, actions to be taken and methodology for monitoring each activity. Indicative list of procedures is enclosed as Annexure-H
- EIL/Owner review/audit requirement.
- Organization structure along with responsibility and authority, on HSE activities.
- Administrative & disciplinary steps involving implementation of HSE requirements
- Emergency evacuation plan/ procedures for site and labour camps
- Procedures for reporting & investigation of accidents and near misses.
- HSE Inspection
- HSE Training programme at project site
- HSE Awareness program eat project site
- Reference to Rules, Regulations and statutory requirements.
- HIRAC
- Environment Aspect Impact Register
- Legal Register
- HSE documentation viz reporting, analysis & record keeping.

4.2 During Job Execution

Contractor shall implement approved Health, Safety and Environment management plan or programme including but not limited to as brought out under para 3.0. Contractor shall also ensure:

a) to arrange workmen compensation insurance, registration under ESI Act, third party liability insurance, registration under BOCW Act etc., as applicable.

b) to arrange all HSE permits before start of activities (as applicable), like permits for hot work, working at heights (Refer Format No. HSE-6), confined space (Refer Format No. HSE-7), Radiation Work Permit (Refer Format No. HSE-8), Demolishing/ Dismantling Work Permit (Refer Format No. HSE-9),Permit for erection/modification & dismantling of scaffolding(Refer Format No:HSE-14),Permit for heavy lift/critical erection (Refer Format No:HSE-15) ,Permit for energy Isolation & De-isolation" (HSE-16) ,storage of chemical/explosive materials & its use and implement all precautions mentioned therein. In this regard, requirements of *Oil industry Safety Directorate Standard No.* Std -105 "Work Permit Systems" shall be complied with while working in existing Oil or Gas processing plants. List of the persons involved shall be maintained as annexure to the work permit issued for a particular activity.

c) to submit, timely, the completed checklist on HSE activities in Format No.HSE-1, Monthly HSE report in Format No.HSE-5 (use of web based package (www.eil.co.in/conthse) is compulsory wherever the facility is available else a hard copy is to be submitted), accident/ incident reports, investigation reports etc. as per EIL/Owner requirements. Compliance of instructions on HSE shall be done by Contractor and informed urgently to EIL/Owner.

d) that his top most executive at site attends all the Safety Committee/HSE meetings arranged by EIL/Owner and carries out safety walk regularly. Only in case of his absence from site that a second senior most person shall be nominated by him, in advance, and communicated to EIL/Owner for performing the above tasks.

e) display at site office and at prominent locations HSE Policy, caution boards, list of hospitals, emergency services available, safety signs like Men at work, Speed Limits, Hazardous Area, various do's & don'ts, etc.

f) provide posters, banners for safe working to promote safety consciousness.

g) identify, assess, analyze & mitigate the construction hazards& incorporate relevant control measures before actually executing site works. (HIRAC = Hazard Identification, Risk Analysis and Control).

h) identify, assess, analyze & mitigate the environmental impact & incorporate relevant control measures through Environmental Aspect Impact Register

i) Identify and comply to all applicable HSE related legal requirements by preparing and maintaining a Legal register.

j) To maintain & monitor the level of legal compliance at site, a committee shall be formed comprising of contractor's RCM as Head and lead representatives as member(s)from HR/Legal, HSE and discipline engineer(s) (Civil, Mechanical, Electrical, Instrumentation) as applicable. Committee shall review the applicable legal requirements during periodical meetings and monitor the compliance status.

k) arrange testing, examination, inspection of own as well as borrowed construction equipment's/ machinery (stationary &mobile) before being used at site and also at periodical interval, through own resources and also by 3rd party competent agencies (as deemed fit in statutes). Records of such test, examination etc. shall be maintained & shall be submitted to EIL/Owner as & when asked for.

l) carryout audits/inspection (internal & external) at his works as well as sub-contractor works as per approved HSE plan/procedure/programme & submit the compliance reports of identified shortfalls for EIL/Owner review.

m) Arranging HSE training for site workmen (of his own &subcontractors) through internal or external faculty at periodical intervals.

n) Assistance& cooperate during HSE audits by EIL/Owner or any other 3rd party and submit compliance report.

o) Generate & submit of HSE records/report as per this specification.

p) Contractor shall arrange minimum 100 lux. illumination level at construction site for night works& record shall be maintained.

q) Mobile phones shall not be permitted in operational area of the Project Site. However, intrinsically safe mobile phone can be permitted on approval from EIL/Owner. Alternatively, telephone booth(s) may be set up by the contractor after obtaining approval from EIL/Owner. Use of mobile phone shall also be restricted during construction activities such as height work, erection of material, confined space and Pre-commissioning & Commissioning activities at all project sites.

r) The contractor shall assign responsible person as in charge for night works and it shall be informed to owner/EIL.

s) Appraise EIL/Owner on HSE activities at site regularly.

t) Carry-out all dismantling activities safely, with prior approval of EIL/Owner representative.

u) The Contractor shall ensure that "Hot works" and painting works do not continue at the same place/ location at project site for which chance or probability of "fire" incident exists.

4.3 During Short Listing of the Sub-Contractors

The contractor shall review the HSE management system of the sub-contractors in line with the requirements given in this specification. The contractor shall be held responsible for the shortcomings observed in the HSE management system of the sub-contractor(s) during execution of the job.

5.0 RECORDS

At the minimum, the contractor shall maintain/ submit HSE records in the following reporting formats:

Safety Walk Through Report	HSE-1
Accident/ Incident Report	HSE-2
Supplementary Accident/ Incident Investigation report	HSE-3
Near Miss Incident Report	HSE-4
Monthly HSE Report	HSE-5
Permit for working at height	HSE-5
Permit for working in confined space	HSE-7
Permit for radiation work	HSE-8
Permit for demolishing/ dismantling	HSE-9
Daily Safety checklist	HSE-10
Housekeeping Assessment & compliance	HSE-11
Inspection of temporary electrical booth/installation	HSE-12
Inspection for scaffolding	HSE-13
Permit for erection/modification &dismantling of scaffolding	HSE-14
Permit for heavy lift/critical erection.	HSE-15
Permit for Energy isolation and de-isolation.	HSE-16
Permit for Excavation	HSE-17
Environmental Aspect Impact Register	HSE-18
HIRAC Register	HSE-19
Checklist for Tower Crane	HSE-20
Crane Inspection Checklist	HSE-21
Hydraulic Mobile Crane Inspection Checklist	HSE-22
Hydraulic Rig Inspection Checklist	HSE-23

Boom Lift Inspection Checklist	HSE-24
Inspection reports of Equipment/tools/tackles	*
Report of Toolbox Talks	As indicated in specification
PPE issue report/register	*
Site inspection reports	*
Training records	*

(*) The formats shall be developed by contractor in consultation with EIL/Owner.

APPENDIX-A
(Sheet 1 of 2)

A.	**IS CODES ON HSE**
SP: 53	Safety code for the use, Care and protection of hand operated tools.
IS: 838	Code of practice for safety & health requirements in electric and gas welding and cutting operations
IS: 1179	Eye & Face precautions during welding, equipment etc.
IS: 1860	Safety requirements for use, care and protection of abrasive grinding wheels.
IS: 1989 (Pt -II)	Leather safety boots and shoes
IS: 2925	Industrial Safety Helmets
IS: 3016	Code of practice for fire safety precautions in welding & cutting operation.
IS: 3043	Code of practice for earthing
IS: 3764	Code of safety for excavation work
IS: 3786	Methods for computation of frequency and severity rates for industrial injuries and classification of industrial accidents
IS: 3696	Safety Code of scaffolds and ladders
IS: 4083	Recommendations on stacking and storage of construction materials and components at site
IS: 4770	Rubber gloves for electrical purposes
IS: 5121	Safety code for piling and other deep foundations
IS: 5216 (Pt-I)	Recommendations on Safety procedures and practices in electrical works
IS: 5557	Industrial and Safety rubber lined boots
IS: 5983	Eye protectors
IS: 6519	Selection, care and repair of Safety footwear
IS: 6994 (Pt-I)	Industrial Safety Gloves (Leather & Cotton Gloves)
IS: 7293	Safety Code for working with construction Machinery
IS: 8519	Guide for selection of industrial safety equipment for body protection
IS: 9167	Ear protectors
IS: 11006	Flash back arrestor (Flame arrestor)
IS: 11016	General and safety requirements for machine tools and their operation
IS: 11057	Specification for Industrial safety nets
IS: 11226	Leather safety footwear having direct moulded rubber sole
IS: 11972	Code of practice for safety precaution to be taken when entering a sewerage system
IS: 13367	Code of practice-safe use of cranes
IS: 13416	Recommendations for preventive measures against hazards at working place

APPENDIX-A
(Sheet 2 of 2)

B. INTERNATIONAL STANDARDS ON HSE

Safety Glasses	:	ANSI Z 87.1, ANSI ZZ 87.1, AS 1337, BS 2092, BS 1542, BS 679, DIN 4646/ 58311
Safety Shoes	:	ANSI Z 41.1, AS 2210, EN 345
Hand Gloves	:	BS 1651
Ear Muffs	:	BS 6344, ANSI S 31.9
Hard Hat	:	ANSI Z 89.1/89.2, AS 1808, BS 5240, DIN 4840
Goggles	:	ANSI Z 87.1
Face Shield	:	ANSI Z 89.1
Breathing Apparatus	:	BS 4667, NIOSH
Welding & Cutting	:	ANSI Z49.1
Safe handling of compressed:		P-1 (Compressed Gas Association Gases in cylinders 1235 Jefferson Davis Highway, Arlington VA 22202 - USA)
Full body harness	:	EN-361
Lanyard	:	EN-354
Karabiner	:	EN-362 and EN-12275

APPENDIX-B

DETAILS OF FIRST AID BOX

SL. NO.	DESCRIPTION		QUANTITY
1.	Small size Roller Bandages, 1 Inch Wide	(Finger Dressing small)	6 Pcs.
2.	Medium size Roller Bandages, 2 Inches Wide	(Hand & Foot Dressing)	6 Pcs.
3.	Large size Roller Bandages, 4 Inches Wide	(Body Dressing Large)	6 Pcs.
4.	Large size Burn Dressing	(Burn Dressing Large)	4 Pkts.
5.	Cotton Wool	(20 gms packing)	4 Pkts.
6.	Antiseptic Solution Dettol (100 ml.) or Savlon		1 Bottle
7.	Mercurochrome Solution (100 ml.) 2% in water		1 Bottle
8.	Ammonia Solution (20 ml.)		1 Bottle
9.	A Pair of Scissors		1 Piece
10.	Adhesive Plaster (1.25 cm X 5 m)		1 Spool
11.	Eye pads in Separate Sealed Pkt.		4 pcs.
12.	Tourniqut		1 No.
13.	Safety Pins		1 Dozen
14.	Tinc. Iodine/ Betadine (100 ml.)		1 Bottle
15.	Polythene Wash cup for washing eyes		1 No.
16.	Potassium Permanganate (20 gms.)		1 Pkt.
17.	Tinc. Benzoine (100 ml.)		1 Bottle
18.	Triangular Bandages		2 Nos.
19.	Band Aid Dressing		5 Pcs.
20.	Iodex/Moov(25 gms.)		1 Bottle
21.	Tongue Depressor		1 No.
22.	Boric Acid Powder (20 gms.)		2 Pkt.
23.	Sodium Bicarbonate (20 gms.)		1 Pkt.
24.	Dressing Powder (Nebasulf) (10 gms.)		1 Bottle
25.	Medicinal Glass		1 No.
26.	Duster		1 No.
27.	Booklet (English& Local Language)		1 No. each
28.	Soap		1 No.
29.	Toothache Solution		1 No.
30.	Vicks (22 gms.)		1 Bottle
31.	Forceps		1 No.
32.	Snake –Bite Lancet		1No.
33.	Note Book		1 No.
34.	Splints		4 Nos.
35.	Lock		1 Piece
36.	Life Saving/Emergency/Over-the counter Drugs		As decided at site

Box size: Suitable size first aid box to be used for first aid items

Note : The medicines prescribed above are only indicative. Equivalent medicines can also be used. A prescription, in this regard, shall be required from a qualified Physician.

APPENDIX-C

TYPE OF FIRES VIS-À-VIS FIRE EXTINGUISHERS

Fire / Extinguisher →	Water	Foam	CO_2	Dry Powder	Multi purpose (ABC)
Originated from paper, clothes, wood	✔	✔	can control minor surface fires	can control minor surface fires	✔
Inflammable liquids like alcohol, diesel, petrol, edible oils, bitumen	×	✔	✔	✔	✔
Originated from gases like LPG, CNG, H_2	×	×	✔	✔	✔
Electrical fires	×	×	✔	✔	✔

LEGEND : ✔ : CAN BE USED

× : NOT TO BE USED

Note: Fire extinguishing equipment must be checked atleast once a year and after every use by an authorized person. The equipment must have an inspection label on which the next inspection date is given. Type of extinguisher shall clearly be marked on it.

APPENDIX-D

List of Statutory Acts & Rules Relating to HSE

- The Indian Explosives Act and Rules
- The Motor Vehicle Act and Central Motor Vehicle Rules
- The Factories Act and concerned Factory Rules
- The Petroleum Act and Petroleum Rules
- The Workmen Compensation Act
- The Gas Cylinder Rules and the Static & Mobile Pressure Vessels Rules
- The Indian Electricity Act and Rules
- The Indian Boiler Act and Regulations
- The Water (Prevention & Control & Pollution) Act
- The Water (Prevention & Control of Pollution) Cess Act
- The Mines & Minerals (Regulation & Development) Act
- The Air (Prevention & Control of Pollution) Act
- The Atomic Energy Act
- The Radiation Protection Rules
- The Indian Fisheries Act
- The Indian Forest Act
- The Wild Life (Protection) Act
- The Environment (Protection) Act and Rules
- The Hazardous Wastes (Management & Handling) Rules
- The Manufacturing, Storage & import of Hazardous Chemicals Rules
- The Public Liability Act
- The Building and Other Construction Workers (Regulation of Employment and Condition of Service) Act
- Other statutory acts Like EPF, ESIS, Minimum Wages Act.

APPENDIX-E(Sheet 1 of 12)

CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
(A) EXCAVATION Pit Excavation upto 3.0m	Falling into pit	Personal injury	Provide guard rails/ barricade with warning signal Provide atleast two entries/ exits. Provide escape ladders.
	Earth Collapse	Suffocation/ Breathlessness Buried	Provide suitable size of shoring and strutting, if required. Keep soil heaps away from the edge equivalent to 1.5m or depth of pit whichever is more. Don't allow vehicles to operate too close to excavated areas. Maintain atleast 2m distance from edge of cut. Maintain sufficient angle of repose. Provide slope not less than 1:1 and suitable bench of 0.5m width at every 1.5m depth of excavation in all soils except hard rock. Battering/benching the sides.
	Contact with buried electric cables Gas/ Oil Pipelines	Electrocution Explosion	Obtain permission from competent authorities, prior to excavation, if required. Locate the position of buried utilities by referring to plant drawings. Start digging manually to locate the exact position of buried utilities and thereafter use mechanical means.
Pit Excavation beyond 3.0m	Same as above plus Flooding due to excessive rain/ underground water	Can cause drowning situation	Prevent ingress of water Provide ring buoys Identify and provide suitable size dewatering pump or well point system
	Digging in the vicinity of existing Building/ Structure	Building/Structure may collapse Loss of health & wealth	Obtain prior approval of excavation method from local authorities. Use under-pining method Construct retaining wall side by side.
	Movement of vehicles/ Equipments close to the edge of cut.	May cause cave-in or slides. Persons may get buried.	Barricade the excavated area with proper lighting arrangements Maintain at least 2m distance from edge of cut and use stop blocks to prevent over-run Strengthen shoring and strutting

APPENDIX-E: (Sheet 2 of 12)

CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES (...Contd.)

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
Narrow deep excavations for pipelines, etc.	Same as above plus Frequent cave-in or slides	May cause severe injuries or prove fatal	Battering/benching of sides Provide escape ladders
	Flooding due to Hydro- static testing	May arise drowning situation	Same as above plus Bail out accumulated water Maintain adequate ventilation.
Rock by excavation blasting	Improper handling of explosives	May prove fatal	Ensure proper storage, handling & carrying of explosives by trained personnel. Comply with the applicable explosive acts & rules.
	Uncontrolled explosion	May cause severe injuries or prove fatal	Allow only authorized persons to perform blasting operations. Smoking and open flames are to be strictly prohibited
	Scattering of stone pieces in atmosphere	Can hurt people	Use PPE like goggles, face mask, helmets etc.
Rock excavation by blasting (Contd)	Entrapping of persons/ animals.	May cause severe injuries or prove fatal	Barricade the area with red flags and blow siren before blasting.
	Misfire	May explode suddenly	Do not return to site for atleast 20 minutes or unless announced safe by designated person.
Piling Work	Failure of pile-driving equipment	Can hurt people	Inspect Piling rigs and pulley blocks before the beginning of each shift.
	Noise pollution	Can cause deafness and psychological imbalance.	Use personal protective equipment's like ear plugs, muffs, etc.
	Extruding rods/casing	Can hurt people	Barricade the area and install sign boards Provide first-aid
	Working in the vicinity of 'Live-Electricity'	Can cause electrocution/ Asphyxiation	Keep sufficient distance from Live-Electricity as per IS code. Shut off the supply, if possible Provide artificial/rescue breathing to the injured
(B) CONCRETING	Air pollution by cement	May affect Respiratory System	Wear respirators or cover mouth and nose with wet cloth.
	Handling of ingredients	Hands may get injured	Use gloves & other PPE.
	Protruding reinforcement rods.	Feet may get injured	Provide platform above reinforcement for movement of workers or provide end caps for protection on reinforcement bars.

APPENDIX-E :(Sheet 3 of 12)

CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES (...Contd.)

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
	Earthing of electrical mixers, vibrators, etc. not done.	Can cause electrocution/ asphyxiation	Ensure earthing of equipments and proper functioning of electrical circuit before commencement of work.
	Falling of materials from height	Persons may get injured	Use hard hats Remove surplus material immediately from work place. Ensure lighting arrangements during night hours
	Continuous pouring by same gang	Cause tiredness of workers and may lead to accident.	Insist on shift pattern Provide adequate rest to workers between subsequent pours.
	Revolving of concrete mixer/ vibrators	Parts of body or clothes may get entrapped.	Allow only mixers with hopper Provide safety cages around moving motors Ensure proper mechanical locking of vibrator.
Super-structure	Same as above plus Deflection in props or shuttering material	Shuttering/props may collapse and prove fatal	Avoid excessive stacking on shuttering material Check the design and strength of shuttering material before commencement of work Rectify immediately the deflection noted during concreting.
	Passage to work place	Improperly tied and designed props/planks may collapse	Ensure the stability and strength of passage before commencement of work. Do not overload and stand under the passage.
(C) REINFOR-CEMENT	Curtailment and binding of rods	Persons may get injured	Use PPE like gloves, shoes, helmets, etc. Avoid usage of shift tools
	Carrying of rods for short distances/at heights	Workers may get injured their hands and shoulders.	Provide suitable pads on shoulders and use safety gloves. Tie up rods in easily liftable bundles Ensure proper staging.
	Checking of clear distance/ cover with hands	Rods may cut or injure the fingers	Use measuring devices like tape, measuring rods, etc.
	Hitting projected rods and standing on cantilever rods.	Persons may get injured and fell down	Use safety shoes and avoid standing unnecessarily on cantilever rods Avoid wearing of loose clothes

APPENDIX-E:(Sheet 4 of 12)

CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES (...Contd.)

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
	Falling of material from height	May prove fatal	Use helmets Provide safety nets
	Transportation of rods by trucks/ trailers	Protruded rods may hit the persons	Use red flags/lights at the ends Do not protrude the rods in front of or by the side of driver's cabin. Do not extend the rods 1/3rd of deck length or 1.5m whichever is less
(D)WELDING AND GAS CUTTING	Welding radiates invisible ultraviolet and infra-red rays	Radiation can damage eyes and skin.	Use specified shielding devices and other PPE of correct specifications. Avoid thoriated tungsten electrodes for GTAW
	Improper placement of oxygen and acetylene cylinders	Explosion may occur	Move out any leaking cylinder Keep cylinders in vertical position Use trolley for transportation of cylinders and chain them Use flashback arrestors
	Leakage/ cuts in hoses	May cause fire	Purge regulators immediately and then turn off Never use grease or oil on oxygen line connections and copper fittings on acetylene lines Inspect regularly gas carrying hoses Always use red hose for acetylene & other fuel gases and black for oxygen
	Opening-up of cylinder	Cylinder may burst	Always stand back from the regulator while opening the cylinder Turn valve slowly to avoid bursting Cover the lug terminals to prevent short circuiting
	Welding of tanks, container or pipes storing flammable liquids	Explosion may occur	Empty & purge them before welding Never attach the ground cable to tanks, container or pipe storing flammable liquids Never use LPG for gas cutting

APPENDIX-E:(Sheet 5 of 12)

CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES ...(Contd.)

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
(E) RADIOGRAPHY	Ionizing radiation	Radiations may react with the skin and can cause cancer, skin irritation, dermatitis, etc.	Ensure Safety regulations as per BARC/AERB before commencement of job. Cordon off the area and install Radiation warning symbols Restrict the entry of unauthorized persons Wear appropriate PPE and film badges issued by BARC/AERB
	Transportation and Storage of Radiography source	Same as above	Never touch or handle radiography source with hands Store radiography source inside a pit in an exclusive isolated storage room with lock and key arrangement. The pit should be approved by BARC/AERB. Radiography source should never be carried either in passenger bus or in a passenger compartment of trains. BARC/AERB has to be informed before source movement. Permission from Director General of Civil Aviation is required for booking radio isotopes with airlines.
	Loss of Radio isotope	Same as above	Try to locate with the help of Survey Meter. Inform BARC/AERB (*)
(F) ELECTRICAL INSTALLATION ANDUSAGE	Short circuiting	Can cause Electrocution or Fire	Use rubberized hand gloves and other PPE Don't lay wires under carpets, mats or door ways. Allow only licensed electricians to perform on electrical facilities Use one socket for one appliance Ensure usage of only fully insulated wires or cables Don't place bare wire ends in a socket Ensure earthing of machineries and equipment's Do not use damaged cords and avoid temporary connections Use spark-proof/flame proof type field distribution boxes.

(*) Atomic Energy Regulatory Board (AERB),
Bhabha Atomic Research Centre (BARC)
Anushakti Nagar, Mumbai – 400 094

APPENDIX-E:(Sheet 6 of 12)

CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES (...Contd.)

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			Do not allow open/bare connections Provide all connections through 30mAELCB Protect electrical cables/equipments from water and naked flames Check all connections before energizing
	Overloading of Electrical System	Bursting of system can occur which leads to fire	Display voltage and current ratings prominently with 'Danger' signs. Ensure approved cable size, voltage grade and type Switch off the electrical utilities when not in use Do not allow unauthorized connections. Ensure proper grid wise distribution of Power
	Improper laying of overhead and underground transmission lines/cables	Can cause electrocution and prove fatal	Do not Jay un armoured cable directly on ground, wall, roof of trees Maintain atleast 3m distance from HT cables All temporary cables should be laid atleast 750 mm below ground on 100 mm fine sand overlying by brick soling Provide proper sleeves at crossings/ inter-sections Provide cable route markers indicating the type and depth of cables at intervals not exceeding 30m and at the diversions/termination
(G) FIRE PREVENTION AND PROTECTION	Small fires can become big ones and may spread to the surrounding areas	Cause burn injuries and may prove fatal	In case a fire breaks out, press fire alarm system and shout "Fire, Fire". Keep buckets full of sand & water/ fire extinguishing equipment near hazardous locations. Confine smoking to 'Smoking Zones' only. Train people for using specific type of fire fighting equipments under different classes of fire. Keep fire doors/shutters, passages and exit doors unobstructed. Maintain good housekeeping and first-aid boxes (for details refer Appendix-B). Don't obstruct assess to Fire extinguishers. Do not use elevators for evacuation during fire. Maintain lightening arrestors for elevated structures. Stop all electrical motors with internal combustion.

APPENDIX-E :(Sheet 7 of 12)

CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES (...Contd.)

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			Move the vehicles from dangerous locations. Remove the load hanging from the crane booms Remain out of the danger areas.
	Improper selection of Fire extinguisher	It may not extinguish the fire	Ensure usage of correct fire extinguisher meant for the specified fire (for details refer Appendix-C). Do not attempt to extinguish Oil and electric fires with water. Use foam cylinders/CO_2/sand or earth.
	Improper storage of highly inflammable substances	Same as above	Maintain safe distance of flammable substances from source of ignition. Restrict the distribution of flammable materials to only min. necessary amount. Construct specifically designed fuel storage facilities. Keep chemicals in cool and dry place away from heat. Ensure adequate ventilation. Before welding operation, remove or shield the flammable material properly. Store flammable materials in stable racks, correctly labeled preferably with catchment trays. Wipe off the spills immediately
	Short circuiting of electrical system	Same as above Can cause Electrocution	Don't lay wires under carpets, mats or door ways Use one socket for one appliance. Use only fully insulated wires or cables. Do not allow open/bare connections. Provide all connections through 30mAELCB. Ensure earthing of machineries and equipments.
(H) VEHICULAR MOVEMENT	Crossing the Speed Limits (Rash driving)	Personal injury	Obey speed limits and traffic rules strictly. Always expect the unexpected and be a defensive driver. Use seat belts/helmets. Blow horn at intersections and during overtaking operations. Maintain the vehicle in good condition. Do not overtake on curves, bridges and slopes.
	Adverse weather condition	Same as Above	Read the road ahead and ride to the left. Keep the wind screen and lights clean. Do not turn at speed. Recognize the hazard, understand the defense and act correctly in time.

APPENDIX-E :(Sheet 8 of 12)

CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES (...Contd.)

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
	Consuming alcohol before and during the driving operation	Same as above	Alcohol and driving do not mix well. Either choose alcohol or driving. If you have a choice between hitting a fixed object or an on-coming vehicle, hit the fixed object Quit the steering at once and become a passenger. Otherwise take sufficient rest and then drive. Do not force the driver to drive fast and round the clock. Do not day dream while driving
	Falling objects/ Mechanical failure	May prove fatal	Ensure effective braking system, adequate visibility for the drives, reverse warning alarm. Proper maintenance of the vehicle as per manufacturer instructions
(I) PROOF TESTING (HYDROSTATIC/ PNEUMATIC TESTING)	Bursting of piping Collapse of tanks Tanks flying off	May cause injury and prove fatal	Prepare test procedure & obtain EIL/owner's approval. Provide separate gauge for pressurizing pump and piping/equipment. Check the calibration status of all pressure gauges, dead weight testers and temperature recorders. Take dial readings at suitable defined intervals and ensure most of them fall between 40-60% of the gauge scale range. Provide safety relief valve (set at pressure slightly higher than test pressure) while testing with air/ nitrogen. Ensure necessary precautions, stepwise increase in pressure, tightening of bolts/nuts, grouting, etc. before and during testing. Keep the vents open before opening any valve while draining out of water used for hydro-testing of tanks. Pneumatic testing involves the hazard of released energy stored in compressed gas. Specific care must therefore be taken to minimize the chance of brittle failure during a pneumatic leak test. Test temperature is important in this regard and must be considered when the designer chooses the material of construction.

APPENDIX-E :(Sheet 9 of 12)

CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES (...Contd.)

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			A pressure relief device shall be provided, having a set pressure not higher than the test pressure plus the lesser of 345 KPa (50 psi) or 10% of the test pressure. The gas used as test fluid, if not air, shall be nonflammable and nontoxic.
(J) WORKING AT HEIGHTS	Person can fall down	May sustain severe injuries or prove fatal	Provide guard rails/barricade at the work place Use PPE like full body harness, life line, helmets, safety shoes, etc. Obtain a permit before starting the work at height above 2 meters Fall arrest and safety nets, etc. must be installed Provide adequate working space(min. 0.6 m) Tie/weld working platform with fixed support Use roof top walk ladder while working on a slopping roofs Avoid movement on beams
		May hit the scrap/material stacked at the ground or in between	Keep the work place neat and clean Remove the scrap immediately
	Material can fall down	May hit the workers working at lower levels and prove fatal	Same as above plus Do not throw or drop materials or equipment from height. i.e. do not *bomb* materials All tools to be carried in a tool-kit Bag or on working uniform Remove scrap from the planks Ensure wearing of helmet by the workers working at lower levels. Multiple activities at same location to be avoided. .
(K) CONFINED SPACES	Suffocation/ drowning	Unconsciousness, death	Use respiratory devices, if reqd. Avoid overcrowding inside a confined space Provide Exhaust fans for ventilation Do not wear loose clothes, neck ties, etc. Fulfill conditions of the permit

APPENDIX-E:(Sheet 10 of 12)

CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES (...Contd.)

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			Check for presence of hydrocarbons, O_2 level Obtain work permit before entering a confined space Ensure that the connected piping of the equipment which is to be opened is pressure free, fluid has been drained, vents are open and piping is positively isolated by a blind flange
	Presence of foul smell and toxic substances	Inhalation can pose threat to life	Same as above plus Check for hydrocarbon and Aromatic compounds before entering a confined space Depute one person outside the confined space for continuous monitoring and for extending help in case of an emergency
	Ignition/ flame can cause fire	Person may sustain burn injuries or explosion may occur	Keep fire extinguishers at a hand distance Remove surplus material and scrap immediately Do not smoke inside a confined space Do not allow gas cylinders inside a confined space Use low voltage (24V) lamps for lighting Use tools with air motors or electric tools with max. voltage of 24V Remove all equipment's at the end of the day
(L) HANDLING AND LIFTING EQUIPMENTS	Failure of load lifting and moving equipment's	Can cause accident and prove fatal	Avoid standing under the lifted load and within the operating radius of cranes. Check periodically oil, brakes, gears, horns and tyre pressure of all moving machinery. Check quality, size and condition of all chain pulley blocks, slings, U-clamps, D-shackles, wire ropes, etc. Allow crane to move only on hard, firm and leveled ground. Allow lifting slings as short as possible and check gunny packings at the friction points. Do not allow crane to tilt its boom while moving Install Safe Load Indicator. Ensure certification by applicable authority.

APPENDIX-E :(Sheet 11 of 12)

CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES (...Contd.)

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
	Overloading of lifting equipments	Same as above	Safe lifting capacity of derricks and winches written on them shall be got verified The max. safe working load shall be marked on all lifting equipments Check the weight of columns and other heavy items painted on them and accordingly decide about the crane capacity, boom and angle of erection Allow only trained operators and riggers during crane operation.
	Overhead electrical wires	Can cause electrocution and fire	Do not allow boom or other parts of crane to come within 3m reach of overhead HT cables Hook and load being lifted shall preferably remain in full visibility of crane operators.
(M) SCAFFOLDING, FORMWORK AND LADDERS	Person can fall down	Person May sustain severe injuries and prove fatal	Provide guard rails for working at height. Face ladder while climbing and use both hands. Ladders shall extend about 1m above landing for easy access and tying up purpose. Do not place ladders against movable objects and maintain base at 1/4 unit of the working length of the ladder. Suspended scaffolds shall not be less than 500 mm wide and tied properly with ropes. No loose planks shall be allowed. Use PPE, like helmets, safety shoes etc.
	Failure of scaffolding material	Same as above	Inspect visually all scaffolding materials for stability and anchoring with permanent structures. Design scaffolding for max. load carrying capacity. Scaffolding planks shall not be less than 50X250 mm full thickness lumber or equivalent. These shall be cleated or secured and must extend over the end supports by at least 150mm and not more than 300mm. Don't overload the scaffolds. Do not splice short ladders to make a longer one. Vertical ladders shall not exceed 6m.
	Material can fall down	Persons working at lower level gets injured	Remove excess material and scrap immediately. Carry the tools in a tool-kit bag only. Provide safety nets.

APPENDIX-E:(Sheet 12 of 12)

CONSTRUCTION HAZARDS, THEIR EFFECTS &PREVENTIVE MEASURES (...Contd.)

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
(N) STRUC-TURAL WORKS	Personal negligence and danger of fall	Can cause injury or casualty	Do not take rest inside rooms built for welding machines or electrical distribution system. Avoid walking on beams at height. Wear helmet with chin strap and full body harness while working at height. Use hand gloves and goggles during grinding operations. Cover or mark the sharp and projected edges. Do not stand within the operating radius of cranes.
	Lifting/ slipping of material	Same as above	Do not stand under the lifted load. Stack properly all the materials. Avoid slippage during handling. Control longer pieces lifted up by cranes from both ends. Remove loose materials from height. Ensure tightening of all nuts & bolts.
(O)PIPELIN E WORKS	Erection/ lowering failure	Can cause injury	Do not stand under the lifted load. Do not allow any person to come within the radii of the side boom handling pipes. Check the load carrying capacity of the lifting tools & tackles. Use safe Load Indicators (SLI). Use appropriate PPEs.
	Other	Same as above	Wear gum boots in marshy areas. Allow only one person to perform signaling operations while lowering of pipes. Wedges to be provided below the pipe to prevent spool/pipe roll out. Provide night caps on pipes. Provide end covers on pipes for stoppage of pigs while testing/ cleaning operations.
(P) GRIT BLASTING	Pollution in neighboring area, hit by grit sand high pressure air	Can cause personal injury	Ensure the blasting is done in enclosed shed. Keep safe distance while blasting operations. Wear positive pressure blast hood or helmet with view-window, ear-muff/plug, gloves, overall or leather coat /apron, rubber shoes.

APPENDIX-F

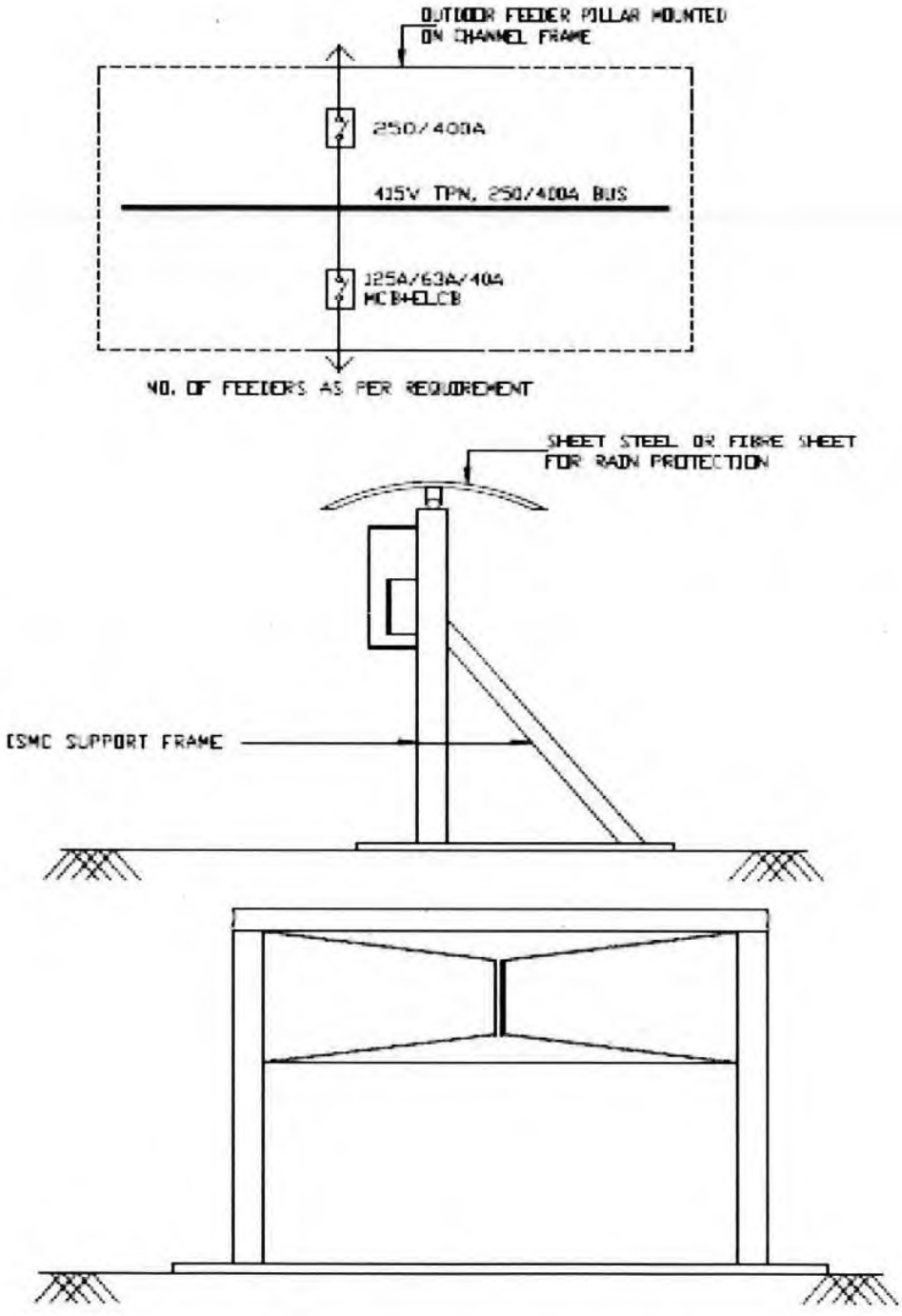
TRAINING SUBJECTS / TOPICS

(For contractors' personnel)

1. The Law & Safety – Statutory Requirement / Applicable statutes / Duties of employer / employee.
2. Policy & Administration – Why HSE? / Duties & Responsibilities of Safety Personnel at project site / Effect of incentive on accident prevention.
3. HSE & Supervision – Duties of Supervisor / HSE integrated supervision / Who should be held responsible for site accidents?
4. Safety Budget / Cost of Accidents – Direct costs / Indirect costs.
5. Hazard Identification / Type of hazards / HIRAC.
6. Behavioral Safety & Motivation.
7. Housekeeping – Storage / Stacking / Handling of materials / Hydraulic Mobile Crane handling.
8. Occupational Health in Construction sector.
9. Personal Protective Equipment's – Respiratory & Non- respiratory.
10. Electricity & Safety – ELCB / Fuse / Powered tools / Project illumination.
11. Handling of Compressed Gas – Transportation / Storage / FBAs / Fire prevention.
12. Machine Safety – Machine guarding / Maintenance.
13. Transportation – Hazards & risks in transp. of materials / ODC consignments.
14. Cranes & Other Lifting machinery – Legal requirements vis-à-vis essential safety requirements.
15. Communication – HSE Induction / TBTs / Safety Committee / Safety meeting / Safety propaganda / Publicity.
16. Excavation – Risks & Dangers / Safety measures.
17. Working at Heights – Use of ladder / Work on roofs / Scaffolds / Double harness lanyards / Life-line / Fall arrester / Safety Nets / Floor openings.
18. Hazards in Welding & important safety precautions.
19. Gas Cutting – Hazards & safety measures.
20. Fire prevention & fire protection.

APPENDIX - G

CONSTRUCTION POWER BOARD(typ)



NOTES:-

1. CONTRACTOR TO INSTALL TEMPORARY CONST. POWER BOARD AS SHOWN IN THE DRG. ITS LOCATION SHALL BE EASILY ACCESABALE.
2. POWER DISTRIBUTION BOARD SHALL BE EARTHED AT TWO POINTS BY MINIMUM 40X5MM GI STRIP FROM THE AVILABLE GRID OR DIRECTLY CONNECTED TO TWO DIRECTLY DRIVEN EARTH ELECTRODES.
3. DISTRIBUTION BOARD SHALL BE FABRICATED BY USING 14MM CRCA SHEET STEEL WITH HINGED DOORS AND ALL COMPONENT MOUNTED IN IT.
4. ALL INCOMING AND OUTGOING CABLES SHALL HAVE BOTTOM ENTRY.

APPENDIX-H

LIST OF PROCEDURES (MINIMUM) TO BE FORMING PART OF HSE PLAN:-

A. HSE Management Procedures:

- HSE Risk Management (including HIRA)
- HSE Legal Compliance and Other Requirements
- HSE Objectives & Performance
- HSE Training and Competence (including Induction)
- HSE Motivation &Award Scheme
- HSE Audits
- HSE Sub Contractor Management
- HSE Emergency Management
- HSE Incidents Reporting and Management
- HSE procedure for Behaviour based Safety
- First Aid & Management
- Roles, Responsibility, accountabilities and Authorities

B. Job procedures/Safe Operating procedures

- Setting Up Site &Signages
- Working at Height
- Confined Space Entry
- Permit to Work (including hot works)
- Housekeeping
- Transportation of materials including Manual Handling
- Earthmoving Operations & excavation
- Scaffolding
- Fire Prevention/Protection
- Hazardous Substance handling & Storage
- Personal Protective Equipment

APPENDIX-I

LIFE SAVING RULES

Obtain authorisation before overriding or disabling safety controls

- I understand & use safety-critical equipment and procedure which apply to my task
- I obtain authorization before:
  - disabling or overriding safety equipment
  - deviating from procedures
  - crossing a barrier

Obtain authorisation before entering a confined space

- I confirm energy sources are isolated
- I confirm the atmosphere has been tested and is monitored
- I check and use my breathing apparatus when required
- I confirm there is an attendant standing by
- I confirm rescue plan is in place
- I obtain authorization to enter

Follow safe driving rules

- I always wear a seatbelt
- I do not exceed the speed limit, and reduce my speed for road conditions
- I do not use phones or operate devices while driving
- I am fit, rested and fully alert while driving
- I follow journey management requirements

Verify isolation and zero energy before work begins

- I have identified all energy sources
- I confirm that hazardous energy sources have been isolated, locked and tagged
- I have checked there is zero energy and tested for residual or stored energy

Controls flammables and ignition sources

- I identify and control ignition sources
- Before starting any hot work:
  - I confirm flammable material has been removed or isolated
  - I obtain authorization
- Before starting hot work in a hazardous are I confirm:
  - a gas test has been completed
  - gas will be monitored continually

Keep yourself and others out of the line of fire

- I position myself to avoid:
  - moving objects
  - vehicles
  - pressure releases
  - dropped objects
- I establish and obey barriers and exclusion zones
- I take action to secure loose objects and report potentialdropped objects

Plan lifting operations and control the area

- I confirm that the equipment and load have been inspected and are fit for purpose
- I only operate equipment that I am qualified to use
- I establish and obey barriers and exclusion zones
- I never walk under a suspended load

Work with a valid permit when required

- I am authorised to perform the work
- I understand the permit
- I have confirmed that hazards are controlled and it is safe to start
- I stop and reassess if conditions change

Protect yourself against a fall when working at height

- I inspect my fall protection equipment before use
- I secure tools and work materials to prevent dropped objects
- I tie off 100% to approved anchor points while outside a protected area

Follow safe excavation procedure

- Before starting any excavation:
  - I confirm availability of underground utilities
  - I obtain authorization
  - I take adequate precautions to prevent collapse of soil

FORMAT NO. : HSE-1 REV 1

(Sheet 1 of 6)

SAFETY WALK-THROUGH REPORT

(Name & signature of walk through performer to be inserted at the bottom of each page)

Project : _____ Report no. : _____

Date : _____ Ccontractor : _____

Inspection by : _____ Owner : _____

Frequency : Monthly Job no. : _____

Note : Write 'NA' wherever the item is not applicable

SL. NO.	ITEM	Satisfactory/ Yes	Non satisfactory/ No	Remarks	Action
1.	HOUSEKEEPING				
a)	Waste containers provided and used				
b)	Sanitary facilities adequate and Clean				
c)	Passageways and Walkways Clear				
d)	General neatness of working areas				
e)	Other				
2.	PERSONNEL PROTECTIVE EQUIPMENT				
a)	Goggles; Shields				
b)	Face protection				
c)	Hearing protection				
d)	Foot protection				
e)	Hand protection				
f)	Respiratory Masks etc.				
g)	Full body harness conforming to CE, EN 361				
h)	Hard hat (HDPE)				
i)	Other				
3.	EXCAVATIONS/OPENINGS				
a)	Openings properly covered or barricaded				
b)	Excavations shored				
c)	Excavations barricaded				
d)	Overnight lighting provided				
e)	Other				

Safety walk-through performer (Name & Signature).....

FORMAT NO. : HSE-1 REV 1

(Sheet 2 of 6)

SL. NO.	ITEM	Satisfactory/ Yes	Non satisfactory/ No	Remarks	Action
4.	WELDING & GAS CUTTING				
a)	Gas cylinders chained upright				
b)	Cables and hoses not obstructing				
c)	Screens or shields used				
d)	Flammable materials protected				
e)	Live electrode bits contained properly				
f)	Fire extinguisher (s) accessible				
g)	Other				
5.	SCAFFOLDING & BARRICADING				
a)	Fully decked platforms				
b)	Guard and intermediate rails in place				
c)	Toe boards in place				
d)	Adequate shoring				
e)	Adequate access				
f)	Positive barricading for critical activities				
g)	Installation of warning signs				
h)	Other				
6.	LADDERS				
a)	Extension side rails 1 m above				
b)	Top of landing				
c)	Properly secured				
d)	Angle + 70^0 from horizontal				
e)	Other				

Safety walk-through performer (Name &Signature).....

FORMAT NO. : HSE-1 REV 1

(Sheet 3 of 6)

SL. NO.	ITEM	Satisfactory/ Yes	Non satisfactory/ No	Remarks	Action
7.	HOISTS, CRANES AND DERRICKS				
a)	Condition of cables and sheaves OK				
b)	Condition of slings, chains, hooks and eyes O.K.				
c)	Inspection and maintenance log-books maintained				
d)	Outriggers used				
e)	Reverse horn installed / active / coupled with gear				
f)	Signs/barricades provided				
g)	Signals observed and understood				
h)	Qualified operators				
i)	Other				
8.	MACHINERY, TOOLS AND EQUIPMENT				
a)	Proper instruction				
b)	Safety devices				
c)	Proper cords				
d)	Inspection and maintenance				
e)	Other				
9.	VEHICLE AND TRAFFIC				
a)	Rules and regulations observed				
b)	Inspection and maintenance				
c)	Licensed drivers				
d)	Other				

Safety walk-through performer (Name &Signature).....

FORMAT NO. : HSE-1 REV 1

(Sheet 4 of 6)

SL. NO.	ITEM	Satisfactory/ Yes	Non satisfactory/ No	Remarks	Action
10.	TEMPORARY FACILITIES				
a)	Emergency instructions posted				
b)	Fire extinguishers provided				
c)	Fire-aid equipment available				
d)	Secured against storm damage				
e)	General neatness				
f)	In accordance with electrical requirements				
g)	Other				
11.	FIRE PREVENTION				
a)	Personnel trained& instructed to make use of facility				
b)	Fire extinguishers checked periodically & record maintained				
c)	No smoking in Prohibited areas.				
d)	Fire Hydrants not obstructed				
e)	Regular fire drill conducted				
12.	ELECTRICAL				
a)	Use of 3-core armored cables everywhere				
b)	Usage of 'All insulated' or 'double-insulated' electrical tools				
c)	All electrical connection are routed through ELCB				
d)	Natural Earthing at the source of power (Main DB)				
e)	Continuity and tightness of earth conductor				
f)	Effective covering of junction boxes, panels and other energized wiring places				
g)	Ground fault circuit interrupters provided				
h)	Prevention of tripping hazards maintained				
f)	DCP extinguishers arranged & licensed electrician engaged at site				

Safety walk-through performer (Name &Signature).....

FORMAT NO. : HSE-1 REV 1

(Sheet 5 of 6)

SL. NO.	ITEM	Satisfactory/ Yes	Non satisfactory/ No	Remarks	Action
13.	HANDLING AND STORAGE OF MATERIALS				
a)	Safely stored or stacked				
b)	Passageways clear / free from obstructions				
c)	Fire fighting facility in place				
14.	FLAMMABLE GASES AND LIQUIDS				
a)	Containers clearly identified / protected from fire				
b)	Safe storage & transportation arrangement made				
c)	Fire extinguishers positioned nearby				
d)	Facilities kept away from electric spark, hot spatters & ignition source.				
15.	WORKING AT HEIGHT				
a)	Approved Erection plan and work permit in place				
b)	Safe access, Safe work platform & Safety nets provided				
c)	Life lines, Fall arrester, Full body harness with double lanyards used;				
d)	Health Check record available for workers going up?				
e)	Protective handrails arranged around floor openings				
16.	CONFINED SPACE				
a)	Work Permit obtained from requisite authority				
b)	Test for toxic gas and sufficient availability of oxygen conducted & status				
c)	Supervisor present at site & at least one person outside the confined space for monitoring deputed				
d)	Availability of safe means of entry, exit and ventilation (register for entry & exit maintained)				
e)	Fire extinguisher and first-aid facility ensured				
f)	Lighting provision made by using 24V Lamp				
g)	Proper usage of PPEs ensured				
17.	RADIOGRAPHY				
a)	Proper storage and handling of source as per BARC/ AERB guidelines (authorized radiographer available)				
b)	Work permit obtained				

Safety walk-through performer (Name &Signature).....

FORMAT NO. : HSE-1 REV 1

(Sheet 6 of 6)

SL. NO.	ITEM	Satisfactory/ Yes	Non satisfactory/ No	Remarks	Action
c)	Cordoning of the area done				
d)	Use of appropriate PPE's ensured				
e)	HSE training to workers/supervisors imparted during the fortnight (indicate topic)				
f)	Minimum occupancy of workplace ensured				
18.	HEALTH CHECKS				
a)	All Workers medically examined and found be fit for working at heights (slinging, rigging, painting etc.) in confined space in excavation / trenching in shot blasting				
b)	Availability of First Aid box with contents				
c)	Proper sanitation at site, office and labour camps				
d)	Arrangement of medical facilities.				
e)	Measures for dealing with illness at site & labour camps.				
f)	Availability of Potable drinking water for workmen & staff.				
g)	Provision of crèches for children.				
h)	Stand by vehicle / ambulance available for evacuation of injured				
i)	Adherence to Govt. Guidelines/procedures during epidemic and pandemic (as applicable).				
19.	ENVIRONMENT				
a)	Chemical and Other Effluents properly disposed				
b)	Cleaning liquid of pipes disposed off properly				
c)	Seawater used for hydro-testing disposed off as per agreed procedure				
d)	Lubricant Waste/Engine oils properly disposed				
e)	Waste from Canteen, offices, sanitation etc. disposed properly				
f)	Disposal of surplus earth, stripping materials, Oily rags and combustible materials done properly				
g)	Green belt protection				

Safety walk-through performer (Name &Signature).....

FORMAT NO. : HSE-2 REV 0

(Sheet 1 of 3)

ACCIDENT REPORT

(To be submitted by Contractor after every Accident within 24 hours to EIL/ Owner)

Report No.: _____ **Date:** _____

Project site: _____ **Name of work:** _____

Contractor's name: _____ Contractor's Job Engineer (name) _____

Non-disabling injury (Non-LTI)	Hospitalized but resumed duty before end of 48 hrsof accident	
Disabling injury (other LTI)	Hospitalized & failed to resume duty within next 48 hrs	
Fatal (LTI):	Death / Expiry	
First Aid case	Resume duty after first aid	

Name of the injured:_____ Father's name of victim: _____

Sub Contractor's Name: .....

Gate Pass No.:.....Age: _____Yrs. Victim's medical fitness exam. (Pre-empl.) date: - _____

Date & time of Accident / Incident: _____

Names of Witnesses: (1_____ (2)_____ (3) _____

Profession of victim:

Bar bender		Carpenter		Meson	
Fitter		Helper		Gas cutter	
Grinder		Welder		Electrician	
Driver		Rigger		M/c.operator	
Engineer		Manager		Other/specify	

Qualification

No formal education		Non-Matriculate		Matriculate	
Graduate		Post- grad		Other/specify	

Job Experience

NIL		Less than 2 yrs		2-5 yrs	
5-10 yrs		11-15 yrs		15 years and above	

Location where the incident happened: _____

_____

FORMAT NO. : HSE-2 REV 0

(Sheet 2 of 3)

Activity / Works that were continuing during incident / accident: -

Excavation		Demolition		Concrete carrying	
Concrete pouring		Transportation of materials (manually)		Transportation of materials (mechanically)	
Work on or adjacent to water		Work at height (+2.0 mts)		Scaffold preparation	
Scaffold dismantling		Piling works		Welding	
Grinding		Gas-cutting		Pipe fit-ups & fabrication	
Structural fabrications		Machine works		Hydro-testing works	
Electrical works		Erection activities		Other/specify	

What exactly the victim was doing just before the incident / accident? .....

.....

.....

Nature of injury:

Bruise or Contusion		Abrasion (superficial wound)		Sprains or strains	
Cut or Laceration		Puncture or Open wound		Burn	
Inhalation of toxic or Poisonous fumes or gases		Absorption		Amputation	
Fracture		Other/specify			

Parts of body involved in incident / accident

Head		Face		Eyes	
Throat		Arm (above wrist)		Hand (including wrist)	
Fingers		Truck (Abdomen / Back / Chest / Shoulder)		Throat	
Leg (above ankle)		Foot (incl. ankle)		Toes	
Multiple				Other/specify	

Accident type:

Struck against		Struck by		Fall from Elevation	
Fall on same level		caught in		caught under	
caught in between		Rubbed or abraded		Contact with (Electricity)	
Contact with (Temp./ extremes)		Contact with chemicals oroils		Vehicle accident	
Other/specify					

FORMAT NO. : HSE-2 REV 0

(Sheet 3 of 3)

Medical Aid provided:-(indicate specific aids / treatment etc.)-

.....

.....

Actions taken to prevent recurrence of similar incident / accident:.....

.....

.....

.....

.....

.....

.....

Intimation to local authorities (Dist. Collector / Local Police Station / ESI authority): Yes / No / NA.

If yes, to whom .....

Safety Officer
(Signature and Name)
Stamp of Contractor

Site Head / Resident Construction Manager
(Signature and Name)

To : Owner
: RCM/Site-in-charge EIL (3 copies)
- Nodal Officer HO through RCM (In case of major accident)
- Divisional Head (Constn) through RCM
- Project Manager, EIL, through RCM

FORMAT NO. : HSE-3 REV 0

(Sheet 1 of 5)

SUPPLEMENTARY ACCIDENT INVESTIGATION REPORT

TICK THE APPROPRIATE ONEAS APPLICABLE (furnish within 72 hours)

Supplementary to Incident / Accident Report No: _____ (Copy enclosed)

Report No.: _____ **Date**: _____

Project site: _____ **Name of work:** _____

Contractor's name: _____ Contractor's Job Engineer (name) _____

Non-disabling injury (Non-LTI **)**	Hospitalized but resumed duty before end of 48 hrs of accident.	
Disabling injury (other LTI)	Hospitalized & failed to resume duty within next 48 hrs.	
Fatal (LTI)	Death / Expiry	
First Aid case	Resume duty after first aid	

Name of the injured: _____ Father's name of victim: _____

Sub Contractor's Name: .....

Gate Pass No.:..... Age: _____Yrs. Victim's medical fitness exam. (Pre-empl.) date: - _____

Date & time of Accident / Incident: _____

Names of Witnesses: (1_____ (2)_____ (3) _____

Profession of victim:

Bar bender		Carpenter		Meson	
Fitter		Helper		Gas cutter	
Grinder		Welder		Electrician	
Driver		Rigger		M/c. operator	
Engineer		Manager		Other/specify	

Qualification

No formal education		Non-Matriculate		Matriculate	
Graduate		Post- grad		Other/specify	

Job Experience

NIL		Less than 2 yrs.		2-5 yrs.	
5-10 yrs.		11-15 yrs.		15 years and above	

Location where the incident happened: _____

_____

FORMAT NO. : HSE-3 REV 0

(Sheet 2 of 5)

Activity / Works that were continuing during incident / accident: -

Excavation		Demolition		Concrete carrying	
Concrete pouring		Transportation of materials (manually)		Transportation of materials (mechanically)	
Work on or adjacent to water		Work at height (+2.0 mts)		Scaffold preparation	
Scaffold dismantling		Piling works		Welding	
Grinding		Gas-cutting		Pipe fit-ups & fabrication	
Structural fabrications		Machine works		Hydro-testing works	
Electrical works		Erection activities		Other/specify	

What exactly the victim was doing just before the incident / accident? .....

.....

.....

Particular of tools & tackles being used and condition of the same after incident/accident:

.....

.....

Description of Incident/Accident (How the incident was caused) : .....

.....

.....

.....

Nature of injury:

Bruise or Contusion		Abrasion (superficial wound)		Sprains or strains	
Cut or Laceration		Puncture or Open wound		Burn	
Inhalation of toxic or Poisonous fumes or gases		Absorption		Amputation	
Fracture		Other/specify			

Parts of body involved in incident / accident

Head		Face		Eyes	
Throat		Arm (above wrist)		Hand (including wrist)	
Fingers		Truck (Abdomen / Back / Chest / Shoulder)		Throat	
Leg (above ankle)		Foot (incl. ankle)		Toes	
Multiple				Other/specify	

FORMAT NO. : HSE-3 REV 0

(Sheet 3 of 5)

Accident type:

Struck against		Struck by		Fall from Elevation	
Fall on same level		caught in		caught under	
caught in between		Rubbed or abraded		Contact with (Electricity)	
Contact with (Temp./ extremes)		Contact with chemicals or oils		Vehicle accident	
Other/specify					

Name & Designation of person who provided First-Aid to the victim: _____

Name & Telephone number of Hospital where the victim was treated _____

Mode of transport used for transporting victim – Ambulance / Private car / Tempo / Truck / Others

How much time taken to shift the injured person to Hospital_____

In case of FATAL incident, indicate clearly the BOCW Registration No. of the victim/Company.....
...

Comments of Medical Practitioner, who treated / attended the victim/injured (attached / described here)_____

What actions are taken for investigation of the incident, please indicate clearly – (Video film / Photography / Measurements taken etc. .....)

Immediate cause (Please tick the right applicable) –

Hazardous methods or procedures inadequately guarded		Poor housekeeping		Inadequate or improper PPE	
Environmental hazards (excess noise/ space constraint/ inadequate ventilation		improper illumination/Moving on oval surface		Working on dangerous equipment	

FORMAT NO.: HSE-3 REV 0

(Sheet 4 of 5)

Failure to secure		Horse-play		Failure to use PPE	
Inattention to surroundings		Improper use of hands & body-parts		By-passing safety devices	
Unsafe mixing or placement of tools & tackles		Bypassing standard procedures		Failure in communication	
Operating without authority		Improper use of equipment or tools & tackles		drug or alcoholic influence	
excessive haste		Others(specify)			

Basic cause

Over confidence		Impulsiveness		over-exertion	
Faulty judgement or poor understanding		Failing to keep attention constantly		Nervousness & Fear	
Fatigue		Defective vision		Ill health or sickness	
Slow reaction		Others(specify)			

Root cause

Inadequate Engg.		Improper Design		Inadequate Planning & organization	
Inadequate knowledge		Inadequate skill		Inadequate training	
Inadequate supervision		Improper work procedure		Inadequate compliance with standard	
Substandard performance		Inadequate maintenance		Improper inspection	
Others(specify)					

Loss of man days and impact on site works, (if any) –

_____

Remarks from Contractor's Safety Officer/ Engineer –

Was the victim performing relevant tasks for which he was engaged /employed? Yes / No
Was the Supervisor present on work-site during the incident? Yes / No
Have the causes of incident rightly identified? Yes / No
Cause of Accident was _____

FORMAT NO. : HSE-3 REV 0

(Sheet 5 of 5)

Remedial measures recommended by **Safety Officer of Contractor** for avoiding similar incident in future

: .....

.....

.....

.....

.....

.....

.....

Intimation to local authorities (Dist. Collector / Local Police Station / ESI authority): Yes / No / NA.

If yes, to whom .....

Safety Officer
(Signature and Name)

Site Head / Resident Construction Manager
(Signature and Name)
Stamp of Contractor

To : Owner
: RCM/ Site-in-charge of EIL (3 copies)
Nodal Officer HO through RCM (In case of major accident)
Divisional Head (Constn.) through RCM
Project Manager EIL, through RCM

FORMAT NO. : HSE-4 REV 0

NEAR MISS INCIDENT/ DANGEROUS OCCURRENCE REPORTPROFORMA

(to be submitted within 24 hours)

Report No.: _____

Name of Site: _____ Date: _____

Name of work: _____ Contractor: _____

Incident reported by :

Date & Time of Incident :

Location :

Brief description of incident

Probable cause of incident

Suggested corrective action

Steps taken to avoid recurrence Yes ☐ No ☐

Safety Officer
(Signature and Name)

Site Head / Resident Construction Manager
(Signature and Name)

Stamp of Contractor

Note:

- **Near Miss:** Human injury escaped & no damage to property, equipmentor interruption to work.
- **Dangerous Occurrence**: Occurrences as mentioned below shall be considered as "Dangerous occurrences"

a. collapse or failure of lifting appliances or hoist or conveyors or other similar equipment for handling building or construction material or breakage or failure of rope, chain or loose gears; overturning of cranes used in building or other construction work; falling of objects from height;
b. collapse or subsidence of soil, any wall, floor, gallery, roof or any other part of any structure, platform, staging, scaffolding or any means of access including formwork;
c. collapse of transmission tower;
d. fire and explosion causing damage to property at Construction site.
e. spillage or leakage of hazardous substances and damage to their container;
f. Collapse, capsizing, toppling or collision of transport equipment;
g. Leakage or release of harmful toxic gases at the construction site.

To :Owner
:RCM/Site-in-charge EIL (3 copies)

Divisional Head (Const.) through RCM
Project Manager EIL, through RCM
} (Applicable for Dangerous Occurrence only)

FORMAT NO. : HSE-5 REV 0

MONTHLY HEALTH, SAFETY &ENVIRONMENTAL (HSE) REPORT

(To be submitted by each Contractor)

Actual work start Date: _____ For the Month of: _____

Project: _____ Report No: _____

Name of the Contractor: _____ Status as on: _____

Name of Work: _____ Job No : _____

(Contractor in consultation with EIL shall generate the reports through web basedpackage (www3.eil.co.in/eilhse)only.

ITEM		UPTO PREVIOUS MONTH	THIS MONTH	CUMULATIVE
1) Average number of Staff & Workmen (average daily headcount, not man days)				
2)Total Man-hours worked				
3) Number of site personnel undergone HSE Induction				
4) Number of HSE meetings organized at site				
5) Number of HSE awareness programmes conducted at site				
6) Number of Tool Box Talks conducted				
7) Number of Loss Time Injuries (LTI)	Fatalities			
	Other LTI			
8) Number of Non disabling injury (Non-LTI)				
9) Number of First Aid Cases				
10) Number of Near Miss Incidents				
11) Number of Dangerous Occurrences				
12) No. of unsafe acts/ practices detected				
13) No. of disciplinary actions taken against staff/ workmen				
14) Man-days lost due to injury				
15) LTI Free man-hours i.e. LTI free man-hours counted from the Last LTI (enter date: .....)				
16) Frequency Rate (No. of reportable LTI per 10lacs man-hours worked)				
17) Severity Rate (No. of man days lost due to LTI per 10lacs man-hours worked)				
18) No. of activities for which HIRAC Completed				
19) No. of incentives/ awards given				
20) No. of occasions on which penalty imposed by EIL/ Owner				
21) No. of Audits conducted				
22) No. of pending NCs in above Audits				
23) Compensation cases raised with Insurance				
24) Compensation cases resolved and paid to workmen				
25) No of Vehicular Accident cases				
26) No of fire/Explosion cases				

27) Whether workmen compensation policy taken			Yes		No
28) Whether workmen compensation policy is valid			Yes		No
29) Whether workmen registered under ESI Act, as applicable			Yes		No
30) Whether HIRAC Register prepared and updated			Yes		No
31)Whether Environment Aspect Impact Register prepared and updated			Yes		No
32) Whether Legal Register prepared and updated			Yes		No
Remarks, if any					

Date:

Prepared by Safety Officer Approved by Site Head / Resident Construction Manager

(Signature and Name)(Signature and Name)

To: -

- RCM EIL

FORMAT NO. : HSE-6 REV 1

PERMIT FOR WORKING AT HEIGHTS (ABOVE 2.0 METER)

(In duplicate to be issued daily for site and for office)

Permit No..... Name of Main Contractor.....
Name of work executing agency / sub agency / vendor:.....
Date..... Exact Location of work.....
Nature of work .....Duration of work (from) ..... (to) .....
Number of workers covered within this permit.....
(*List enclosed with name & gate pass numbers.*)

Sl. No.	Items / Subjects	Status of compliance (Yes / No)	
1	Work areas / Equipment's inspected		
2	Work area cordoned off		
3	Adequate lighting is provided		
4	Precautions against public traffic taken		
5	Concerned persons in & around have been alerted & cautioned		
6	Hazards / risks involved in routine / non-routine task assessed and control measures have been implemented at specific task		
7	ELCB provided for electrical connection & found working		
8	Ladder safely attached / fixed		
9	Scaffoldings are checked and TAGs are found used correctly		
10	Working platforms are provided and are found sound /safe for use		
11	Safe access & egress arrangements (e.g. ladders, fall arresters, life-lines etc.) are satisfactorily incorporated		
12	a. Openings on platform / floors are effectively cordoned / covered		
	b. Safety Nets are provided wherever required		
13	Use of following safety gadgets by people working at area under this permit, is checked and found satisfactory - Safety helmet Safety harness (full body) with double lanyard Safety Shoes Safety gloves Safety goggles		
14	Housekeeping of work area found satisfactorily tidy / clean & clear		
15	Adequate measures have been taken for works being continued at the ground level, when simultaneous works are permitted overhead at that very location.		
16	Materials are not thrown from heights on to ground		
17	Medical examination of workers are made & found satisfactory		
18	Responsible job engineer / supervisor found physically present at work spot for overall administration of work as well as safety of people.		

Above items have been checked & compliance has been found in place. Hence work is permitted to start / continue at the above-mentioned location. Work shall not start till identified lapses are rectified.

Additional Precautions, if any .....
.....

Work Permit Receiver Verification By Work Permit issuer
Contractor Job Supervisor Contractor Safety Officer Contractor Engineer/RCM

AT THE END OF THE DAY/WORK:
All works at height are completed & workmen have returned safely from work location at (time)..... (date).....

(Sig. Contractor Engineer)

FORMAT NO. : HSE-7 REV 1

CONFINED SPACE ENTRY PERMIT

Project site _____ Sr. No. _____

Name of the work _____ Date _____

Name of Contractor _____ Nature of work _____

Exact location of work _____

Safety Requirements POSITIVE ISOLATION OF THE VESSEL IS MANDATORY

(A) Has the equipment been ?

Y	NR		Y	NR		Y	NR	
☐	☐	Isolated from power/steam/air	☐	☐	water flushed &/or steamed	☐	☐	radiation sources removed
☐	☐	isolated from liquid or gases	☐	☐	Man ways open & ventilated	☐	☐	proper lighting provided
☐	☐	depressurized &/or drained	☐	☐	cont. inert gas flow arranged	☐	☐	
☐	☐	blanked/ blinded/ disconnected	☐	☐	adequately cooled	☐	☐	

(B) Expected Residual Hazards

☐	☐	lack of O_2	☐	☐	combustible gas/ liquid	☐	☐	H_2S / toxic gases
☐	☐	corrosive chemicals	☐	☐	pyrophoric iron / scales	☐	☐	electricity / static
☐	☐	heat/ steam / frost	☐	☐	high humidity	☐	☐	ionizing radiation
☐	☐		☐	☐		☐	☐	

(C) Protection Measures

☐	☐	gloves	☐	☐	ear plug / muff	☐	☐	goggles / face shield
☐	☐	protective clothing	☐	☐	dust / gas / air line mask	☐	☐	personal gas alarm
☐	☐	grounded air duct/blower /AC	☐	☐	attendant with SCBA/air mask	☐	☐	rescue equipment/team
☐	☐	Fire fighting arrangements	☐	☐	safety harness & lifeline	☐	☐	communication equipment
☐	☐		☐	☐		☐	☐	

Authorization / Renewal (It is safe to enter the confined space)

	No. of persons allowed	Name of persons allowed	Signature			Time		Signature
			Work Permit Receiver(Contractor Supervisor)	Verification by Contractor Safety officer	Work permit issuer Contractor Engineer/RCM	From	To	Workman

Permit Closure :

(A) Entry ☐ was closed ☐ stopped ☐ will continue on ...

(B)☐ Site left in a safe condition ☐ Housekeeping done

(C) Multi lock☐ removed ☐ key transferred

☐ Ensured all men have come out ☐ Man-ways barricaded

Remarks, if any:

FORMAT NO. : HSE-8 REV 0

RADIATION WORK PERMIT

Project :
Name of the work :
Name of site contractor :

Sr. No. :
Date :
Job No. :

Location of work :

Source strength :

Cordoned distance (m) :

Name of Radiography agency :

Approved by Owner/EIL ☐

No. of workers engaged :
(List enclosed with name & gate pass numbers.)

The following items have been checked &compliance shall be ensured during currency of the permit:

S. No.	Item description	Done
	Safety regulations as per BARC/AERB ensured while source in use/in transit & during storage	
	Area cordoned off / safe working platform provided	
	Lighting arrangements for working during nights ensured	
	Warning signs/ flash lights installed	
	Cold work permit taken (if applicable)	
	PPEs like film badges, dosimeters used	

Additional precautions, if any _____

(Radiography Agency's BARC/AERB authorized Supervisor)

Permission is granted.

Permit is valid from _____ AM/PM _____ Date to _____ AM/PM _____ Date

(Signature of permit issuing authority-RCM of contractor)
Name : Designation: Date:

Permit renewal:

Permit extended up to		Additional precautions required, if any	Sign of issuing authority with date (of site contractor)	
Date	Time			

Work completed/ stopped/ area cleared at _____ Hrs of Date _____
(Sign. of permit issuing authority)
Name& Signature of site contractor:

FORMAT NO. : HSE-9 REV 1

DEMOLISHING/DISMANTLING WORK PERMIT

Project : Sr.No. :
Name of the work : Date :
Name of contractor : Job No. :

Name of sub-contractor : No. of workers to be engaged:
(*List enclosed with name & gate pass numbers.*)

Line No./ Equipment No./ Structure to be dismantled :

Location details of dismantling/ demolition with sketch : (clearly indicate the area)

The following items have been checked &compliance shall be ensured during currency of the permit:

S. No.	Item description	Done	Not Applicable
	Services like power, gas supply, water, etc. disconnected	☐	☐
	Dismantling/ Demolishing method reviewed & approved	☐	☐
	Usage of appropriate PPEs ensured	☐	☐
	Precautions taken for neighboring structures	☐	☐
	First-Aid arrangements made	☐	☐
	Fire fighting arrangements ensured	☐	☐
	Precautions taken for blasting	☐	☐

Work Permit Receiver
(Contractor's Supervisor/Engineer)

Verification by Contractor
(Contractor's Safety Officer)

Permission is granted.

(Work Permit issuer-Client)

Name :
Date :

Completion report:

Dismantling/ Demolishing is completed on _____ Date at _____ Hrs.

Materials/ debris transported to identified location ☐ Tagging completed (as applicable) ☐

Services like power, gas supply, water, etc. restored ☐

(Permit issuing authority-Client)

CONTRACTOR's NAME

FORMAT NO. : HSE-10 REV 0

DAILY SAFETY CHECKLIST

(To make use of before start of day's work)

Project :
Name of the work :
Name of contractor :

Sr.No. :
Date :
Job No. :

Description of Job decided to perform : -

- **Use of PPE / Safety Gadgets**

Sl. No	PPEs	Compliance (Yes / No)	Sl. No	PPEs	Compliance (Yes / No)
1	Safety Helmets		6	Face Shield	
2	Safety Shoes		7	Full body harness	
3	Hand Gloves		8	Fall Arrest System	
4	Dust Musk		9	Safety net	
5	Safety Goggles		10	Horizontal life-line made of steel wire, (dia not less than 8.0 mm.)	

(Serial No. 1 & 2 are compulsory for everyone. Specify & ensure use of other safety gadgets as required for the job)

- **Identify following important unsafe conditions: -**

Sl. No	Conditions	Yes / No
1	Access to work site / emergency escape clear	
2	Soil / Loose earth kept away from excavated pit / slope / ladder provided	
3	Electrical wire / welding lead lying entangled on ground / welding m/c. booth accessible	
4	Elevated work platform / open ends are protected	
5	Ground area cordoned off before lifting works or erection at height / ground area checked & cordoned-off before start of height works	
6	Structural members / erected pipes / wooden boards/pieces etc. are safely anchored at heights and are not likely to fall down on people when working beneath	
7	Ladders tied-up on tall steel structures, long before are removed to get rid of their use	
8	Any Other	

- **Indicate actions taken, if status of any of the above items is found "No"**
  .....
  .....

- **Specific Safety guidelines / precautions, if any** (communicated thro' TBT)
  .....
  .....

- **Above conditions and PPE compliances are checked by undersigned and correct status are indicated after verification**

Prepared by
Contractor Site Engineer

Verification By
Contractor Safety Officer

FORMAT NO. : HSE-11 REV 0

(Sheet 1 of 2)

HOUSEKEEPING ASSESSMENT& COMPLIANCE

Project :
Name of the work :
Name of contractor :
Name of contractor : Fortnightly

Sr.No. :
Date :
Job No. :

Sl. No.	Subjects of Review	Satisfactory/ Yes	Non satisfactory/No	Remarks	Action
1.	Cleanliness at the Main entry / access of site				
2.	Ground condition / floor areas free from water-logging / oil spillage				
3.	Ground & elevated floors free from rubbish / wastes / accumulated debris / scraps.				
4.	Manholes / openings are covered / fenced				
5.	Trenches are barricaded / walkways are in place				
6.	Drains are cleaned / not choked / not occupied by dumped materials				
7.	Sufficient CAUTION boards / instructions displayed				
8.	Construction machinery are maintained & parked in orderly manner.				
9.	Movement of site people are not obstructed because of dumping / storing of construction materials				
10.	Access / egress to Electrical Distribution Boards / Panels clear from wires / cables / earth-strips etc.				
11.	Electrical panel rooms / sheds / MCC / Control rooms / Substations etc. are clean & tidy and not used for storing dress / clothes, tiffin-box or bicycles.				
12.	Passage behind Elec. panels are free for access				
13.	Fire extinguishers / fire-buckets are accessible without any difficulty.				
14.	Stair-steps, platforms & landings are clear & tidy				
15.	Sheds / rooms & work areas have got sufficient illumination as well as ventilation				
16.	Cables / Wires / welding leads are routed / hanged appropriately & are not creating unsafe condition.				
17.	Stacking / storing of insulation materials or their packing.				
18.	Removal or cleanliness of left-over sand, concrete, brick-bats, insulation-materials, excess earth, wastes etc.				
19.	Storing / stacking of sand, metal chips, re-bars, steel pipes, valves, fittings etc.				
20.	One escape route at ground & minimum two escape routes at elevation available,				

FORMAT NO. : HSE-11 REV 0

(Sheet 2 of 2)

Sl. No.	Subjects of Review	Satisfactory/ Yes	Non satisfactory/No	Remarks	Action
21.	Captions / Posters / Slogans on various safety instructions are displayed legibly in local language				
22.	Cable trenches are water-free or regular arrangement for taking out accumulated water exists.				
23.	Windows of rooms / offices are regularly cleaned				
24.	Facilities for cycle sheds, drinking water, washing, rest-rooms etc. are maintained in tidy manner.				
25.	Toilet, Urinals, Canteen / kitchen / pantry etc. are maintained & free from obnoxious smell.				
26.	Construction tools / tackles are stored systematically - the items are tagged / tested / certified by competent third party.				
27.	Sufficient numbers of Dust-bins / Waste-bins found at site and are regularly emptied.				

Additional remarks, if any -

.....

.....

.....

Inspected by
Contractor Engineer

Verification By
Contractor Safety Officer

FORMAT NO. : HSE-12 REV 0

INSPECTION OF TEMPORARY ELECTRICAL BOOTH / INSTALLATION

Project :
Name of the work :
Name of contractor :
Sub Station No:/Booth No

Sr.No. :
Date :
Job No. :
Location:

SL NO	SUBJECTS	OBSERVATION (YES /NO)	ACTION TAKEN
1	Switchboards installed properly are in order and protected from rain & water-logging.		
2	Adequate illumination provided for switchboard operation during night hours & the lamps are protected from direct human contact.		
3	Voltage ratings. DANGER signs. Shock-Treatment-Chart displayed in the installation / booth		
4	Fire extinguisher (DCP or CO_2) & Sand Bucket kept in close vicinity of Switchboards		
5	Valid License & Competent Electrician / Wireman available & name/ license no. displayed at booth / installation.		
6	General housekeeping in & around booth / installation found in order.		
7	Cable-route-markers for U/G cables provided.		
8	Monthly inspection report of Electrical hand tools available in booth / installation.		
9	Electrical Panel door to be in closed condition and Insulated Mat to be provided in front of panel.		
10	Rubber hand gloves available/ used by Electricians		
11	Availability of CAUTION boards for shutdown & / or repairing works.		
12	All incoming & outgoing feeders have proper MCCB / HRC fuses / Switches.		
13	Switchboards "earthed" at two distinctly isolated locations.		
14	Switchboards have adequate operating space at the front face & at the rear face too.		
15	All connections provided through 30mA ELCB.		
16	Testing records of all ELCBs available at site		
17	Only industrial type plugs & sockets are used.		
18	Temporary connections are 3-core double insulated & free from cuts & joints and 3rd core is earthed at both ends		
19	Socket boards are properly mounted on stand & protected from water ingress.		
20	Electrical equipments operating above 250V have two earthing / double earthing.		
21	All incoming / outgoing cables are properly glanded& terminated with "lugs".		
22	Switch-boards are of industrial variety / type.		
23	Sketch for installation / connection (SLD) made & pasted& other safety labels/display boards		
24	Labeling of incoming / outgoing feeders made.		
25	All hand lamps are protected from direct contact.		
26	All electrical cable / joints are in safe condition		

Inspected by
Contractor Engineer

Verification By
Contractor Safety Officer

FORMAT NO. : HSE-13 REV 0

(Sheet 1 of 2)

INSPECTION FOR SCAFFOLDING

Project : Sr.No. :
Name of the work : Date :
Name of contractor : Job No. :

Sl. No	Description	Yes	No	N.A.	Actions taken
1	Whether work permit is obtained to take up work at height above 1.5 Mts?				
2	Whether atmospheric condition is "stormy" or "raining" and works at heights have been permitted?				
3	Whether steel pipes scaffoldings are used for units /off-site areas?				
4	Whether scaffolding has been erected on rigid/firm/leveled surfaces / ground? Whether "foot-seals" or "base-plates" are used beneath the up-rights (vertical steel pipes)				
5	Whether scaffold construction is as per IS specification with toe-board and hand-rails (top-rail as well as mid-rail)?				
6	Whether distance between two successive up-rights are less than 2.5 Mts (height of scaffold & load carrying capacity governs the distance between two uprights)				
7	Whether all uprights are extended at least 900 mm above the top most working platform (to enable fitting of handrails)?				
8	Whether vertical distance of two successive ledgers is satisfactory? *(varying between 1.3 Mts. To 2.1 Mts)*				
9	Whether the peripheral areas of working at height are cordoned-off? (for avoiding accident to people arising out of dropped / deflected materials)				
10	Whether platform is provided? Is it safely approachable?				
11	Whether end of scaffold platform / board are extended beyond transoms? (125mm to 150 mm)				
12	Whether CE / IS approved quality and worthy conditioned full-body safety harness (with double lanyard & karabiners) are used while working at heights?				
13	Whether life-line of safety harness is anchored to an independent secured support capable of withstanding load of a falling person?				
14	Whether the area around the scaffold is cordoned off to prohibit the entry of unauthorized person / vehicle?				
15	Whether clamps used are of good condition, of adequate strength and free from defects?				
16	Whether ladder is placed at secured and leveled surface?				
17	Whether water-pass and oil-spills are avoided around the scaffold structure?				
18	Whether ladder is extended 1.5mts. above the landing point at height?				
19	Whether more than one access/egress provided to the scaffold?				
20	Whether ladder used are of adequate length and overlapping of short ladders avoided?				
21	Whether metallic ladders are placed much away from near-by electrical transmission line?				
22	Whether rungs of ladder are inspected and found in good order?				
23	Whether fall-arresters provided on both the access/egress routes?				
24	Whether diagonal (cross) bracings are provided at regular interval on the scaffold?				
25	Whether working platform on the scaffold has been made free from "jolt" or "gap"?				
26	Whether tools or materials are removed after completion of the day's job at heights?				
27	Whether a valid Permit for Work (PFW) is obtained before taking up work over asbestos or fragile roof?				
28	Whether sufficient precaution is taken while working on fragile roof?				

FORMAT NO. : HSE-13 REV 0

(Sheet 2 of 2)

Sl. No	Description	Yes	No	N. A	Actions taken
29	Whether provision is made to arrange duck ladder, crawling board for working on fragile roof?				
30	Whether scaffold has been inspected by qualified civil engineers prior to their use?				
31	Whether the scaffolding has been designed for the load to be borne by the same?				
32	Whether the erection and dismantling of the scaffolding is being done by trained persons and under adequate supervision?				
33	Whether safety net with proper working arrangement and life-line has been provided?				
34	Whether TAGS (Green for acceptable and Red for incomplete/unsafe scaffolds) are used on scaffolds?				
35	Whether sufficient illumination is provided in and around the scaffold and access?				
36	Whether emergency rescue / response arrangements are made in place				

Inspected by
Contractor Engineer

Verification By
Contractor Safety Officer

FORMAT NO. : HSE-14 REV 1

(sheet 1 of 2)

PERMIT FOR ERECTION / MODIFICATION & DISMANTLING OFSCAFFOLDING

Project :
Name of the work :
Name of contractor :
Nature of activities :

Sr.No. :
Date :
Job No. :
Duration: From.....To.....

SL. No.	SUBJECTS / ITEMS	DONE	NOT DONE	REMARKS
1	Specific task of Erection / Modification / Dismantling of scaffolds, identified & TAGGED accordingly (before as well as after carrying-out jobs).			
2	People engaged in doing the job are identified & are certified by Job Engineer of Main Contractor as experienced / trained.			Names to be noted
3	Concerned persons are alerted by the Job Engineer of Main Contractor in connection with possible hazards & what the workmen MUST do / MUST not do.			
4	Verification by Job Engineer of Main Contractor made for confirming that all persons permitted to carry-out the jobs are making use of Helmet, Safety Shoes, Goggles, Gloves & Double lanyard safety harness and other relevant PPEs.			
5	Area of work is effectively cordoned-off / barricaded / illuminated.			
6	For taking-up / lowering down Scaffolding members / clamps / couplings etc. appropriate ropes / pulleys/ chains etc. have been arranged for use (not to throw any item) & the same have been verified as "fit for purpose".			
7	Items / members of scaffold, being lowered are removed from the area & stacked correctly.			
8	Ropes, chains, pulley blocks etc. being used for lifting or lowering scaffold items, are inspected by the Job Engineer & their certifications as well as physical conditions have been found O.K. before signing this PERMIT.			
9	Safety Net / Life-line / Fall Arresters etc. are arranged in position and Job Engineer has found working conditions favorable for activities to start.			
10	Scaffold erection or dismantling tasks are being supervised by Experienced Engineer / Competent person.			
11	Only competent & experienced people have been selected / engaged in Scaffolding erection, modification or dismantling tasks.			
12	Adequate & effective actions for traffic and movement of people around the cordoned-off area taken to avoid inadvertent incident			
13	Working platforms are protected with handrails & toe-boards.			
14	Access & Exit (for reach & escape) are safe for use by people.			
15	Tools, tackles to be used for above jobs are verified by job Engineers of Main contractor as genuinely good and tied-up at height (to prevent their fall).			
16	Site important Telephone Nos. are made known to everyone			
17	SOP (Safe Operating Procedure) for the specific task is made & followed too.			
18	Emergency vehicle has been arranged at work locations.			

- This permit for work shall be available at specific work location all the time.
- After completion of work, permit shall be returned to safety cell of main contractor, without fail.
- This Permit shall be issued maximum upto (Monday to Sunday).
- Additional Precautions, if any

  .....

- **ACCORD OF PERMISSION** (to be ticked) - **YES** ( )/ NO ( )

  Work Permit Receiver Verification By Work Permit issuer Contractor Job Supervisor
  Contractor Safety Officer Contractor Engineer/RCM

FORMAT NO. : HSE-14 REV 1

(sheet 2of 2)

Everyday Site working conditions & performance of workmen shall be assessed / checked by Contractor Site Engr. and Safety Officer shall verify the same.

	Name / Sign.	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
Site Engr.								
Safety Off.								

FORMAT NO. : HSE-15 REV 1

PERMIT FOR HEAVY LIFT/CRITICAL ERECTION

Project :
Name of the work :
Name of contractor :
Nature of activities :
Location of work :
Equipment/Structure to be erected:

Sr. No. :
Date :
Job No. :
Duration: From..... To.....
Name /Type of crane :
Wt. of equipment/ structure to be erected

SL. NO.	Description of Item	COMPLIANCE STATUS			Remarks
		Yes	No	Not applicable	
1)	Is the crane type suitable for lift or as per erection procedure?				
2)	Is the crane have the correct number of counterweights fitted?				
3)	Availability of Load Certification of crane from authorized agency.				
4)	Is the load chart of crane available in carne cabin/or with Crane operator?				
5)	Is the device to check the Wind speed in crane is working? Is the safety features in crane are working?				
6)	Availability of Load certification of slings and other accessories from authorized agency				
7)	Availability of Licensee/certificate for crane operator from authorized agency.				
8)	Availability of approved HIRAC for the subject activities.				
9)	Availability of approved erection/rigging procedures.				
10)	Availability of temporary gratings/ platforms for critical lifting(as applicable)				
11)	Tool Box conducted before erection?				
12)	Has the area been cordoned off?				
13)	Are the authorized persons during erection are identified?				
14)	Does each person identified for erection understand their roles and responsibilities?				
15)	Is the ground on which crane will rest or outrigger support are correct?				
16)	Is hard stand requirement (if any) complied?				
17)	Is the communication system (viz walkie-talkies, etc. are working properly?				
18)	If more than one crane is lifting the load, is an Intermediate rigger will supervise the lift?				
19)	If there is other obstruction within the operating radius of the crane, have correct precautions been taken to prevent collision?				
20)	All the persons are wearing the requisite PPE?				

Work Permit Receiver Verification By Work Permit issuer Contractor Job Supervisor
Contractor Safety Officer Contractor Engineer/RCM

FORMAT NO. : HSE-16 REV 1

PERMIT FOR ENERGY ISOLATION & DE-ISOLATION

Project : Sr.No. :
Name of the work : Date :
Name of contractor : Job No. :

ENERGY ISOLATION PERMIT

- Clearance required from:.....Hrs .....Date To .....Hrs ....Date
- Name of equipment/ energy source etc. .....
- Nature of job to be done: .....
- Area.....Location:.....

PERMIT VALIDATION	PERFORMING AUTHORITY
I hereby authorize the .....personnel(performer) to isolate the above equipment/energy source from all sources of power and handover the equipment/energy source for maintenance/repair. Issuing authority Client/Contractor RCM (as applicable) Signature: Date: Name:	The work and precautions will be carried out under my overall responsibility.(Testing/execution engineer) Signature: Date: Name:

SAFETY PRECAUTIONS FOR CLEARANCE	NORMALISING AFTER CLEARANCE
1. Notify workers of intent to de- energize ☐ 2. Obtain lock, tag or locking/tagging devices ☐ 3. Shut down, de-energize, dissipate any residual energies. ☐ 4. Apply lock ,tag and locking and/or tagging devices ☐ 5. *Any other job specific precautions ☐ 6. Verify effectiveness of lockout by attempting to restart. ☐ 7. Proper PPE is ensured ☐ I certify that the energy source mentioned above is isolated from all sources and is safe to start the work. Tag No:..... Lock No:..... Issuing authority Client/Contractor RCM (as applicable) Signature: Date: Name: **(*to be included by contractor in consultation with issuing authority)**	1. Notify workers of intent to re- energize ☐ 2. Conduct visual inspection to confirm that the danger zone is clear of workers ☐ 3. Conduct visual inspection to confirm that tools ,equipment's danger zone is clear of workers ☐ 4. Reposition the safety devices(interlocks, valves, guards, covers ,sensors, as applicable, etc.) ☐ 5. *Any other job specific normalizing details ☐ 6. Remove lock, tag and locking and/or tagging devices. ☐ 7. Re-energize. ☐ 8. Confirm system is operating properly& safely I certify that the energy source mentioned above is isolated from all sources and is safe to start the work. Tag No:..... Lock No:..... Issuing authority Client/Contractor RCM (as applicable) Signature: Date: Name: **(*to be included by contractor in consultation with issuing authority)**

ENERGY DE-ISOLATION PERMIT

PERMIT VALIDATION	PERFORMING AUTHORITY
I hereby authorize the .....personnel(performer) to de- isolate the above equipment/energy source from all sources of power and handover the equipment/energy source for normal operation.. Issuing authority Client/Contractor RCM (as applicable) Signature: Date: Name:	I hereby certify that the equipment/energy source mentioned above has been de-isolated and is ready for normal operation.(Testing/execution engineer) Signature: Date: Name: Countersigned by Issuing authority

FORMAT NO. : HSE-17 REV 1

PERMIT FOR EXCAVATION (depth 2m and above)

(Sheet 1of 2)

Project :
Name of the work :
Name of contractor :
Job Description :
Size of excavation :

Sr.No. :
Date :
Job No. :
Location:

SL. NO.	Description of Item	COMPLIANCE STATUS			Remarks
		Yes	No	Not applicable	
1)	Suitable and sufficient risk assessments and method statements has been carried to ensure that the work shall be undertaken in accordance with specification and standard.				
2)	Are plans/details of underground services available and the same has been reviewed?				
3)	Has survey done to locate the services/obstacles etc.				
4)	Has the live services (electrical, water line, air line, telephone line, etc)has been disabled for carrying out the job.				
5)	Is adequate barriers/fences to protect the excavation are in place?				
6)	Is Adequate warning signs are in place?				
7)	Is Assessment of ground conditions done and remedial action(if any) taken?				
8)	Safe access / egress (e.g. ramp / steps / ladders etc.) provided for site workmen & supervisors.				
9)	Is the excavation work being undertaken in proximity of structure, etc. ?If Yes, it's effect is considered?				
10)	Availability of competent person for supervising the excavation work?				
11)	Adequate safe arrangement to prevent collapse of edges (e.g. shoring / strutting / benching / sloping etc.) made at site.				
12)	Hard barricades (at least 1.0M away from edge & for excavation near site access roads) with warning signs/caution boards are provided				
13)	Accumulation / passage-ways of water at periphery of excavation / trench stopped/ restricted.				
14)	Is the equipment being used for excavation has been checked for adequacy and is in good working condition having all the safety features?				
15)	Age & fitness of workmen ensured by medical test before engagement in job ?				
16)	Arrangement of Monitoring of possible oxygen deficiency or obnoxious gases done & action taken?				

PERMIT GRANTED - Yes / No

(*List enclosed with name & gate pass numbers.*)

Name & Signature of Site Engr.

Name & Signature of Area – In charge/RCM of Contractor (Issuer)

Contractor (Receiver)

Verification by Contractor Safety Officer

FORMAT NO. : HSE-17 REV 1

PERMIT FOR EXCAVATION

(Sheet 2of 2)

NOTES: -

1. Slopes or benches for excavation beyond 2.0M depth shall be designed & approved by Contractor's site head.
2. Excavated earth to be kept at least 1.5M away from edges
3. Safety helmets, Safety shoes or gum-boots, gloves, goggles, Face shield, Safety Harness shall be essential PPEs.
4. Permit shall be made in **duplicate** and original shall be available at site of work.
5. Permit shall be issued for maximum **one week** only (Monday to Sunday)
6. After completion of works, permit shall be closed & preserved for record purpose

GRANT OF PERMIT AND EXTENSIONS

Sl. No.	Validity period From ____To ____	Working Time From _____To _____	Receiver (site Engr. of Main Contractor)	Issuer(Area In charge/RCM of Main Contractor)	Review by EIL / Owner (Remarks with date
1.					
2.					
3.					
4.					
5.					
6.					
7.					

Additional safety instructions if any: -

1.

2.

3.

FORMAT NO. : HSE-18 REV 0 **(Sheet 1of 2)**

IDENTIFICATION OF ENVIRONMENTAL ASPECTS, IMPACT ASSESSMENT AND CONTROL MEASURES

S.No	Activity	Environmental Aspect	N/A/E	Environment Impact	Control Measures	Consequences						Risk Level	Significant	Gaps/ Recommendations
						A	B	C	D	E	F	G	Yes/No	

(Sheet 2 of 2)

INITIAL ENVIRONMENT REVIEW TECHNIQUE

Environmental Impacts	AP = Air Pollution	WP = Water Pollution	LC = Land Contamination	DNR = Depletion of Natural Resources	NP = Noise Pollution

Scale	Quantity (A)	Occurrence (B)	Severity of Impact (C)	Detection (D)	Control (E)	Legal and other requirements (F)
1	Negligible	Very Rare	Negligible visual impact	Immediately	Available & effective at place	In compliance or not applicable
2	Low	Once a month or less	Causes Discomfort or Nuisance	Within 1 hour	Has in-built Secondary control	
3	Moderate	Once a day	Resource Depletion	Within 8 hours	Needs human Intervention	
4	High	Several times a Day	Affects Aquatic Life, flora, fauna or global issue	Within 24 hours	Mechanism in place but not reliable	
5	Excessive	Continuous	Human health effect	More than 24 hours	Absent or no effective control	Not in compliance

Risk Level - G : A x B x C x D x Ex F

Aspects with score of **100 and above** are considered as significant.
Also, Irrespective of the score, all legal noncompliance's to be considered as significant

Condition	
N	NORMAL
A	ABNORMAL
E	EMERGENCY

FORMAT NO. : HSE-19 REV 0 HIRAC

Risk Identification						Desired Controls & Existing Gaps, If Any		Risk Assessment				Recommended Control Actions To Reduce The Risk Level	Action By	Remarks
SN	Activity	Activity Type (R/NR)	Hazards	Condition(N/AN/E)	Associated Risk	Desired Control Measures	Gaps If Any	Probability(P)	Impact (I)	Risk R= P*I	Risk Classification			

Likelihood – Possibility of occurrence of risks based on present gaps (technological / operational / competence / measurement and monitoring);

UL: Unlikely, **L:** Likely, **VL:** Very Likely, **FR:** Frequent, **C**: Continuous

Impact –

SI: Slight Injury, **MI:** Minor Injury, **MJ:** Major Injury, **SF:** Single Fatality, **MF:** Multiple Fatalities

Level of consequence – Refer Guidance criteria for this i.e. possible degree of damage;

Condition- N: Normal, **AN**: Abnormal, **E**-Emergency

Activity Type: R- Routine, NR- Non Routine

RISK –

L: Low Risk, **M:** Moderate Risk, **H:** High Risk

FORMAT NO.: **HSE-20 REV 0**

Inspection of Tower Crane

Name of Contractor: **Project:**

Name of Work: **Job No:**

Vehicle Identification/Registration No: **Date:**

Sr. No.	Description	Observation	Remarks & Suggestions
1	Serial number plate &SWL marking		
2	Valid TPI Certificate		
3	Valid Insurance		
4	Safe access and egress are provided to the crane operator.		
5	Front glass of Operator cabin		
6	Operator crane cabin is provided with a locking mechanism so as to prevent unauthorised entry.		
7	A safety bar is fitted across the operator's cabin window where there is likelihood of the operator falling through it.		
8	Manufacturer Operating Manual and Maintenance Manual are made available.		
9	An updated Operation and Maintenance log book is available in the operator cabin.		
10	All mounting bolts are in good condition.		
11	Load chart provided		
12	SLI available		
13	Crane hooks have got smooth surface and no dent		
14	Hook-latch / Dog-clamp in hook is effective		
15	Over hoist limit switch		
16	Double body earthing of Tower Crane		
17	Jib angle indicator is provided (For Luffing Jib Tower Crane).		
18	Emergency stop button, which will terminate the operation of the crane engine, is installed in the operator cabin and correctly identified.		
19	Effective braking mechanisms for Hoisting, Derricking, Slewing, Trolley Travelling maintained:		
20	Trolley Travelling limiter to prevent over-travelling of trolley is functional.		
21	Limit switches to prevent over-derricking and over-lowering of jib (For Luffing Jib Tower Crane) is functional.		
22	Slewing limiter to restrict slewing of crane is functional.		
23	Over load Limiter to prevent overloading of crane is functional.		
24	Load Moment Limiter to prevent over-turning moment is functional.		
25	Anti-collision devices are tested to stop the tower crane's operation such that the crane-to-crane interference must be maintained at not less than 3 m.		
26	Condition of boom		
27	Counter weight placement and pins		
28	Winches, pulleys and wire ropes are in good working condition.		
29	Colour coding		
30	Leakage in hydraulic cylinder		

31	Fire Extinguisher		
32	Tower crane is adequately grounded or protected against lightning.		
33	Wind anemometer is installed and is in good working condition.		
34	Aviation lamp is functional (Reqd. for 30mt and above)		
35	Pre Medical Check-up& Periodic Medical check-up (every 6 months) including vision test for Operator		
36	Safety Induction for Operator		
37	Others		

Signature & Name of Operator:

Signature and name of Job Engineer

Signature & Name of Contractor's Safety Officer

FORMAT NO. : HSE-21 REV 0

Crane Inspection Checklist

Name of Contractor: **Project:**

Name of Work: **Job No:**

Vehicle Identification/Registration No: **Date:**

Sr. No.	Description	Observation	Remarks & Suggestions
1	Crane hooks have got smooth surface and no dent		
2	Hook-latch / Dog-clamp in hook is effective		
3	Over hoist limit switch		
4	Over Load Indicator		
5	Over Boom limit switch		
6	Boom angle indicator		
7	Colour coding		
8	Condition of boom		
9	Condition of wire rope		
10	Rope drum / sheaves are in good working condition		
11	Swing break & lock		
12	Swing Alarm		
13	Over hoist break & lock		
14	Boom break & lock (For Telescopic Boom)		
15	Leakage in hydraulic cylinder		
16	Condition of Outrigger (For Tyre Mounted Crane)		
17	Outrigger fully extended Marking (For Tyre Mounted Crane)		
18	Condition of Tyre (For Tyre Mounted Crane)		
19	Wheel chokes are present and are used whenever required (For Tyre mounted)		
20	Battery & lamps		
21	Moving & rotating parts guarded		
22	Load chart provided		
23	Reverse horn (For Tyre Mounted Crane)		
24	Body Condition of crane		
25	Front glass of Operator cabin		
26	Both side Mirror		
27	Number Plate (For Tyre Mounted Crane)		
28	Fire Extinguisher		
29	Horn		
30	Windshield and wipers		
31	Working of light & Indicator		
32	SLI		
33	Spark Arrestor(For Running Refinery/ Petrochemical/Chemical Plant)		

34	Foot-steps and hand-holds are in good working condition for exit /enter in to cabin		
35	TPI Certificate		
36	RC Document (For Tyre Mounted Crane)		
37	Fitness Certificate of Vehicle by authority		
38	Insurance		
39	PUC		
40	HMV License for Operator		
41	Pre Medical Check-up& Periodic Medical check-up (every 6 months) including vision test for Operator		
42	Safety Induction for Operator		
43	Others		

Signature & Name of Operator:

Signature & Name of Contractor's Concern Engineer

Signature & Name of Contractor's Safety Officer

FORMAT NO. : HSE-22 REV 0

Hydraulic Mobile Crane- Inspection Checklist

Name of Contractor: **Project:**

Name of Work: **Job No:**

Vehicle Identification/Registration No: **Date:**

Sr. No.	Description	Observation	Remarks & Suggestions
1	Identification number of Hydraulic Mobile crane boldly scribed in front and rear end of machine		
2	Operator has got adequate document in support of his competency (i.e. HMV driving license, knowledge & training)		
3	Marking of SWL on hook position is clearly visible		
4	Test & examination of Hydraulic Mobile crane by statutory / competent authority is carried out & document is valid		
5	Colour Coding		
6	RC Document		
7	Fitness Certificate of Vehicle by authority		
8	Valid Insurance		
9	Valid PUC		
10	Pre Medical Check-up& Periodic Medical check-up (every 6 months) including vision test for Operator		
11	Safety Induction for Operator		
12	Crane hooks have got smooth surface and no dent		
13	Hook-latch / Dog-clamp in hook is effective		
14	Over hoist limit switch		
15	Over Load Indicator		
16	SLI		
17	Condition of boom		
18	Condition of wire rope		
19	Rope drum / sheaves are in good working condition		
20	Leakage in hydraulic cylinder		
21	Tyre condition		

22	Battery		
23	Moving & rotating parts guarded		
24	Break		
25	Parking Break		
26	Front horn		
27	Reverse horn		
28	Hydraulic Mobile Crane cabin body and frame of machine is in good order		
29	Both side Mirror		
30	Fire Extinguisher		
31	Front glass pane of the Hydraulic Mobile operator's cabin is clean & clear (i.e. not cracked / damaged / broken)		
32	Windshield and wipers condition		
33	Working of front & back lights, turn Indicators, parking lights & fog lamps		
34	Spark Arrestor(For Running Refinery/ Petrochemical/Chemical Plant)		
35	Wheel chokes are present and are used whenever required		
36	Foot-steps and hand-holds are in good working condition for exit /enter in to cabin		
37	Others		

Signature & Name of Operator

Signature & Name of Contractor's Concern Engineer

Signature & Name of Contractor's Safety Officer

FORMAT NO. : HSE-23 REV 0

Hydraulic Rig Inspection Checklist

Name of Contractor: **Project:**

Name of Work: **Job No:**

Vehicle Identification/Registration No: **Date:**

Sr. No.	Description	Observation	Remarks & Suggestions
1	Control panel is clean & all buttons/switches are clearly visible (no paint over spray, etc.)		
2	All switch & mechanical guards are in good condition and properly installed		
3	All Safety Indicator lights work		
4	Drive controls function properly & accurately labelled (up, down, right, left, forward, back)		
5	Motion alarms are functional		
6	Safety decals are in place and readable		
7	Any defects such as cracked welds, fuel leaks, hydraulic leaks, damaged control cables or wire harness, etc.		
8	Braking devices are operating properly		
9	Winches, pulleys and wire ropes are in good working condition.		
10	Function of interlocks and limit switch		
11	The manufacturer's operations manual (in all languages of the operators)		
12	Oil level, Hydraulic Oil Level, Fuel Level, Coolant Level		
13	Battery Charge		
14	Outriggers in place or functioning. Associated alarms working		
15	Moving & rotating parts guarded		

16	Load chart provided		
17	Fire Extinguisher		
18	Spark Arrestor, if operated by using fuel(For Running Refinery/ Petrochemical/Chemical Plant)		
19	Serial number plate		
20	SLI		
21	TPI Certificate		
22	Colour Coding		
23	Insurance		
24	Pre Medical Check-up& Periodic Medical check-up (every 6 months) including vision test for Operator		
25	Safety Induction for Operator		
26	Others		

Signature & Name of Operator:

Signature & Name of Contractor's Concern Engineer

Signature & Name of Contractor's Safety Officer

FORMAT NO. : HSE-24 REV 0

Boom Lift Inspection Checklist

Name of Contractor: **Project:**

Name of Work: **Job No:**

Vehicle Identification/Registration No: **Date:**

Sr. No.	Description	Observation	Remarks & Suggestions
1	Operating and emergency controls are in proper working condition, EMO button or Emergency Stop Device		
2	Functional upper drive control interlock (i.e. foot pedal, spring lock, or two hand controls)		
3	Emergency Lowering function operates properly		
4	Lower operating controls successfully override the upper controls		
5	Both upper and lower controls are adequately protected from inadvertent operation.		
6	Control panel is clean & all buttons/switches are clearly visible (no paint over spray, etc.)		
7	All switch & mechanical guards are in good condition and properly installed		
8	All Safety Indicator lights work		
9	Drive controls function properly & accurately labelled (up, down, right, left, forward, back)		
10	Motion alarms are functional		
11	Safety decals are in place and readable		
12	Guardrails and anchor points are in place, and in good condition		
13	Work platform & extension slides are clean, dry, & clear of debris		
14	Work platform extension slides in and out freely with safety locking pins in place to lock setting on models with extension platforms.		
15	Any defects such as cracked welds, fuel leaks, hydraulic leaks, damaged control cables or wire harness, etc.		
16	Braking devices are operating properly		
17	The manufacturer's operations manual is stored on AWP (in all languages of the operators)		
18	Oil level, Hydraulic Oil Level, Fuel Level, Coolant Level		

19	Battery Charge		
20	Outriggers in place or functioning. Associated alarms working		
21	Tyres and wheels are in good condition, with adequate air pressure if pneumatic		
22	Wheel chokes are present and are used whenever required		
23	Moving & rotating parts guarded		
24	Load chart provided		
25	Fire Extinguisher		
26	Spark Arrestor, if operated by using fuel(For Running Refinery/ Petrochemical/Chemical Plant)		
27	Serial number plate with Load capacity		
28	TPI Certificate		
29	Colour Coding		
30	Insurance		
31	Pre Medical Check-up& Periodic Medical check-up (every 6 months) including vision test for Operator		
32	Safety Induction for Operator		
33	Others		

Signature & Name of Operator:

Signature & Name of Contractor's Concern Engineer

Signature & Name of Contractor's Safety Officer