JOB SPECIFICATION
FOR
SHOP & FIELD PAINTING

SMMS DEPARTMENT

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
0	15-06-2009	ISSUED JOB SPECIFICATION	AS	DR.DNW	RC

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

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.
ASA A 13.1-1981:		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 16.0 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, $A1_2O_3$ 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 $5^{o}F$ above dew point when the relative humidity is greater than 85% or when the temperature is below $40^{o}F$ and when the ambient/substrate temp is below the paint manufacturer's recommended temperature of application and curing. 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, doubers, or sheepkin.

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^{o}C to 550^{o}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	SA 2½	SSPC-SP-10	NACE#2	The minimum requirement for chemically resistant paint systems such as epoxy, vinyl, polyurethane based

SL. NO.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)			REMARKS
		ISO 8501-1/ SIS-05 59 00	SSPC-SP, USA	NACE, USA	
	free of all visible residues with desired surface profile.				and inorganic zinc 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	4 hrs	1.5 hrs	1 hr	1 hr

	paints (minimum.)				
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 225ºC (Intertherm 228 from M/s Akzo Nobel Coatings & Sealants, Bangalore). For all other companies, the temperature resistance shall be a maximum of 150ºC.

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 400ºC for CS surfaces and 600ºC for SS surfaces.

   'Berger 938' from Berger Paints Ltd Kolkata, suitable upto 400ºC 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 400ºC 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.

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, H_2SO_4, 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 16.0.

2. Primers & Finish paints covered in Tables 8.0 to 16.0 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 - 16.0

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 ^{o}C	Surface Preparation	Paint System	Total DFT in Microns (min.)	Remarks
7.1	-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	-90 to 400	SSPC-SP-3	1 coat of F-9	65-75	-DO-
7.3	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 ^{o}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 SYSTEMS FOR CARBON STEEL AND LOW ALLOY STEEL STORAGE TANKS (INTERNAL)
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		
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^{o}**C** and design temperature is upto 200^{o}C. Cases of operating temperature > 150^{o}**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.

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	
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 & Offsites) for insulated Piping, Storage Tanks, Stacks & 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)

17.0 STORAGE

17.1 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.

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 COLOR FOR PAINT SYSTEM	RAL COLOR CODE	
			BASE COLOR	BAND COLOR
		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	
	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
	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
	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
	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
	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 pearl white 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	Yellow green with 1 signal red band	6018	3001
65	INSTRUMENT AIR	Yellow green with 1 black band	6018	9005
66	NITROGEN	Yellow green with 1 orange band	6018	2011
67	FREON	Yellow 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	Electrical Equipment – Indore	Pebbel grey	7032
111	Electrical Equipment - Outdoor	Blue grey	7031
112	HAND RAILING	Fluorescent yellow	1026
113	STAIRCASE, LADDER AND WALKWAYS	Black	9005
114	LOAD LIFTING EQUIPMENT AND MONORAILS ETC	Leaf brown	8003
115	GENERAL STRUCTURE	Dark grey	7031
116	LOCAL PANEL FACE	Opaline green	6026
117	PANEL REAR SURFACE, FRAME WORK & MOUNTING PLATES	Pale cream	9001
118	MONORAIL	Signal red	3001
PIPES AND FITTINGS OF ALLOY STEEL AND SS MATERIAL IN STORE			
119	IBR	Signal red	3001
120	9Cr-1Mo	Verdigris green	6021
121	5Cr-0.5Mo	Satin blue	5012
1 22	$2_{1/4}$Cr-1 Mo	Aircraft yellow	1026
123	$1_{1/4}$Cr-½ Mo	Traffic Yellow	1023
124	SS-304	Dark blue grey	5008
125	SS-316	Dark violet	4005
126	SS-321	Navy blue	5014
SAFETY COLOUR SCHEMES			

127	DANGEROUS OBSTRUCTION	Black and alert orange band	9005	2008
128	DANGEROUS OR EXPOSED PARTS OF MACHINERY	Alert orange	2008	

RAL COLOR CODING FOR PETROCHEMICAL COMPLEX

Sr. No.	SERVICE	RECOMMENDED COLOR FOR PAINT SYSTEM	RAL COLOR CODE	
			BASE COLOR	BAND COLOR
	REFINERY PRODUCTS			
1	NATURAL GAS	Orange with 3 Oxide red bands	2011	3009
2	PROPANE	Orange with 3 Blue band	2011	5013
3	METHANE	Orange with 1 Brown band	2011	8004
4	CYCLOHEXANE	Orange with 1 Pearl night blue band	2011	5026
5	n-HEXANE	Orange with 1 Pearl green bend	2011	6035
6	ETHANE	Orange with 4 Blue bands	2011	5013
7	BLENDED FUEL OIL	Black with 3 Yellow bands	9005	1023
8	ETHYLENE OXIDE	Orange with 3 Green bands	2011	6010
9	POLYMER PELLETS & SLURRY	Brown beige with 1 white bands	1011	9010
10	HDPE PELLETS	Brown beige with 2 white bands	1011	9010
11	WAX	Oxide Red with 1 Pastel Green Band	3009	6019
12	GLYCOL	Canary yellow with 1 Pearl gentian blue	1012	5025
13	BUTADIENE < 15%	Orange with 1 band Pastel Green band	2011	6019
14	BUTADIENE 5 -95%	Orange with 2 Pastel Green bands	2011	6019
15	BUTADIENE > 95%	Orange with 3 Pastel Green bands	2011	6019
16	ALDEHYDE SOLUTION	Sky blue with 1 orange band	5015	2011
17	OCTENE-1	Orange with 1 Blue, 1 Black and 1 Blue band	2011 5013	9005 5013
18	ETHYLENE	Orange with 2 Blue bands + 1 Black band	2011	5013 9005
19	PROPYLENE	Orange with 2 Oxford blue bands	2011	5013
20	BUTENE -1	Orange with 2 Red band	2011	3001
21	HEXANE	Orange with 2 White bands	2011	9010
22	MEG	Canary yellow with 1 Blue lilac band	1012	4005
23	DEG	Canary yellow with 2 Blue lilac band	1012	4005

24	TEG	Canary yellow with 3 Blue lilac band	1012	4005
25	POLYGLYCOL	Canary yellow with 3 Green band	1012	6010
26	GLYCOL / WATER SOLUTION	Canary yellow with 1 Sky blue band	1023	5015
27	DTA	Canary yellow with 2 Green band	1012	6010
28	OXYGEN	Yellow green with 1 Blue band	6018	5013
29	CYCLE GAS SYSTEM	Oxide red with 2 Purple band	3009	4006
	CHEMICALS			
29	ISOPRENYL ALUMINUM	Canary yellow with 1 copper brown bands	1012	8004
30	MAGNESIUM ETHYLATE	Canary yellow with 2 copper brown bands	1012	8004
31	TITANIUM TETRA CHLORIDE	Canary yellow with 1 chocolate brown band	1012	8017
32	SULPHURIC ACID	Golden Yellow with 3 red bands	1004	3001
33	CALCIUM HYDROXIDE	Canary yellow with 3 black bands	1012	9005
34	SODIUM CHLORIDE	Canary yellow with 1 white band	1012	9010
35	FERRIC CHLORIDE	Canary Yellow with 3 red oxide bands	1012	3009
36	SODIUM BI SULFIDE	Canary yellow with 3 white bands	1012	9010

37	CHLORINE DIOXIDE	Canary yellow with 1 orange band	1012	2011
38	HYDRAZINE	Canary yellow with 3 blue bands	1012	5013
39	CARBON DIOXIDE	Orange with 4 Aluminum bands	2011	9006
40	CARBON MONOXIDE	Orange with 3 Aluminum bands	2011	9006
41	TEAL	Dark admiralty grey with 2 white bands	7012	9010
42	LIQUID PEROXIDE	Canary yellow with 1 red and 1 blue band	1023 3001	5013
43	CATALYST LINE	Canary yellow with 2 Red band	1023	3001
44	CO-CATALYST LINE	Canary yellow with 3 Red band	1023	3001
45	EO / WATER SOLUTION	Sky blue with 3 Green bands	5015	6010

46	BCWS / BCSWR	Sky blue with 1 Brown Biege band	5015	1011
	WATER			
47	CYCLE WATER- LEAN	Sky blue with 2 blue lilac bands	5015	4005
48	CYCLE WATER- RICH	Sky blue with 3 blue lilac bands	5015	4005
49	JACKET WATER	Sky blue with 3 black bands	5015	9005
50	JACKET WATER-BIOCIDE	Sky blue with 2 aluminum bands	5015	9006
51	JACKET WATER-CORROSION INHIBITOR	Sky blue with 3 aluminum bands	5015	9006
52	CHLORINATED WATER	Sky blue with 1 green band	5015	6010

53	BACK FLUSH WATER	Sky blue with 3 signal red bands	5015	3001
54	CUTTING WATER	Sky blue with 1 orange band	5015	2011
55	REFRIGERATED WATER	Sky blue with 2 violet blue bands	5015	5000
56	WASTE WATER	Sky blue with 2 Signal red bands	5015	3001
	INTERMEDIATES			
57	MOTHER LIQUOR SOLUTION	Orange with 3 pebble grey bands	2011	7032
58	ADDITIVES SOLUTION	Pearl green with 2 white band	6035	9010
59	DEACTIVATORS	Pearl green with 2 orange band	6035	2011
60	OFF GAS	Pearl green with 2 yellow band	6035	1023
61	OFF GAS PLUS POLYMER	Pearl green with 2 Aluminum bands	6035	9006
62	RA SOLUTION	Pearl green with 2 oxide red bands	6035	3009
63	DONOR	Pearl green with 2 black bands	6035	9005
	STEAM			
64	VHP	Offwhite / Aluminium with 2 yellow band	9006	1023
65	MHP STEAM (20 KG / CM_2 G)	Off white / Aluminium with 3 yellow bands	9006	1023
66	OTHER PROCESS LINES e.g. PROCESS STEAM, PROCESS CONDENSATE, PROCESS VENTS.	Light grey with 1Trafffic yellow band	7035	1023
67	DECOKING AIR	Yellow Green with 1 Terrabrown band	6018	8028
68	RPG	Orange with 1 Yellow Green band	2011	6018
69	C6-C8 CUT	Orange with 1 terrabrown band	2011	8028
70	C4 MIX	Orange with 1 peral black berry band	2011	4012
71	C9+ CUT / FLUX OIL	Orange with 2 grey Beige band	2011	1019
72	C4 PURGE / C4 MIX	Orange with 2 peral black berry	2011	4012
73	C9 CUT	Orange with 1 grey beige	2011	1019
74	C7-C8 CUT	Orange with 2 terra Brown band	2011	8028
75	C3	Orange with 1 Sky blue band	2011	5015
76	PP RECYCLE	Orange with 1 water blue	2011	5021
77	PLANT AIR	Yellow green with 1 peral light grey	6018	9022
78	AROMATIC	Black with 1 water blue	9005	5021
79	LIGHT DISTILLATION	Orange with 1 Solman pink band	2011	3022
80	C9+	Orange with 3 grey beige	2011	1019
81	OWS-OIL WATER SEWER	Sky blue with 1 band of salmon orange	5015	2012
82	CRWS-CONTAMINATED RAIN WATER SEWER	Sky blue with 2 bands of salmon orange	5015	2012
83	CRYOGENIC TANK	Orange	2011	

	(RCC)		

19.0 IDENTIFICATION OF VESSELS, PIPING ETC.

19.1 Equipment number shall be stencilled in black or white on each vessel, column, equipment & machinery (insulated or uninsulated) after painting. Line number in black or white shall be stencilled 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 Offsites
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 30º to 60º 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:

IICT, Hyderabad
HBTI, Kanpur
DMSRDE, Kanpur
IIT, Mumbai
BIS Laboratories
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)

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	-	-	CAMIDECK	GALBONS HB

	PAINTS PVT. LTD.			PRIMER	
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^{O}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	NEROMASTIC 400	NEROTHERM 250	NEROTHERM 538	

	PAINTS LTD.				

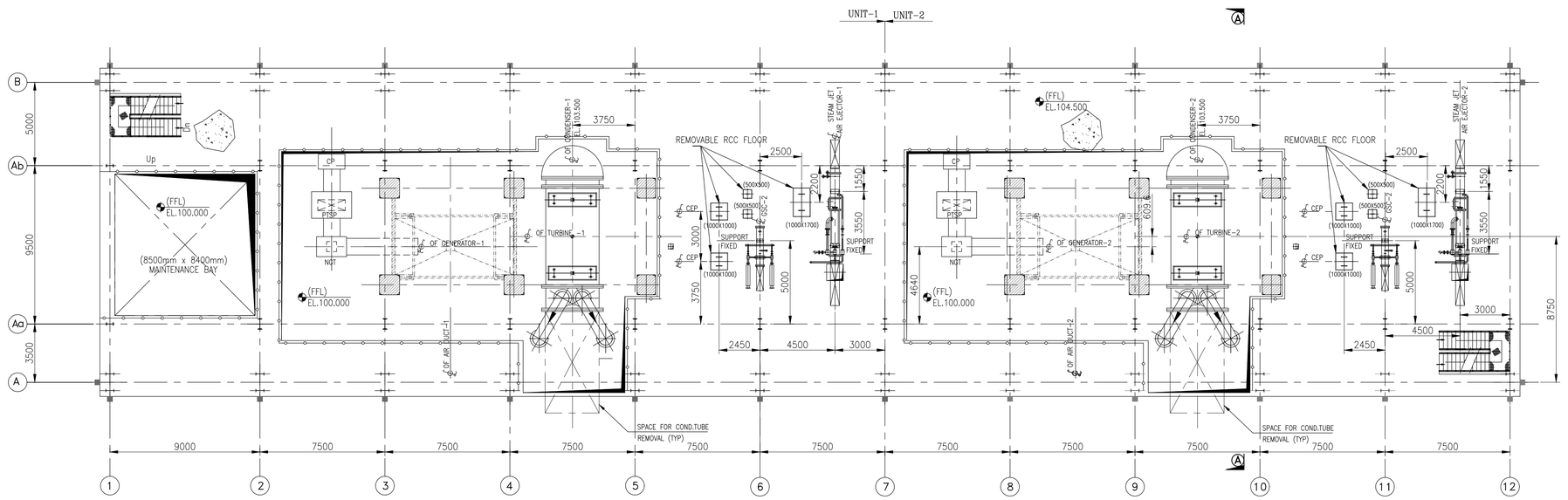
Note : This list is subject to revision based on fresh approval/ re-approval/ deletion.

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 1-381-01-04601

SHT. 2 OF 2



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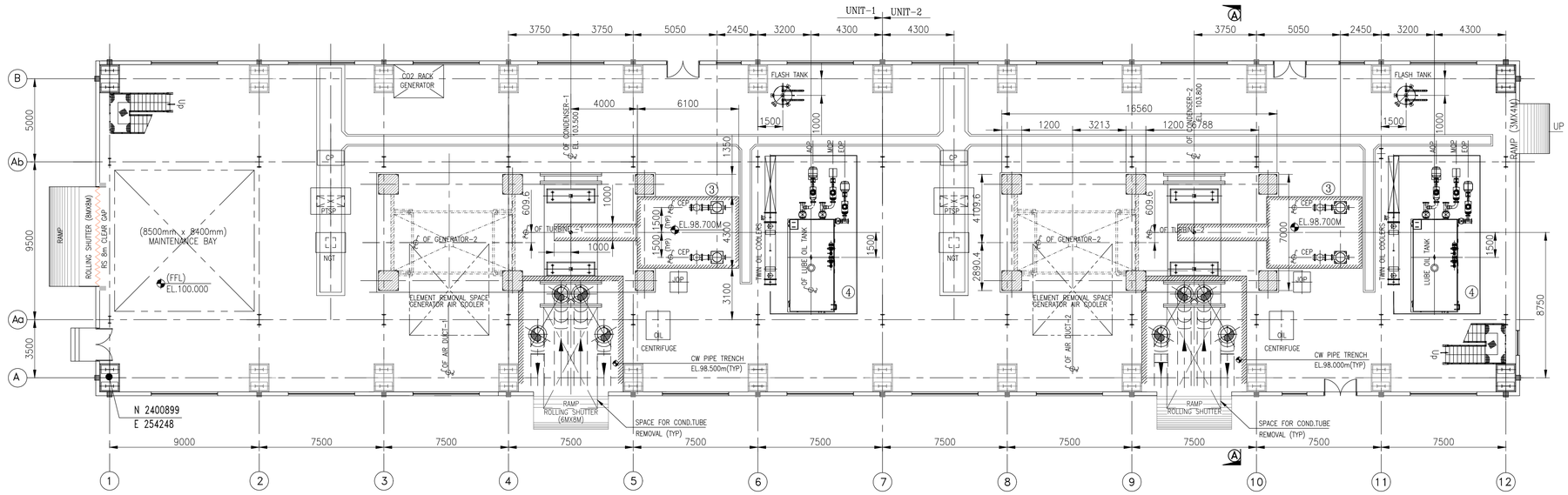

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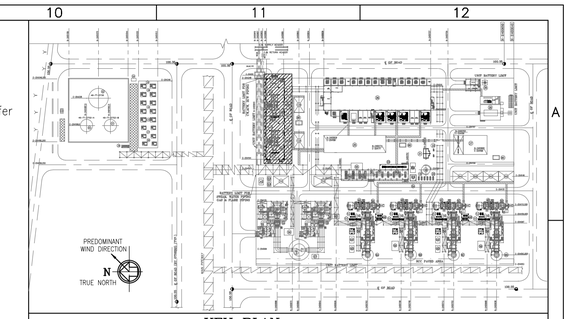

KEY PLAN

For Orientation refer KEY PLAN

NOTES:

1. ALL DIMENSIONS ARE IN MM. CO-ORDINATES & LEVELS ARE IN METRES, UNLESS OTHERWISE STATED.
2. EL 100.000 CORRESPONDS TO FFL OF STG HALL CORRESPONDS TO EXISTING SITE RL 7.8M.

SL.NO.	DESCRIPTION	SIZE (m)	WEIGHT (Kgs)	QTY
1	CONDENSER	O.D 2.624m x 7.9m L	FLOODED/WORKING/EMPTY 145000/105000/75000	2
2	GENERATOR AIR COOLER	–	–	2
3	CEP (MOTOR DRIVEN)	–	–	4
4	LUBE OIL SKID	9.525m x 5.2m (HOLD)	–	2
5	OIL CENTRIFUGE	1.7m x 1.4m	–	2
6	JOP	1.22m x 1.02m	–	2
7	GENERATOR CO2 RACK	3m x 2m (HOLD)	–	2
8	STG OPERTAOR ROOM	4m x 3m	–	1

REFERENCE DRAWINGS

SL.NO.	DESCRIPTION	DRAWING No.
01	PLOT PLAN	0-381-01-01108
02	MACHINERY ARRANGEMENT AND FOUNDATION. (4 SHEETS)	1-313-00-99935
03	G.A OF SURFACE CONDENSER	1-160-10-01352
04	G.A OF GLAND STEAM CONDENSER	2-162-14-00458
05	TWIN OIL COOLER	3-165-01-20
06	G.A OF AIR COOLER ELEMENT	2-166-03-00

OWNER

DAHEJ PETROCHEMICAL COMPLEX
STEAM & POWER GENERATION SYSTEM
ONGC Petro-additions LIMITED,
SEZ, Dahej, Gujarat, India

PMC

Tender No.-MR/OW/MM/STG-NOM/19/2009

EIL JOB No. 6987 / EPCC-10 Pkg.

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	J.C.S		03.08.11	
CHD.	PALLABI DEY		03.08.11	
APPD.	K.SRINIVAS		03.08.11	

REV.	DATE	ALTERED	CHD/APPD
ZONE			

BHEL'S CONSULTANT:

M.N. DASTUR & COMPANY (P) LTD. CONSULTING ENGINEERS- KOLKATA

DASTURCO PROJECT NO : 27278

	NAME	SIGN.	DATE
DRN.	RS		08.07.2011
CHD.	KR		08.07.2011
APPD.	SRM		08.07.2011
REV.			

DRG. NO. 27278-32-01-PWR-0001

DEPT. PED | CODE 450 | UNTOL. DIMS. GR. f/M/f | SCALE 1:160 | WEIGHT (KG)

REF. TO ASSY. DRG. | ITEM NO. | NO.OF ITEMS

TITLE
EQUIPMENT LAYOUT FOR STG BUILDING - PLAN

CARD CODE NA

DRG. NO. 1-381-01-04601 REV. 00

CUST. DRG. NO.

SHT. No 01 NO. OF SHT. 02

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 1-366-09-69065

SH. 02 OF 02

GENERAL DIMENSIONAL LIMITS, FITS & TOLERANCES AS PER HY0230261

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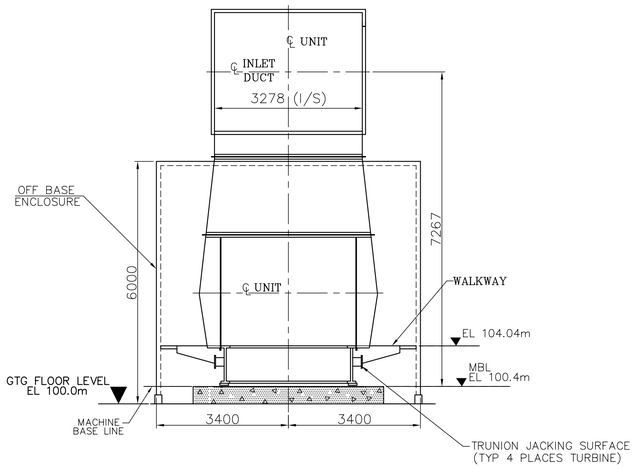
REF. DRG. NO.

SIGN. AND DATE

INVENTORY NO



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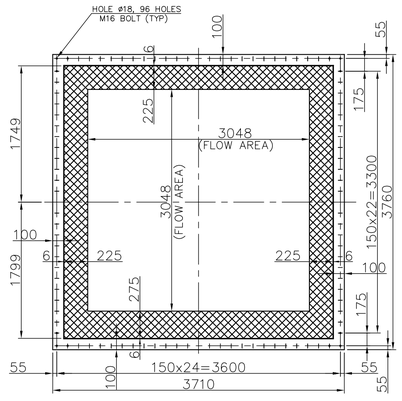
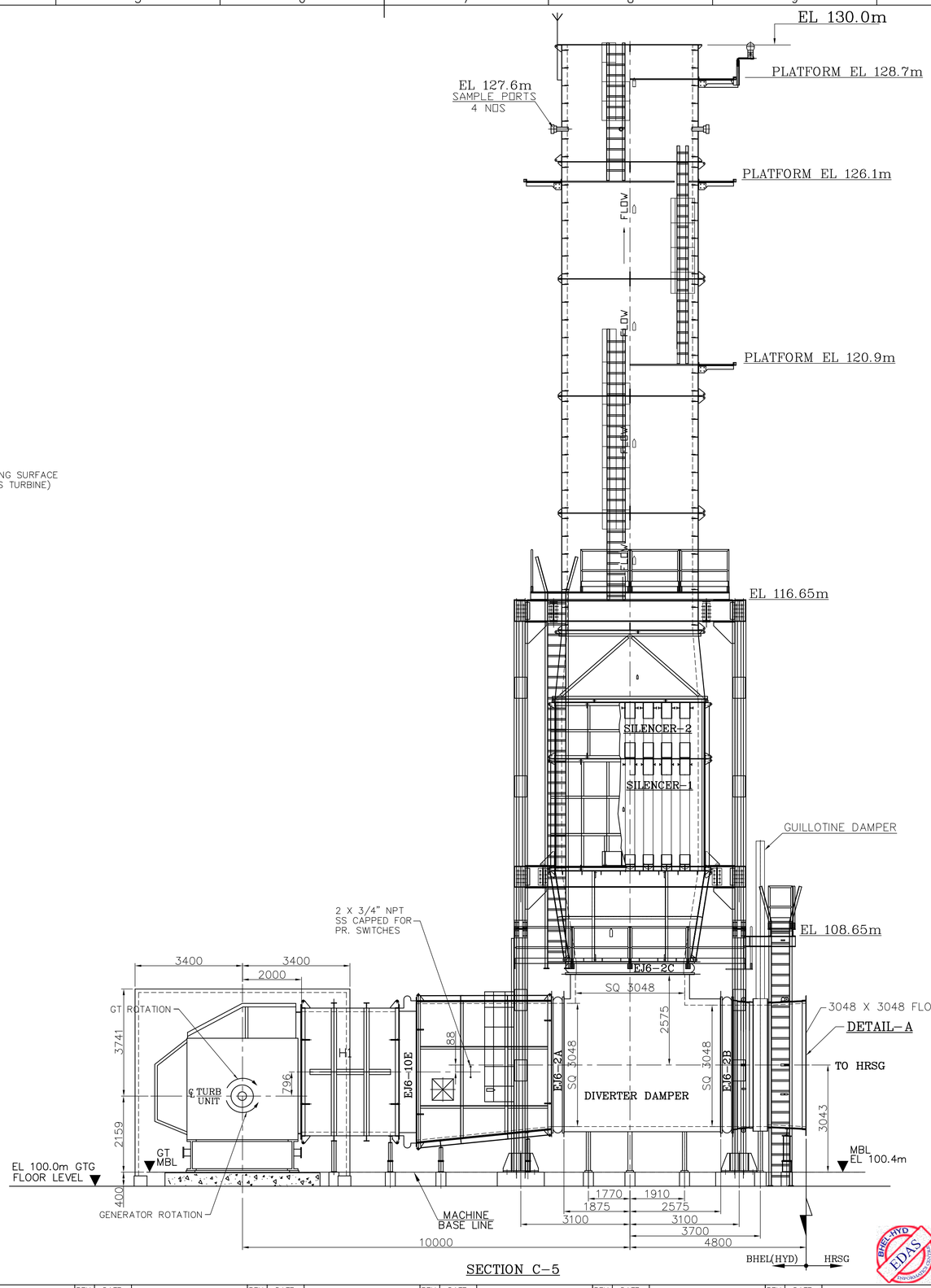


DETAIL–A

HRSG END FLANGE DETAIL IN EXHAUST DUCT



SECTION C–5

ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD
	ZONE			ZONE			ZONE			ZONE			ZONE			ZONE			ZONE		

CLIENT: ONGC PETRO ADDITIONS LTD.
DAHEJ, GUJARAT

CONSULTANT : ENGINEERS INDIA LTD
1, BHIKAIJI CAMA PLACE, NEW DELHI – 110 066

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: 4 X FR–6B GTG, COGEN CYCLE PLANT, OPAL

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN	DATE	NO. OF VAR.
DRN.	DEEPTHI		24.06.11	–N.A.–
CHD.	V.S.H		24.06.11	
APPD.	B.S.N		24.06.11	

RESTRICTED USE

DEPT.	UNTOL. DIMS. GR.		SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO. OF ITEMS
GTD	~~C/M/F~~		1:1	N.A	N.A	–N.A.–	–N.A.–
CODE. 423							

TITLE: GENERAL ARRANGEMENT GAS TURBINE & GENERATOR

CARD CODE: N.A.

DRAWING NO. 1-366-09-69065 REV. 00

SHT. No 02 NO. OF SHT. 02

DRAWING No. 0-00-561-93543

FIRST ANGLE PROJECTION (ALL DIMENSIONS IN MILLIMETRES)

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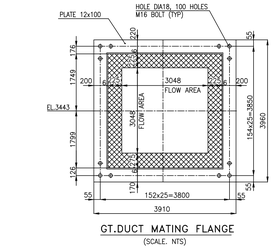
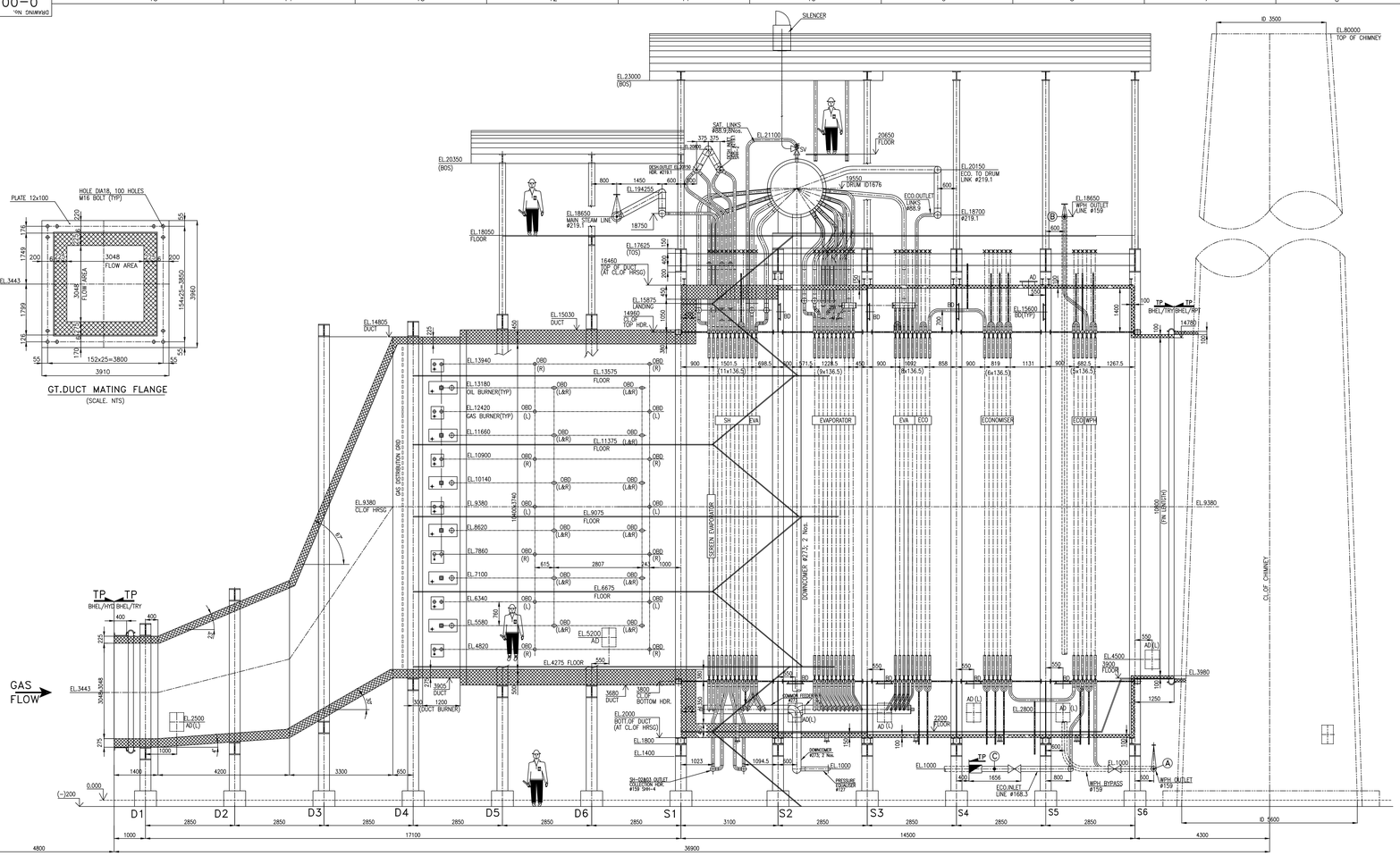
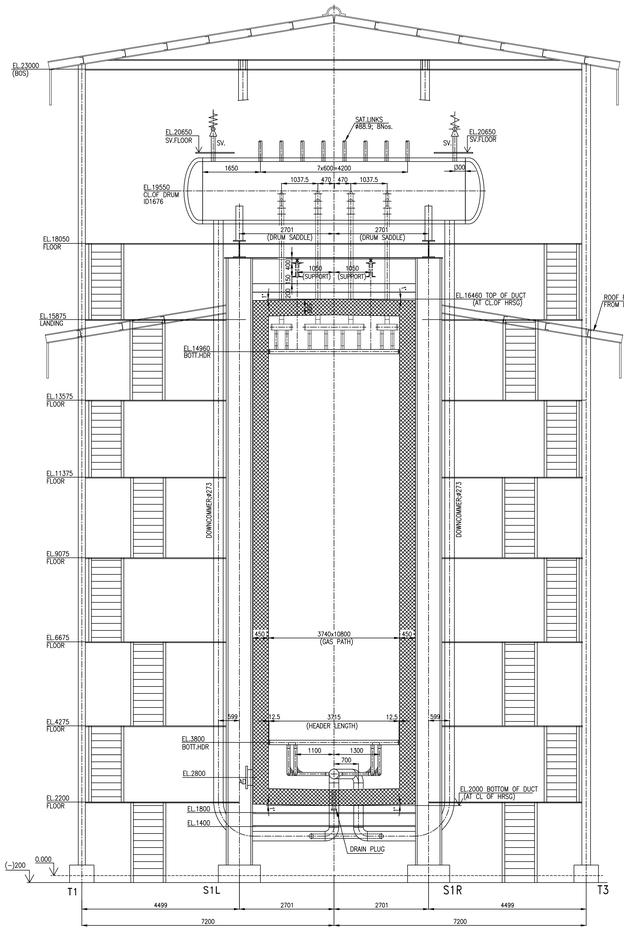


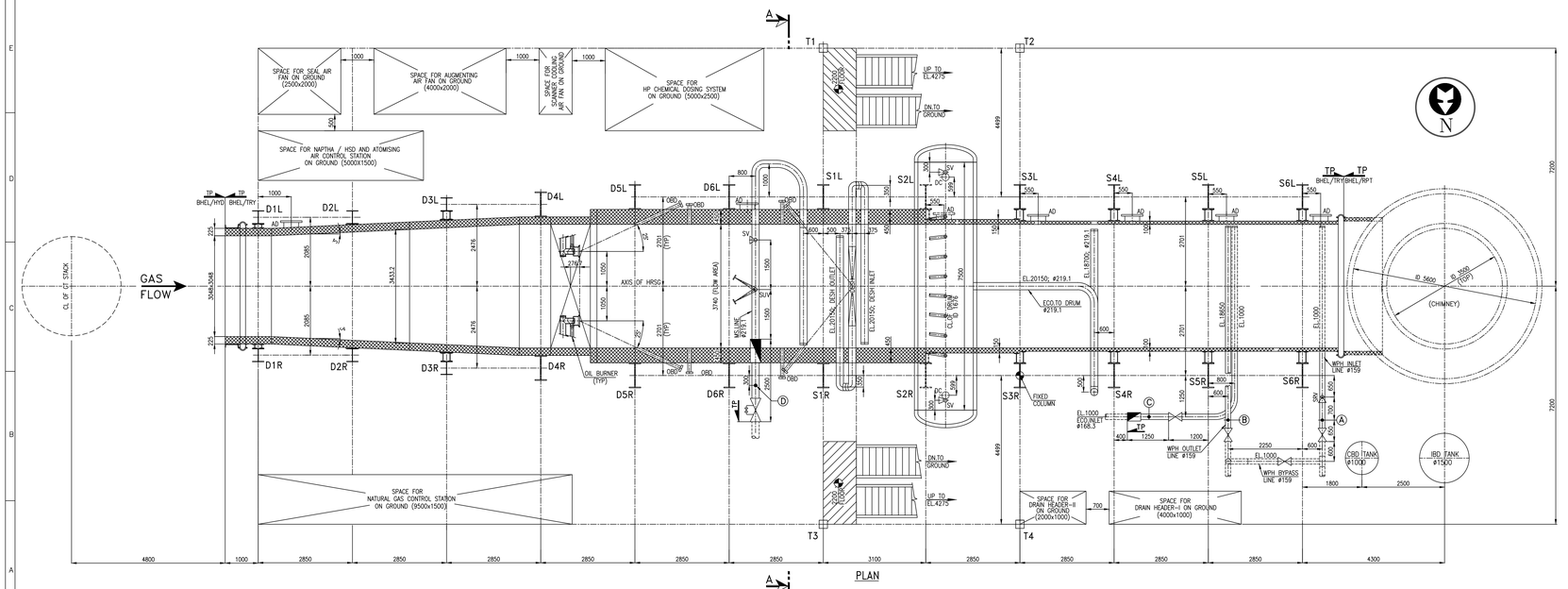
GT.DUCT MATING FLANGE
(SCALE. NTS)



ELEVATION



SECTION–AA



PLAN

LEGEND

SL.No.	CONTENT	ABBREVIATIONS& SYMBOL
01.	ACCESS DOOR (450x600) (SIDE WALL ONLY)	AD
02.	ACCESS DOOR (450x450) (OTHER AREA)	AD
03.	BOLTED DOOR (450x450)	BD
04.	TERMINAL POINT (BHEL TRICHY's SCOPE)	TP
05.	SAFETY VALVE	SV
06.	STARTUP VENT	SUV
07.	SAFETY RELIEF VALVE	SRV
08.	LEFT SIDE	(L)
09.	RIGHT SIDE	(R)
10.	WATER PRE HEATER	WPH
11.	SUPER HEATER	SH
12.	OBSERVATION DOOR	OBD
13.	DOWN COMER	DC
14.	INSULATION	
15.	WATER PRE-HEATER	WPH
16.	OIL BURNER	
17.	GAS BURNER	

DESCRIPTION OF THE UNIT:

4x110 TPH, OUT DOOR, SUPPLEMENTARY FIRED, SINGLE PRESSURE, SINGLE WIDTH NATURAL CIRCULATION, HORIZONTAL TYPE HEAT RECOVERY STEAM GENERATOR BEHIND FRAME 6A GT.

COLUMN SIZE:

D1 TO D3 – I 400 x 350

D4 TO D6 & S1 TO S6 } I 750 x 350

NOTES:

1. ALL DIMENSIONS INDICATED FOR DUCT REPRESENTS INSIDE SIZE ONLY.
2. ENSURE THAT THE BOTTOM CASING AND TOP DUCT IS PROVIDED WITH A SLOPE OF 1° AS SHOWN IN SECTION.
3. ADs ARE PROVIDED ON RIGHT SIDE OF HRSG AND OBD'S ARE LOCATED LEFT & RIGHT SIDE THE BURNER DUCT.
4. (A), (B), (C) & (D) ARE DESIGNATION OF ANCHOR/SLIDING POINTS.
5. OIL BURNER OBDs ARE TO BE KEPT IN INCLINED POSITION.
6. SPACE IDENTIFIED FOR VARIOUS EQUIPEMENTS ARE AT GROUND, UNLESS OTHERWISE SPECIFIED.
7. FIXED COLUMN : S3R

REFERENCE DRAWINGS:

1. PLOT PLAN DRAWING No. ---- 0-381-01-01108

CUSTOMER No. 5750,5751,5752&5753

REV	DATE	A/LTD	KAK
01	30.08.2011	CHD	KAK
		APPD	SG

ZONE:

1. HRSG INLET DUCT FLANGE DETAILS UPDATED AS PER THE GT OUTLET DUCT FLANGE DETAIL DRG(Nos.4-96585-9-16R(Rev.01) RECEIVED FROM BHEL/HYD ON 19.08.2011.

OWNER: DAHEJ PETROCHEMICAL COMPLEX
STEAM & POWER GENERATION SYSTEM
ONGC Petro-additions Limited
SEZ, Dahej, Gujarat, India
4x110 t/hr.; 110Kg/Cm2(g); 515°C,

PMC

Tender No.-MR/OW/MM/STG-NOM/19/2009 | EIL JOB No.6987 / EPCC – 10 Pkg.

BHARAT HEAVY ELECTRICALS LTD.,
BOILER PLANT UNIT, TIRUCHIRAPALLI-620 014.
261-245/A

DRAWN	M.Dharmalingam
CHECKED	Kore Ashok kumar
APPROVED	S.Gnanaraj
DATE	18.05.11

TITLE: GENERAL ARRANGEMENT OF BOILER-ELEVATION,PLAN & SECTIONS

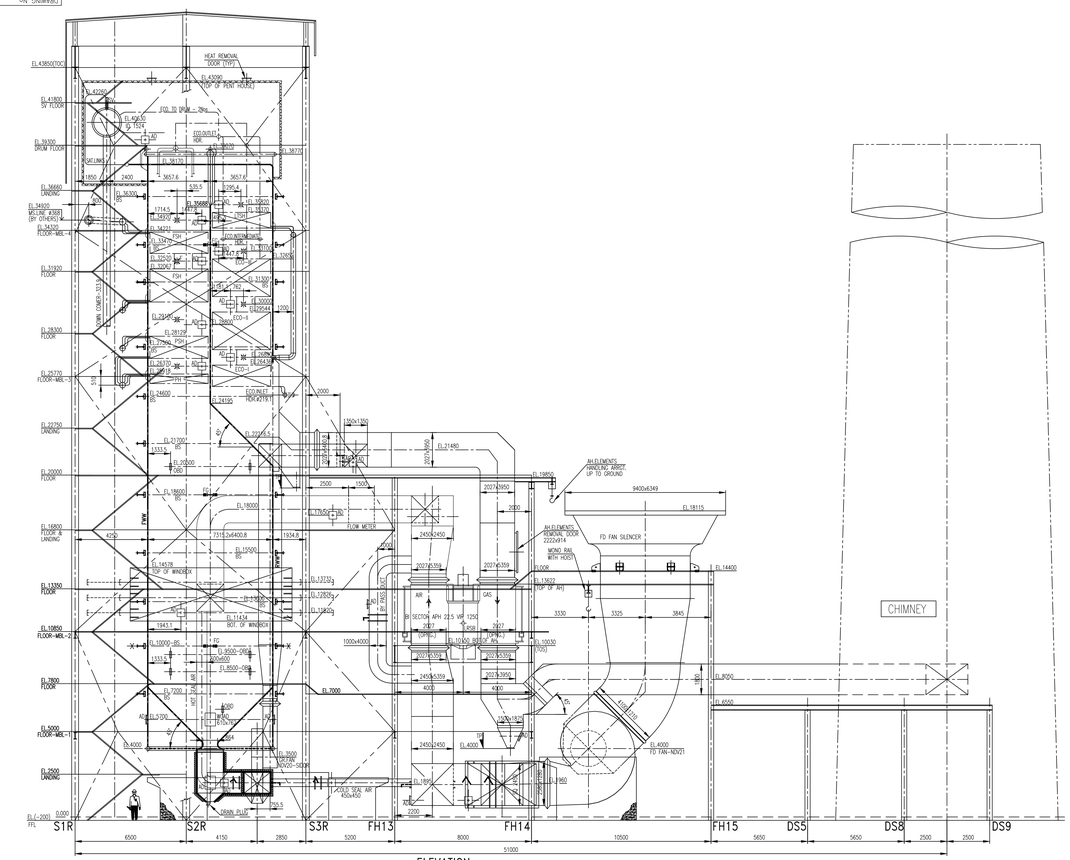
ALL DIMENSIONS ARE IN MILLIMETRES

SCALE 1:60

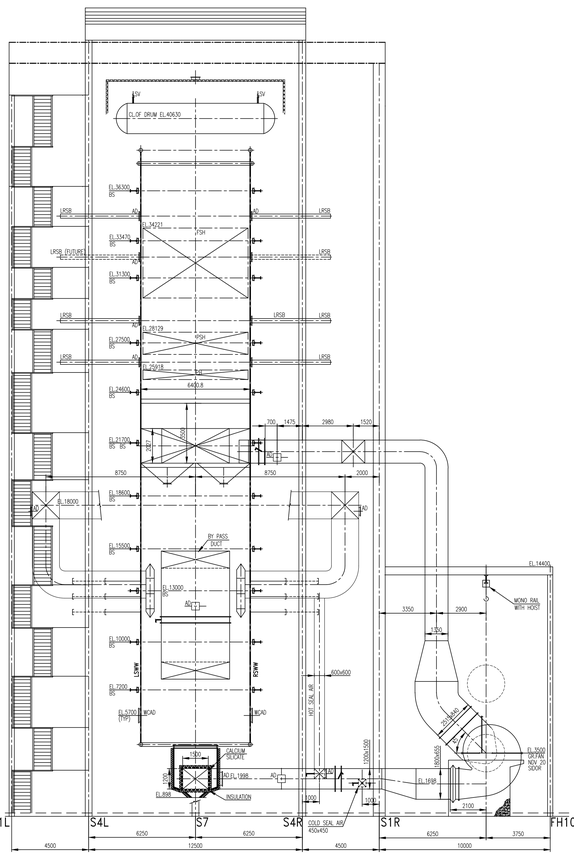
DRG No. 0-00-561-93543 REV. 01

CUST. DRG. NO.

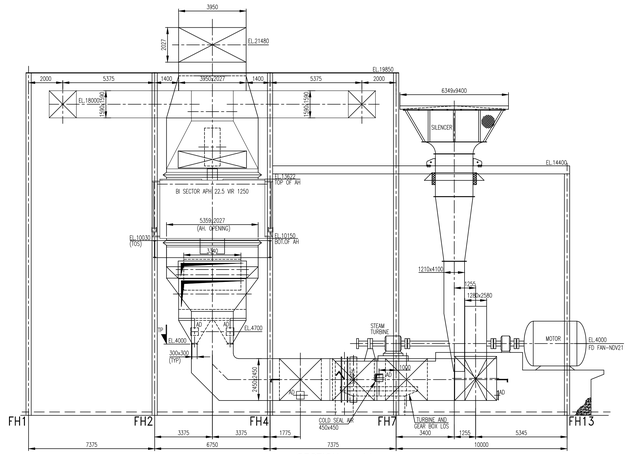
A0 SIZE



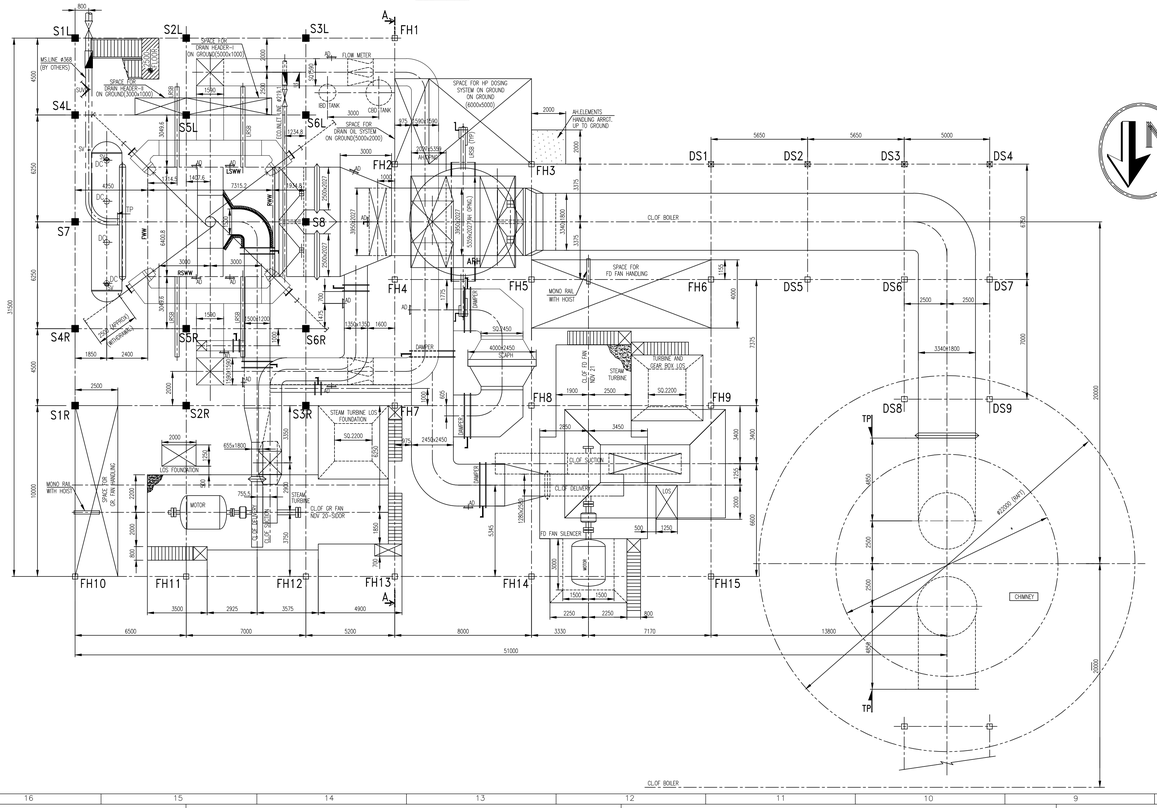
ELEVATION

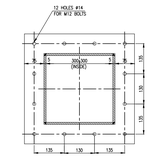


SIDE VIEW



SECTION – AA





LEGEND

AD	ACCESS DOOR
BS	BUCKSTAY
ECO	ECONOMISER
FG	FURNACE GUIDE
FWW	FRONT WATER WALL
RWW	REAR WATER WALL
LSWW	LEFT SIDE WATER WALL
RSWW	RIGHT SIDE WATER WALL
SV	SAFETY VALVE
SUV	START-UP VENT
APH	AIRPREHEATER
FD	FORCED DRAFT
TP	TERMINAL POINT
DC	DOWNCOMER
GR	GAS RE-CIRCULATION
LRSB	LONG RETRACTABLE SOOT BLOWER
OBD	OBSERVATION DOOR
WCAD	WATER COOL ACCESS DOOR
PH	PLATEN HANGER
PSH	PLATEN SUPER HEATER
FSH	FINAL SUPER HEATER

BOILER PARAMETERS:–

1. STEAM FLOW AT MAIN STEAM STOP VALVE OUTLET ---------- 2x220 T/H
2. STEAM PRESSURE AT MAIN STEAM STOP VALVE OUTLET -------- 111 Kg/cm^2 (g)
3. STEAM TEMPERATURE AT MAIN STEAM STOP VALVE OUTLET ------ 515±5°C

DESCRIPTION OF THE UNIT:–

2x220 t/hr BOX TYPE (PRESSURIZED FURNACE), 100% FUEL GAS FIRING,
100% FUEL OIL (NAPHTHA) FIRING, TILTING TANGENTIAL FIRING UTILITY BOILER.

NOTES

1. ALL DUCT DIMENSIONS REPRESENT INSIDE DIMENSIONS ONLY.
2. INNER RADIUS OF ALL DUCT BEND IS 300mm, UNLESS SPECIFIED OTHERWISE.
3. ◢TP = TERMINAL POINT FOR BHEL/TRICHY SCOPE OF SUPPLY

REFERENCE DRAWINGS

1. PLOT PLAN DRG. No: – – – 0-381-01-01108

CUSTOMER No. 6011 & 6012

REV	DATE	
01	19.03.11	ALTD RP.Nathan
		CHD P.K.Sahoo
		APPD S.Gnanaraj

ZONE

1. CHIMNEY BREACH LEVEL ALTERED.
2. FD FAN SILENCER ORIENTATION CHANGED AS PER BAP/RANIPET.
3. SCAPH SIZE CHANGED TO 4000x2450 AS PER BAP/RANIPET.
4. DRAWING TITLE BLOCK UPDATED.
5. DRAWING REVISED BASED ON CUSTOMER COMMENTS RECIVED VIA e-mail DATED 22.02.11.

CUSTOMER OWNER: ONGC Petro-additions LIMITED, STEAM & POWER GENERATION SYSTEM
PMC: Fluor
CONSULTANT: ENGINEERS INDIA LIMITED
PROJECT: OPAL DAHEJ PETROCHEMICAL COMPLEX
SEZ, Dahej, Gujarat, India
2 x 220 TPH ; 111Kg / cm^2 (g) : 515±5°C
Tender No.-MR/OW/MM/STG-NOM/19/2009 | EIL JOB No. 6987 / EPCC – 10 Pkg.

BHARAT HEAVY ELECTRICALS LTD.,
BOILER PLANT UNIT, TIRUCHIRAPALLI–620 014.
381-2457/A

DRAWN	RP.Nathan
CHECKED	P.K.Sahoo
APPROVED	S.Gnanaraj
DATE	05.02.2011

TITLE: GENERAL ARRANGEMENT OF BOILER

ALL DIMENSIONS ARE IN MILLIMETRES | SCALE 1:125
DRG No. 0-00-511-93529 | REV. 01
A0 SIZE