CORRIGENDUM -1 TO TENDER SPECIFICATION BHEL PSSR SCT 1583 - Civil, Structural and Architectural works of Utility Boiler and allied works including Multi Flue RCC Chimney for 1 x 150TPH RESID Upgradation Project at CPCL, Manali, Chennai. DT:28/04/2015

Some of the bidders sought clarifications vide letters in regard to TENDER SPECIFICATION BHEL PSSR SCT 1583 - Civil, Structural and Architectural works of Utility Boiler and allied works including Multi Flue RCC Chimney for 1 x 150TPH RESID Upgradation Project at CPCL, Manali, Chennai and BHEL's clarifications are furnished below for information. Sl.No. 07, 08, 09 & 11 of C.General Issued by BHEL.

Sl. No.	Reference	Clarification/Query	BHEL REPLY
A.	**UB, GT & HRSG Civil, Structural and Architectural works**		
1	BOQ item Sl. No. 102 to 108	BOQ item Sl. No. 102 to 108 is missing. Please clarify.	BOQ item Sl. No. 102 to 108 , these are not relevant for this project.
2	BOQ item Sl. No. 208	Please arrange to provide separate items for petro graphic examination and potential reactivity of aggregate & Ultra-Sonic Pulse Velocity (UPV) test	Contractor to quote as per BOQ items.
3	BOQ item Sl. No. 216	Please provide the size of pockets or openings and also please provide separate items for various size ranges.	Contractor to quote as per BOQ item. Sizing will be available during detailed engineering stage.
4	BOQ item Sl. No. 218	Please provide the size of pockets or openings and also please provide separate items for various size ranges.	Contractor to quote as per BOQ item. Sizing will be available during detailed engineering stage.
5	BOQ item Sl. No. 302	Please provide separate items for circular form work for domes, arches, circular overhead tanks etc.	Domes, arches, circular overhead tanks are not envisaged in this project. Contractor to quote accordingly.
6	BOQ item Sl. No. A501	Please provide the membrane details.	Membrane detail shall be as per BOQ item no. 504(a)
		Please provide separate item for Non skid ceramic tiles of 10 mm thick with CM 1:3 and please furnish the mortar thickness.	Protective layer of screed concrete as per item no. 501(a) to be provided over membrane. The non skid tiles under item no. 501 (a) is deleted. ITEM NO.A501 to read as"**Providing and laying in-situ concrete screed of 50mm thick over the membrane as per owner/consultant, the screed shall be laid panels of 2m x 2m. The screed shall be in concrete mix 1:1.5:3 with polypropylene fibers, the joints shall be filled with polyurethane sealant. All the work shall be done as per manufacruer's specification as per the Owner/consultant complete all as per specifications, drawings and as directed by Engineer"**
7	BOQ item Sl. No. A504	Please provide the specification for layer description.	Layer description to be followed as per BHEL standard specification PEDC/STD.SPEC/019.
8	BOQ item Sl. No. 1304 & 1315	Please confirm that POP is not included in these items.	It is confirmed that POP item is not included in BOQ item Sl. No. 1304 & 1315.
9	BOQ item Sl. No. 1401	Please provide the quantity of non metallic hardener to be used per Sqm of flooring work.	Minimum quantity of hardener per square meter of the floor area shall be 1.2kg.
10	BOQ item Sl. No. 1834	230 mm and down size boulders shall be used. Please confirm.	Aggregate size for bolder soiling shall be 20-40mm.

CORRIGENDUM -1 TO TENDER SPECIFICATION BHEL PSSR SCT 1583 - Civil, Structural and Architectural works of Utility Boiler and allied works including Multi Flue RCC Chimney for 1 x 150TPH RESID Upgradation Project at CPCL, Manali, Chennai. DT:28/04/2015

Some of the bidders sought clarifications vide letters in regard to TENDER SPECIFICATION BHEL PSSR SCT 1583 - Civil, Structural and Architectural works of Utility Boiler and allied works including Multi Flue RCC Chimney for 1 x 150TPH RESID Upgradation Project at CPCL, Manali, Chennai and BHEL's clarifications are furnished below for information. Sl.No. 07, 08, 09 & 11 of C.General Issued by BHEL.

Sl. No.	Reference	Clarification/Query	BHEL REPLY
		Please provide customer soil report recommendation, page no 26.	Soil report page no. 26&27 is attached.
11	BOQ item Sl. No. 2208	Excavation and Backfilling shall be paid at relevant items. Please confirm.	It is confirmed that excavation and backfilling shall be paid separately under relevant items.
12	Micro Grading, Page 33 of Volume – I	Please incorporate suitable item for micro grading in Price Bid.	Micro grading works covered under BOQ item no. 110.
13	Scope of Work, Page 34 of Volume – I	Please confirm that all construction drawings shall be issued by BHEL, which is not clear from the document.	It is confirmed that Construction drawing will be issued by BHEL.
B.	**Chimney Work:**		
1	BOQ item Sl. No. 2501	It is understood that mobilization of hydraulic rotary piling rigs and accessories at BOQ item Sl. No. 2501 is applicable for both Civil works & Chimney work. Please confirm.	YES
2	BOQ item Sl. No. 10.4, Non-metallic expansion compensators (for flues)	Please provide us following technical information.	Typical detail of expansion compensator for flues is attached for tendering purpose.
		Type of fluid:	
		Application:	
		Temperature:	
		Pressure, mm WC:	
		Nature of dust:	
		Direction of flow:	
		Axial movement, mm:	
		Lateral movement, mm:	
		Transverse movement, mm:	
3	BOQ item Sl. No. 10.6	Please provide the details of roof access cover.	Typical detail of roof access cover is attached for tendering purpose.
4	BOQ item Sl. No. 10.7	BOQ item Sl. No. 10.7 is missing. Please clarify.	it is covered under item no. 10.8.
5	BOQ item Sl. No. 10.14	Please provide the weight of one number H.T. Bolt	Contractor to quote as per BOQ items. For weight detail of bolts, relevant IS code may be referred.
6	BOQ item Sl. No. 10.16	Please provide the weight of one number S.S. insert / plug	The actual weight will be available after detail engineering.
7	BOQ item Sl. No. 11, ELECTRICAL WORK	Please provide specification No: 44NC-4600- 0000/ E.02/ 0001/ A4	The specification is attached.
C.	**General**		

CORRIGENDUM -1 TO TENDER SPECIFICATION BHEL PSSR SCT 1583 - Civil, Structural and Architectural works of Utility Boiler and allied works including Multi Flue RCC Chimney for 1 x 150TPH RESID Upgradation Project at CPCL, Manali, Chennai. DT:28/04/2015

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Sl. No.	Reference	Clarification/Query	BHEL REPLY
1	Scope of supply	As per scope of supply in line with TCC Cl. No. ……. that Cement, Reinforcement Steel, Structural Steel, etc shall be supplied by contractor but the same are not in line with relevant SOR item description. Hence, please confirm scope of supply by BHEL.	Cement, Reinforcement steel and structural steel is in the scope of the bidder.
2	Bore log details	Please furnish the bore log details, to know the soil conditions required for piling and other substructure activities.	Bore log details are available in Geotechnical Report
3	BOQ item Sl. No. 2503	a) Please provide the cut-off level of Pile from existing ground level, for correct assessment of Piling rate.	For pile cut-off detail please refer Geotechnical Report.
		b) Please confirm disposal area for muck generated front piling & other construction debris, surplus earth.	Disposal rea will be to a designated place as instructed by the customer outside the refinery premisis. Refer cusomer clause. 1.4.2(a) under heading Leveling and Micro grading.
4	Height of Structure	a) Please furnish the Elevation Drawings for proposed Utility Boiler, GT & HRSG, RCC Chimney and other structures to enable us to assess the correct volume of staging work involved and to offer you the competitive rate.	Boiler, GT & SRSG super structures are not in civil scope, and tentative height of RCC chimney shall be 85m.
		b) Please confirm the max height of RCC Structure and height of Structural Steel Structure.	RCC structure & steel structure height will be available after detailed engineering.
5	Barricading	Please incorporate necessary items for temporary barricading work, since it is understood that the proposed site is adjacent to operating plants of Refinery.	Baricading work in in the scope of BHEL
6	Handing over of site for commencement of work	It is understood that the existing Pavement and other RCC & Steel Structures at site shall be dismantled by BHEL and handed over to the Contractor immediately to start the Piling work. Please confirm.	Dismantling of pavment and other RCC structures at site shall be dismantled by the bidder under relevent item for starting the Pile work.

CORRIGENDUM -1 TO TENDER SPECIFICATION BHEL PSSR SCT 1583 - Civil, Structural and Architectural works of Utility Boiler and allied works including Multi Flue RCC Chimney for 1 x 150TPH RESID Upgradation Project at CPCL, Manali, Chennai. DT:28/04/2015

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Sl. No.	Reference	Clarification/Query	BHEL REPLY
7	BOQ item.207	Providing and laying Design Mix cement concrete confirming to IS:456 & IS 10262-2009 for reinforced concrete works of grade M35 Grade in machine foundations for TG, Gas Turbine, ID/FD/PA fans, BFP, Coal mills at all elevations below/above finished floor level except TG deck and top decks supported over vibration isolation system including addition of suitable plasticizer conforming to IS 9103 (latest) to achieve a slump more than 125mm in concrete as per manufacturer's recommendation with 20 mm nominal size graded aggregate in concrete all complete as per specification & drawing.	To Be read as "Providing and laying Design Mix cement concrete confirming to IS:456 & IS 10262-2009 for reinforced concrete works of grade M35 Grade in **machine foundations for at all elevations below/above finished floor level except TG deck and top decks** supported over vibration isolation system including addition of suitable plasticizer conforming to IS 9103 (latest) to achieve a slump more than 125mm in concrete as per manufacturer's recommendation with 20 mm nominal size graded aggregate in concrete all complete as per specification & drawing."

CORRIGENDUM -1 TO TENDER SPECIFICATION BHEL PSSR SCT 1583 - Civil, Structural and Architectural works of Utility Boiler and allied works including Multi Flue RCC Chimney for 1 x 150TPH RESID Upgradation Project at CPCL, Manali, Chennai. DT:28/04/2015

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Sl. No.	Reference	Clarification/Query	BHEL REPLY
8		Providing and laying Design Mix cement concrete as per IS:456 & IS 10262-2009 of grades mentioned below for reinforced concrete works using graded aggregate in top decks of all machine foundations supported on vibration isolation system (excluding supply and installation of vibration system) and top deck of TG foundation at all levels including addition of suitable plastisizers conforming to IS9103 to achieve a slump more than 125 mm in concrete as per manufacturers recommendation, preperation of scheme for concreting, getting it approved by engineer, labour, materials, equipment, handling, batching, transporting, mixing, pumping, placing, leveling, vibrating, compacting, curing, testing, cleaning and rendering the exposed surface with cement sand mortar to give a smooth and even surface, maintaining and submitting records of concreting, petrographic examination and potential reactivity of aggregate etc. all complete as per specification, drawing and instructions of engineer, including UPV testing as directed by engineer in charge, rectification of the defects in concreting observed by ultra-sonic pulse velocity (UPV) testing by cement/epoxy grout etc, but excluding formwork, staging, reinforcement, embeddments and temperature control of concrete. Payment terms - a) After casting 75% ; b) After receipt of ultrasonic test report - 25%.	To be Read as "Providing and laying Design Mix cement concrete as per IS:456 & IS 10262-2009 of grades mentioned below for reinforced concrete works using graded aggregate in top decks of **all machine foundations supported on vibration isolation system (excluding supply and installation of vibration system)** including addition of suitable plastisizers conforming to IS9103 to achieve a slump more than 125 mm in concrete as per manufacturers recommendation, preperation of scheme for concreting, getting it approved by engineer, labour, materials, equipment, handling, batching, transporting, mixing, pumping, placing, leveling, vibrating, compacting, curing, testing, cleaning and rendering the exposed surface with cement sand mortar to give a smooth and even surface, maintaining and submitting records of concreting, petrographic examination and potential reactivity of aggregate etc. all complete as per specification, drawing and instructions of engineer, including UPV testing as directed by engineer in charge, rectification of the defects in concreting observed by ultra-sonic pulse velocity (UPV) testing by cement/epoxy grout etc, but excluding formwork, staging, reinforcement, embeddments and temperature control of concrete. Payment terms - a) After casting 75% ; b) After receipt of ultrasonic test report - 25%.

CORRIGENDUM -1 TO TENDER SPECIFICATION BHEL PSSR SCT 1583 - Civil, Structural and Architectural works of Utility Boiler and allied works including Multi Flue RCC Chimney for 1 x 150TPH RESID Upgradation Project at CPCL, Manali, Chennai. DT:28/04/2015

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Sl. No.	Reference	Clarification/Query	BHEL REPLY
9	BOQ item.1836	Supplying, laying and commissioning carbon steel pipe line below GL including coating and wrapping, joint testing, cost of materials etc. all complete as per specification no. PEDC-STD,SPEC-38 and drawings. (Earthwork excavation and back filling to be measured separately)	To be read as "Supplying, laying and commissioning carbon steel pipe line below GL including coating and wrapping, joint testing, cost of materials etc. all complete as per specification and drawings. (Earthwork excavation and back filling to be measured separately)"
10	**CONSTRUCTION SCHEDULE**	**Understanding:-**	
	a) Completion of Piling : 90 days	a) Completion of Piling: 90 days from date of commencement.	The completion days given to the respective structure/system rediness from the date of start of work of that respective structure. C) Completion of GT & HRSG & rediness for start of erection to be read as " Completion of SKIDS, Equipment, pits and tanks ,Micelanous Structural platforms, monorail beams, walkways, crossovers, handrails etc. for miscellaneous equipment's, piping , cable trenches etc."
	b) Completion of Boiler Foundation & readiness for start of erection : 90 days	b) Completion of Boiler Foundation & readiness for start of erection: 180 days from date of commencement.	
	c) Completion of GT&HRSG & readiness for start of erection : 60 days	c) Completion of GT&HRSG & readiness for start of erection: 150 days from date of commencement.	
	d) Completion of Fan Foundation : 120 days	d) Completion of Fan Foundation: 210 days from date of commencement.	
	e) Completion of Miscellaneous buildings : 300 days	e) Completion of Miscellaneous buildings: 300 days from date of commencement.	
	f) Completion of RCC Chimney Twin Flue : 300 days	f) Completion of RCC Chimney Twin Flue: 300 days from date of commencement.	
	(Cl. No. 1.6.1, 1.6.7 of Volume-IA of TCC, Page 48, 49)	Please confirm.	

CORRIGENDUM -1 TO TENDER SPECIFICATION BHEL PSSR SCT 1583 - Civil, Structural and Architectural works of Utility Boiler and allied works including Multi Flue RCC Chimney for 1 x 150TPH RESID Upgradation Project at CPCL, Manali, Chennai. DT:28/04/2015

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Sl. No.	Reference	Clarification/Query	BHEL REPLY
11	Chapter IX of Special Conditions of Contract (SCC)		Both BHEL and CPCL guidelines for compliance of safety and permit system shall be followed. Item no 13 of GCC and appendix 6 of SCC of CPCL shall take precedence and prevail in case of any ambiguity on safety and permit system compliance. (Encl. CPCL Item no 13 of GCC and appendix 6 of SCC)
12	Due date of submission	The proposed work involves various vendor based items such as Joineries, Roofing, False ceiling, Fencing, RCC chimney and associated Electrical works, Lightning Protection works with involvement of substantial value. Hence, to prepare & submit competitive bid based on correct inputs from various vendors adequate time shall be required. Hence, we hereby request you to kindly arrange to extend the due date of tender submission up to 20.05.2015.	Due date & Time of Offer Submission :- Date:-11/05/2015 Time:1500Hrs Opening of Tender :- Date:- 11/05/2015 Time:1530Hrs

Note:-

All other Terms & Conditions remain unchanged.

GM / HR & SCT

Encl:-

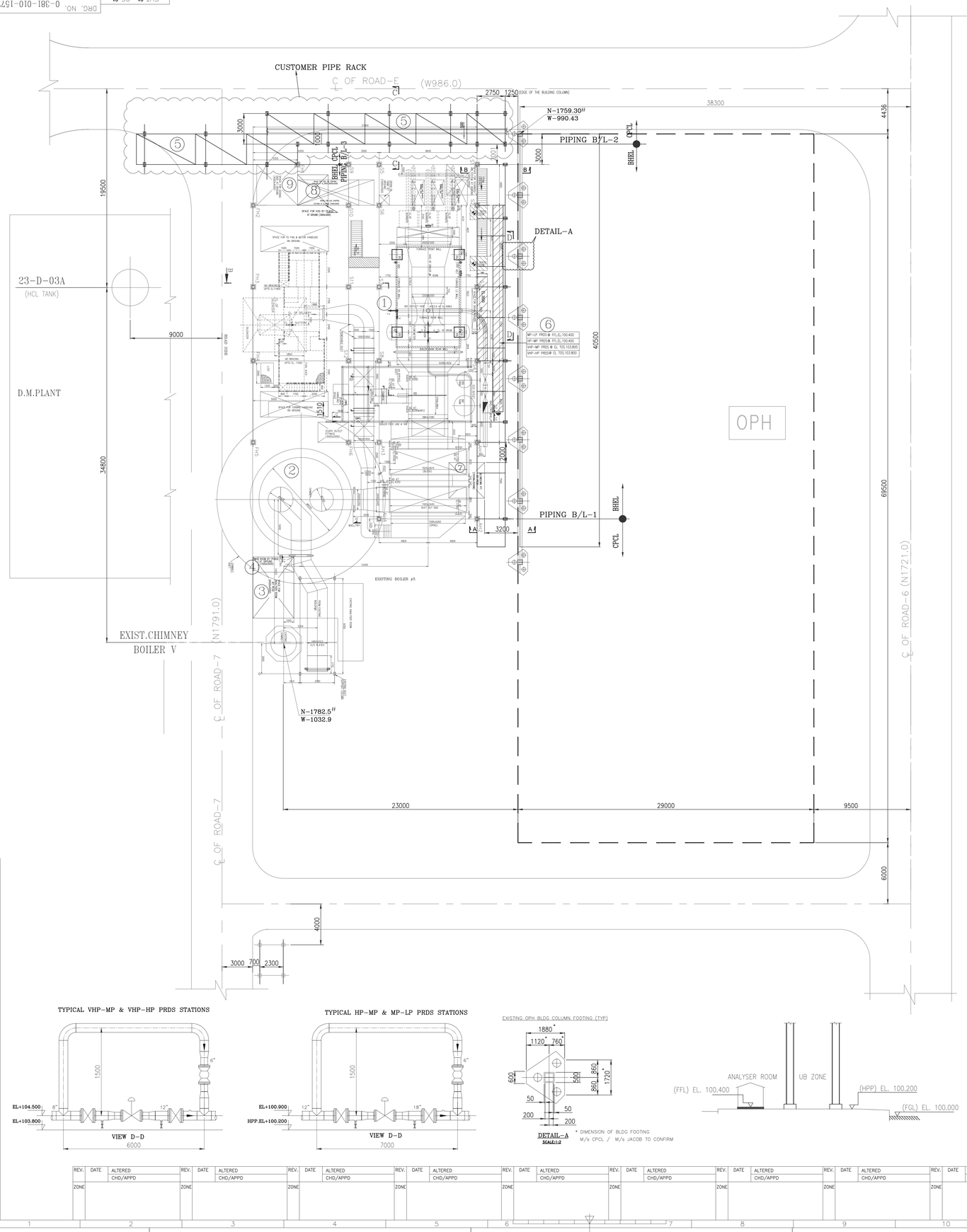
1. Standard Drawings (For Tender Purpose Only) - 12 Pages
2. Soil Report - 34 Pages
3. Engineering design basis - Electrical - 49 Pages
4. Non metallic expansion compensator for flues - 01 Pages
5. Roof access cover - 01 Pages
6. CPCL Safety Clauses - Item no 13 of GCC and appendix 6 of SCC - 49 Pages

1. Standard Drawings – 12 Pages (For Terder Purpose Only)

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 0-381-010-1577 SHT. 01 OF 01



TYPICAL VHP-MP & VHP-HP PRDS STATIONS

TYPICAL HP-MP & MP-LP PRDS STATIONS

EXISTING OPH BLDG COLUMN FOOTING (TYP)

DETAIL-A
SCALE:1:2

* DIMENSION OF BLDG FOOTING M/s CPCL / M/s JACOB TO CONFIRM

DETAILS OF B/L-1

SL.NO.	TP NO	DESCRIPTION	M/s BHEL TENTATIVE PIPE SIZE	M/s CPCL & M/s JACOBS PIPE SIZE	B/L SCOPE DIAGRAM	TENTATIVE ELEVATION W.R.T HPP
1	101	VHP STEAM TO CUSTOMER B/L	300NB x 17.48(P11)	16"	12" 16"**	103.800
2	–	VHP STEAM TO PRDS	200NB x 12.70(P11)	16"	12" 16"**	103.800
3	05	BFW	200NB x 12.70(A106GrB)	12"	8" 12"**	103.800
4	–	FUEL OIL SUPPLY	50NB x 5.54(A106GrB)	–	2" 6"**	103.800
5	–	FUEL OIL RECIRCULATION	50NB x 5.54(A106GrB)	–	2" 6"**	103.800
6	–	MP STEAM FOR STARTUP	50NB x 5.54(A106GrB)	3"	2" ****	103.800
7	–	CBD VENT (PC SCOPE)	–	–	–	–
8	06	BLOWDOWN	50NB X 5.54(A106GrB)	2"	2" 2"**	–

DETAILS OF B/L-2

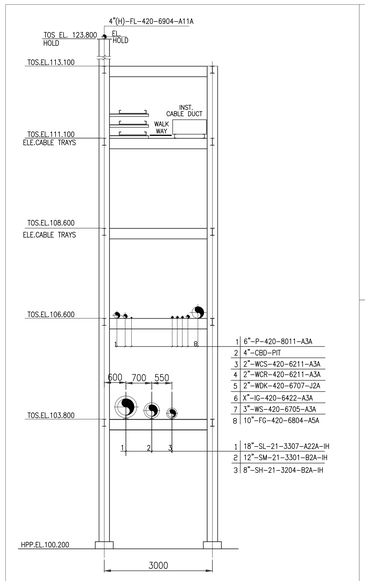
SL.NO.	TP NO	DESCRIPTION	M/s BHEL TENTATIVE PIPE SIZE	M/s CPCL & M/s JACOBS PIPE SIZE	B/L SCOPE DIAGRAM	TENTATIVE ELEVATION W.R.T HPP
1	02	HP STEAM	200NB x 8.18(A106GrB)	16"	8" 16"**	103.8
2	03	MP STEAM	300NB x 9.53(A106GrB)	16"	12" 16"**	103.8
3	04	LP STEAM	450NB x 9.53(A106GrB)	12"	18" 12"**	103.8
4	08	INSTRUMENT AIR	33.4 X 4.55(A106GRB)	2"	1" 2"**	103.8

DETAILS OF B/L-3

SL.NO.	TP NO	DESCRIPTION	M/s BHEL TENTATIVE PIPE SIZE	M/s CPCL & M/s JACOBS PIPE SIZE	B/L SCOPE DIAGRAM	TENTATIVE ELEVATION W.R.T HPP
1	–	FUEL GAS TO KOD DRUM	300NB x 9.53(A106GrB)	**	12" SIZE(**)	**
2	TP10	POTABLE WATER	80NB x 4.85(IS1239)	**	3" SIZE(**)	**
3	–	FLAIR LINE FROM KOD DRUM	100NB x 6.02(A106GrB)	**	4" SIZE(**)	**
4	TP12	DM WATER	50NB x 3.91(SS304)	**	2" SIZE(**)	**
5	TP07	PLANT AIR	80NB x 5.49(A106GrB)	3"	3" 3"**	**
6	TP11	SERVICE WATER	100NB x 6.02(A106GrB)	3"	4" 3"**	**
7	TP09	NITROGEN	25NB X 4.55(A106GRB)	2"**	1" 2"**	**
8	–	COOLING WATER SUPPLY	150NB x 5.4(IS1239)	**	6" SIZE(**)	**
9	–	COOLING WATER RETURN	150NB x 5.4(IS1239)	**	6" SIZE(**)	**

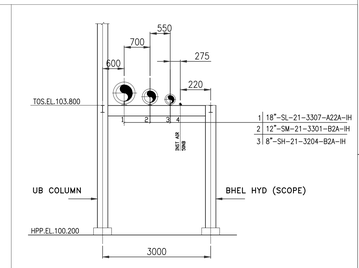
** CUSTOMER TO CONFIRM THE PIPE SIZE & ELEVATION
CUSTOMER TO CONFIRM THE CO-ORDINATES.
TP-TERMINAL POINT AT BATTERY LIMIT

CUSTOMER PIPE RACK



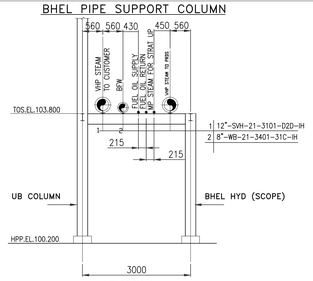
SECTION C-C
SCALE:1:2.5

BHEL PIPE SUPPORT COLUMN

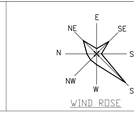


SECTION B-B
SCALE:1:2.5

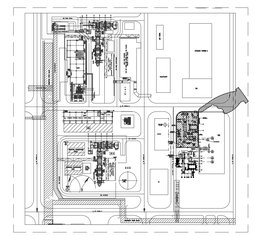
BHEL PIPE SUPPORT COLUMN



SECTION A-A
SCALE:1:2.5



WIND ROSE



KEY PLAN

EQUIPMENT LIST

SL.NO.	TAG NO	DESCRIPTION	QTY	TENTATIVE SIZE	TENTATIVE WEIGHT
1		UTILITY BOILER	01	40M x 25M	
2		CHIMNEY FOR UB	01	DIA 8.250M	
3		ANALYSER ROOM	01	6M x 4M	
4		SWAS ROOM	01	3M x 1.5M	
5		CUSTOMER PIPE RACK	01	WIDTH 3M	
6		PRDS STATIONS	04	1.5M x 12M	
7		BLOWDOWN PIT	01	3.5M x 3.5M	
8		KOD DRUM	01	3M x 3M	
9		DOSING SKID	01	4M x 4M	

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETERS LEVELS & CO-ORDINATES ARE IN METRES
2. FGL LEVEL IS 100.000M & CORRESPONDS TO MEAN SEA LEVEL (MSL) 3.1M.
3. HPP LEVEL IS 100.200M & CORRESPONDS TO MEAN SEA LEVEL (MSL) 3.3M.
4. FFL LEVEL IS 100.400M & CORRESPONDS TO MEAN SEA LEVEL (MSL).3.5M.
5. BHEL'S DRGS WILL INDICATE ELEVATION W.R.T HPP AT BATTERY LIMIT. UNLESS AND OTHERWISE SPECIFIED IN THE DRAWING
6. LOCATION OF COLUMN IN PRDS AREA(OTHER THAN BOILER COLUMN) IS TENTATIVE AND SUBJECT TO CHANGE BASED ON ACTUAL SITE CONDITION W.R.T EXISTING OPH BHUILDING FOUNDATION AND BEAMS

LEGEND:

FFL: Finished Floor Level
HPP: Highest Paved Point and CRANE MOVEMENT AREA Level
FGL: Finished Ground Level

LEGEND :-

- PACKAGE BATTERY LIMIT
- EXISTING NEW PIPE RACK
- PIPE RACK (BY CUSTOMER)
- PIPE RACK (BY BHEL)
- ROAD DRAIN TRENCH
- SCOPE BHEL/CUSTOMER (PE&SD) CUST.
- SCOPE BHEL (PC) CUST.
- SCOPE BHEL (PE&SD) (TNV)
- SCOPE BHEL & CUST. (TNV)

चेन्नै पेट्रोलियम कॉर्पोरेशन लिमिटेड
(इण्डियन ऑयल की एक कम्पनी)
Chennai Petroleum Corporation Limited
(A group company of indianoil)

CONSULTANT :
JACOBS ENGINEERING INDIA PVT LIMITED (MUMBAI)

NAME OF PROJECT : 1X150 TPH UTILITY BOILER PKG RESID UP GRADATION PROJECT AT CPCL MANALI, CHENNAI

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	DSTS		08.01.15	
CHD.	GOPINATH		08.01.15	-NA-
APPD.	VVSSR		08.01.15	

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

DEPT. PED.	UNTOL. DIMS. OR	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
CODE NO.	g/M/f	1 : 150	-NA-	-NA-	-NA-	-NA-

TITLE: UB-6 AREA LAYOUT

CARD CODE: NA

DRG. NO. 0-381-010-1577 REV. 00

CUST. DRG. NO.

SHT. No 01 NO. OF SHT. 01

REV.	DATE	ALTERED	ZONE
		CHD/APPD	

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED, DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

SIGN AND DATE | REF. DRG. NO. | COMPUTER FILE NAME | INVENTORY NO

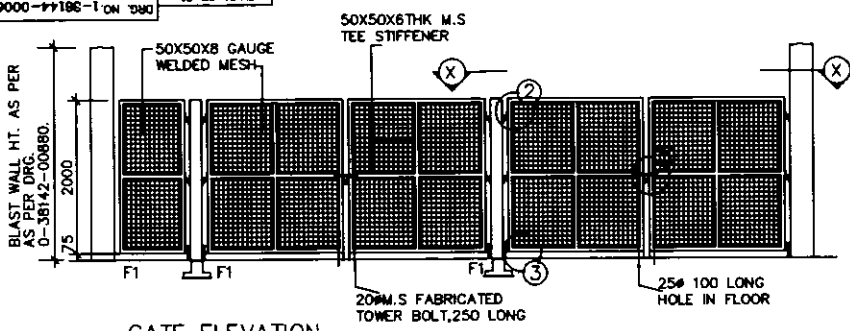
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

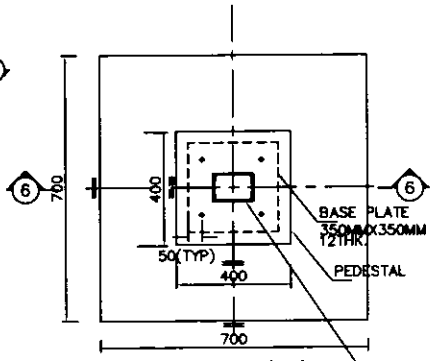
DRG. NO. 1-38144-00062 SH. 01 OF 01

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY

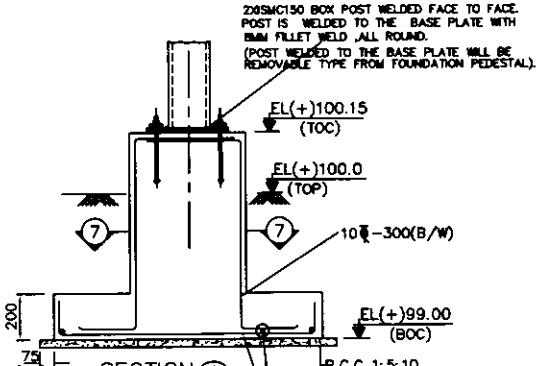
GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261



GATE ELEVATION

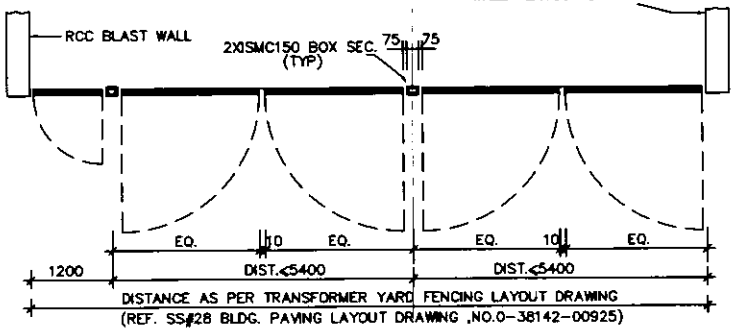


FOUNDATION PLAN(F1)



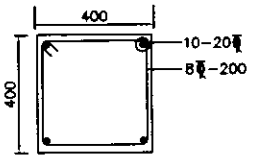
2XISMC150 BOX POST

SECTION (1)



RCC BLAST WALL
(REF. TRANSFORMER YARD BLAST
WALL LAYOUT DRG.NO.0-38142-00880.)

GATE PLAN



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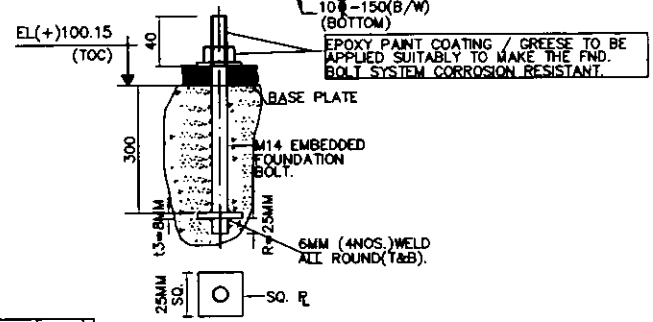
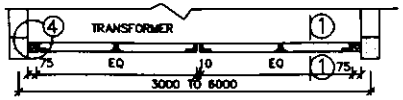
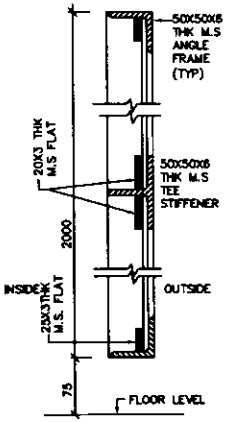


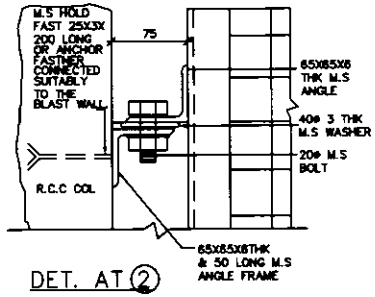
FOUNDATION BOLT
(EMBEDDED).



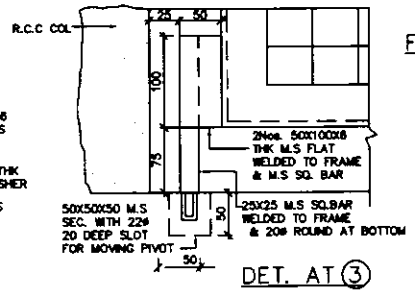
PLAN(TOP VIEW/X-X)



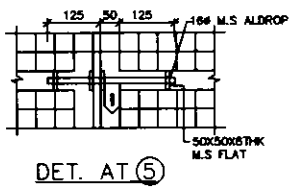
DET 1-1



DET. AT (2)



DET. AT (3)



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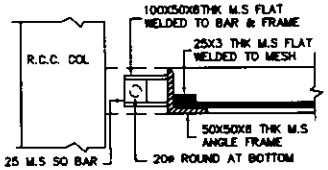


DET. AT (4)

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS & CO-ORDINATES ARE IN METRES, UNO.
2. EL(+)100.150 CORRESPONDS TO FINISHED FLOOR LEVEL OF EXISTING QTG BUILDING UNIT-1 WHICH CORRESPONDS TO SITE RL(+)238.970M.
3. NO DIMENSIONS FROM THIS DRAWING TO BE SCALED OFF AND ONLY FIGURED DIMENSIONS SHALL BE FOLLOWED.

REV.	DATE	ALTERED	DRD/APPD

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE
DRN.	S.SARKAR		3.12.05
CHD.	S.SARKAR		3.12.05
APPR.	K.T.SAILESH		3.12.05

DEPT. PED
CODE 450
UNITOL SIGN. BY PARTY
SCALE N.T.S.
WEIGHT (KG) -NA-
DEP. TO ASSY. SIGN. -NA-
ITEM NO. -NA-
WEIGHT (TONNE) -NA-

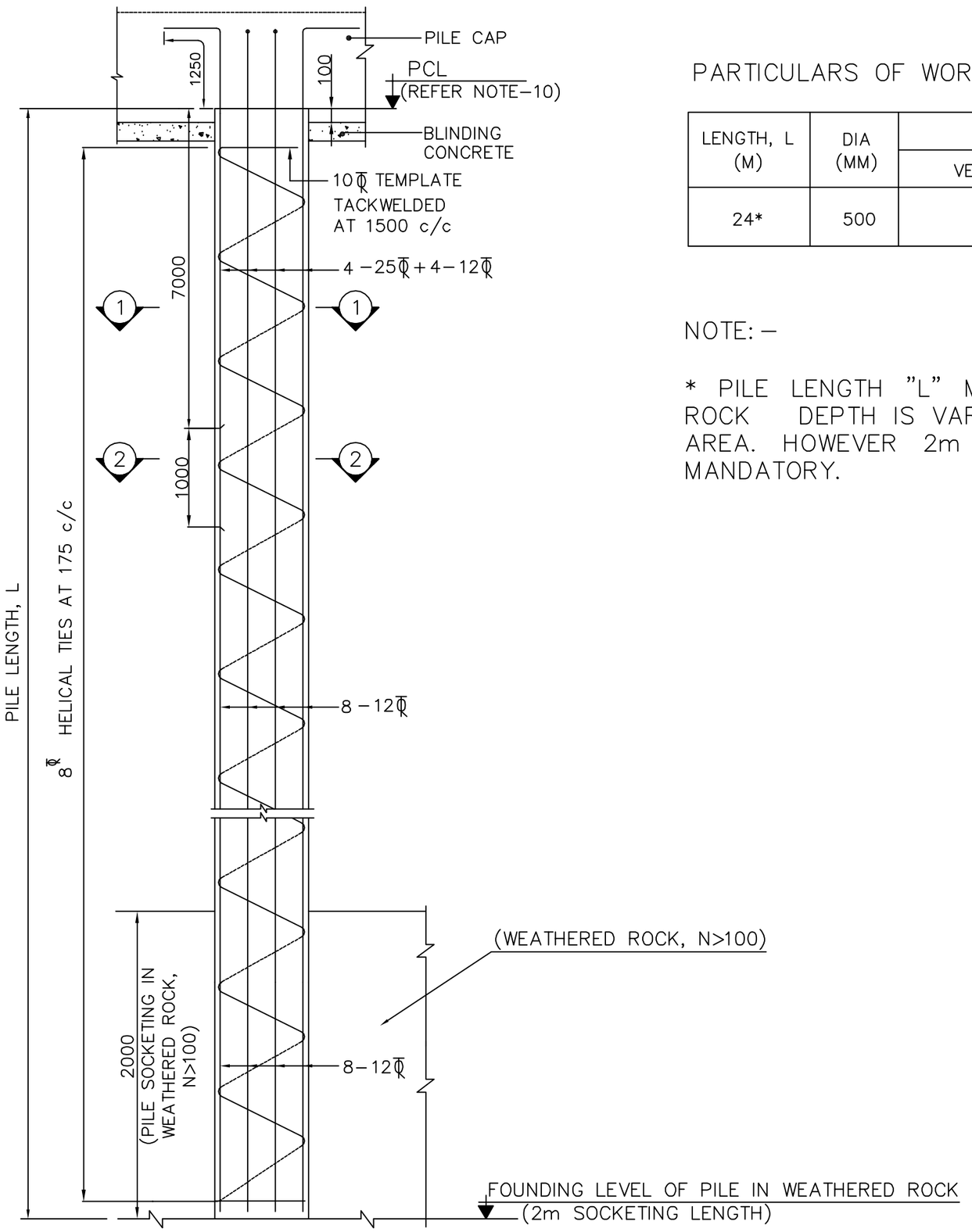
TITLE TYPICAL REMOVABLE TYPE TRANSFORMER GATE & FENCING DETAIL.

CARD CODE NA

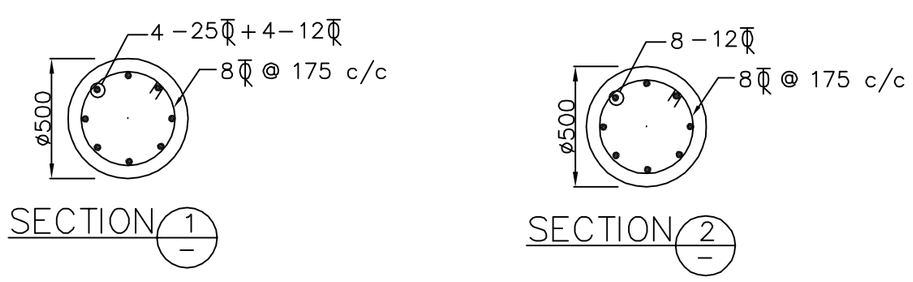
DRAWING NO. 1-38144-00062

REV. 00

SHT. No. 01 NO. OF SHT. 01



LONGITUDINAL SECTION OF PILE



PARTICULARS OF WORKING PILE

LENGTH, L (M)	DIA (MM)	PILE CAPACITY (TONS)			GRADE OF CONCRETE	GRADE OF REINF STEEL
		VERTICAL	HORIZONTAL	PULL OUT		
24*	500	95	3	25	M35	Fe500D

NOTE: –

* PILE LENGTH "L" MAY VARY FOUNDATION TO FOUNDATION AS WEATHERED ROCK DEPTH IS VARYING FROM GROUND LEVEL IN DIFFERENT PLACE OF PLAT AREA. HOWEVER 2m SOCKETING LENGTH OF PILE IN WEATHERED ROCK IS MANDATORY.

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES.
2. PILE SHALL BE BORED CAST-IN-SITU CONCRETE PILE WITH TEMPORARY ENCASING OF 5m.
3. CONCRETING SHALL BE DONE BY TREMIE METHOD.
4. THE GRADE OF CONCRETE SHALL BE 'M35'. MINIMUM CEMENT CONTENT 400KG/CUM.
5. CEMENT SHALL BE OF OPC CONFORMING TO IS: 269
6. REINFORCEMENT STEEL SHALL BE OF Fe500D GRADE, CONFORMING TO IS:1786.
7. CLEAR COVER TO LINKS SHALL BE 50mm.
8. IN ADDITION TO THE REINFORCEMENT SHOWN, SPACER BARS /CIRCULAR TEMPLATE WITH 10 SHALL BE PROVIDED AT 1500C/C. LONGITUDINAL MAIN BARS SHALL BE TACK WELDED TO CIRCULAR TEMPLATE.
9. CONCRETING SHALL BE DONE MIN OF 1000mm ABOVE OF PILE CUT-OFF LEVEL.
10. PILE CUT OFF LEVEL SHALL BE 2.0m BELOW NATURAL GROUND LEVEL, UNO. FOR ACTUAL CUT-OFF LEVELS OF JOB PILE, REFER RESPECTIVE PILING LAYOUTS DRGS.
11. DEVELOPMENT LENGTH SHALL BE 50 TIMES DIA OF BAR.
12. BARS SHALL BE LAPPED IN STAGGERED WAY & WELDED AT ALL LAPPINGS.
13. LOAD TEST SHOULD BE CARRIED OUT AS PER IS: 2911 (P-IV).
14. HELICAL REINFORCEMENT SHALL BE OF REGULAR FORMATION WITH THE TURNS OF THE HELIX SPACED EVENLY & ITS ENDS SHALL BE ANCHORED PROPERLY BY PROVIDING ONE & HALF EXTRA TURNS OF THE SPIRAL BAR.

LEGEND

PCL – PILE CUT OFF LEVEL
UNO – UNLESS NOTED OTHERWISE

(TENDOR PURPOSE ONLY)

	CLASS 1	CLASS 2	CLASS 3	CLASS 5	DATE RECEIVED	DATE RECEIVED	DATE RECEIVED
	FOR APPROVAL	FOR REVIEW	FOR RECORDS	FOR INFORMATION			
APPROVAL CATEGORY	FURTHER ACTION BY EPCC CONTRACTOR				DATE	CHK	APP
CODE 1	NO COMMENTS, WORK MAY PROCEED						
CODE 2	THE CONTRACTOR SHALL PROCEED WITH THE FABRICATION/ MANUFACTURING, TAKING CARE OF & INCORPORATING OWNER/PMC COMMENTS CONTRACTOR SHALL SUBMIT THE DWG. AGAIN DULY REVISED INCORPORATING OWNER/PMC COMMENTS.						
CODE 3	MAJOR NON-CONFORMANCE & DEVIATIONS TO CONTRACT SPECIFICATIONS, HENCE THE DOCUMENT IS REJECTED. CONTRACTOR IS TO RESUBMIT FOR REVIEW AFTER INCORPORATING COMMENTS.						
CODE 5	DOCUMENT/DRAWING RETAINED FOR INFORMATION.						

REVIEW/APPROVED OF DRAWINGS/DOCUMENTS BY OWNER/PMC SHALL NOT ABSOLVE THE CONTRACTOR OF THEIR RESPONSIBILITIES TO ENSURE DEFECT FREE DESIGN & STRICT COMPLIANCE TO CONTRACT SPECIFICATIONS. ALL DOCUMENTS SHALL BE SUBMITTED AS PER AGREED CLASSIFICATION AFTER HAVING FIRST DULY CHECKED & APPROVED INTERNALLY BY THE CONTRACTOR. ANY CHANGES W.R.T PREVIOUS REVISIONS SHALL BE CLEARLY HIGHLIGHTED. INCOMPLETE,UNCHECKED & UNSIGNED DOCUMENTS/DRAWINGS & DESIGNS SHALL NOT BE ACCEPTED FOR REVIEW/CONSTRUCTION & SHALL BE RETURNED FORTHWITH, TIME DELAY ON ACCOUNT OF SUCH SUBMISSION SHALL BE TO CONTRACTORS ACCOUNT.

REV.	DATE	ALTERED	CHD/APPD
ZONE			

चेन्नै पेट्रोलियम कॉर्पोरेशन लिमिटेड
(इंडियन ऑयल कॉर्प यूनि कम्पनी)
Chennai Petroleum Corporation Limited
(A group company of indianoil)

CONSULTANT :
JACOBS ENGINEERING INDIA PVT LIMITED (MUMBAI)

NAME OF PROJECT : 1X150 TPH UTILITY BOILER PKG RESID UP GRADATION PROJECT AT CPCL MANALI, CHENNAI

Tender No.-MR/OW/MM/STG-NOM/19/2009 | EIL JOB No. 6978 / EPPC 10 Pkg.

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	K GOURI	Sd/	16.01.15	N.A.
CHD.	GPP	Sd/	16.01.15	
APPD.	PM	Sd/	16.01.15	

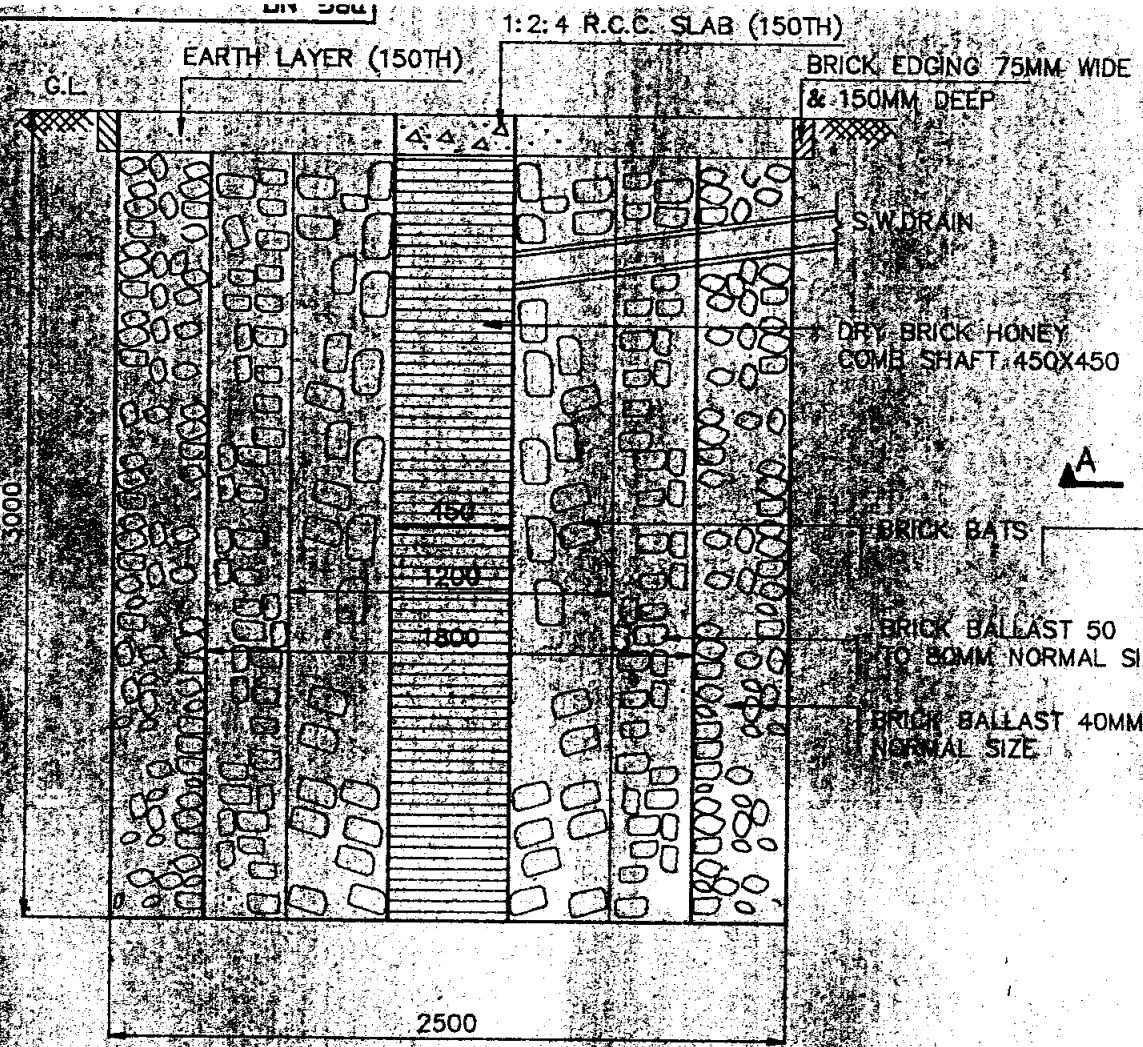
DEPT.	UNTOL. DIMS. GR.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
PED	g/M/f	N.T.S	N.A.	N.A.	N.A.	N.A.
CODE 450						

TITLE: DETAILS OF WORKING (BORED CAST-IN-SITU) PILES

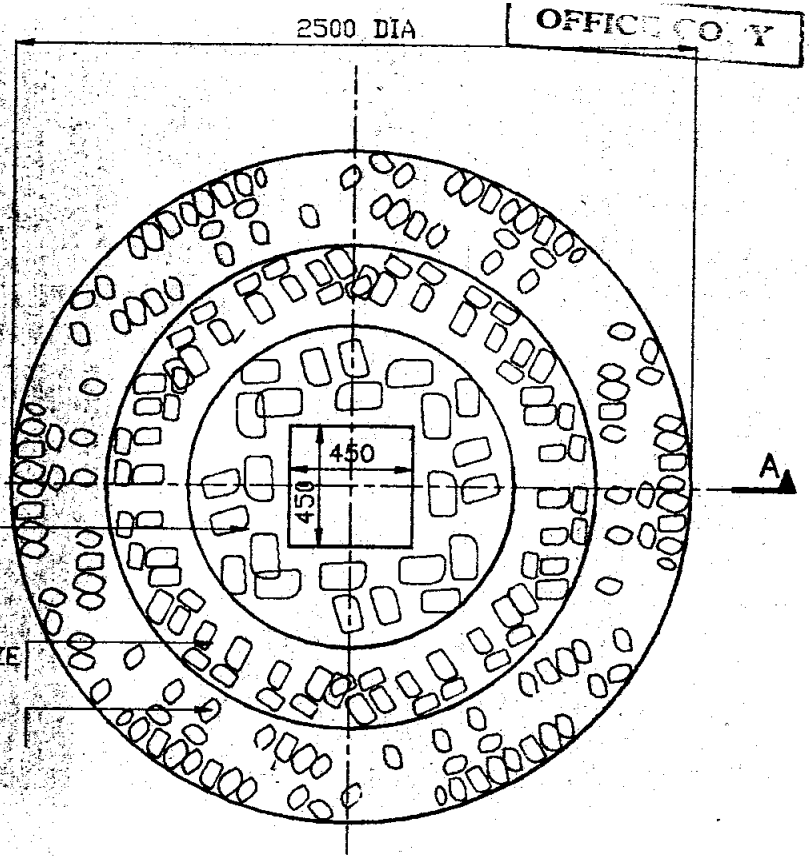
CARD CODE: NA

DRG. NO. 2-381-42-01248 REV. 00
CUST. DRG. NO.
SHT. No 01 | NO. OF SHT. 01

COMPUTER FILE NAME: SET OF BORED CAST IN SITU PILE 2-38142-00605R05.DWG
REF. DRG. NO.:
SIGN. AND DATE:
INVENTORY NO:
GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261



SECTION A-A

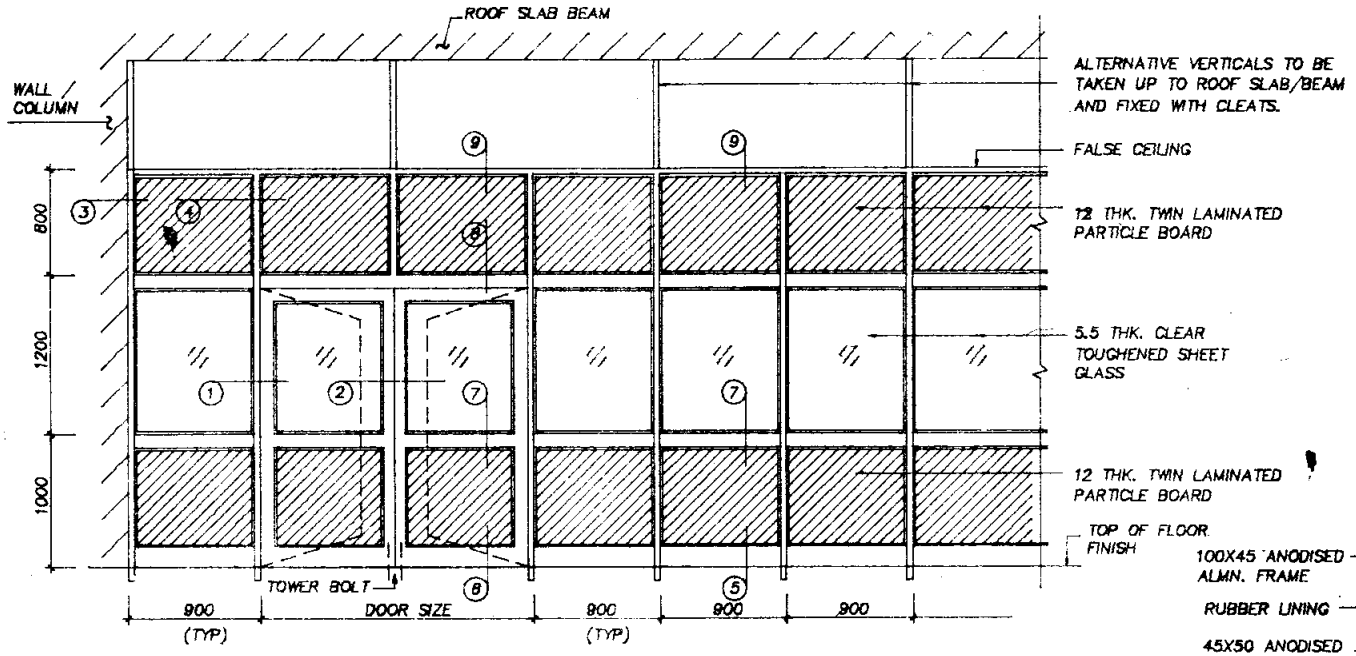


PLAN

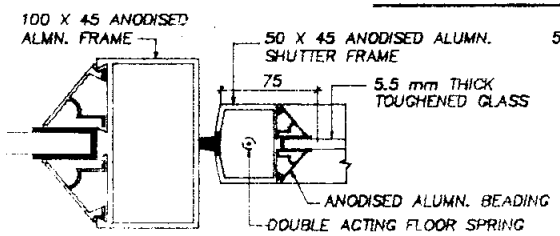
O/C

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT	STANDARD						
BHARAT HEAVY ELECTRICALS LTD. HYDERABAD	DRN.	NAME L.W.C	SIGN.	DATE	NO. OF VAR		
	CHD.	M R RAM		23/10/87			
	APPD.	P. SAHA		23/10/87			
REV. / DATE / ALTERED / CHECKED	DEPT. PED	SCALE 1:20	WEIGHT (KG)	REF. TO ASSY DRG.	ITEM NO.	NO. OF ITEMS	
	CODE 459						
TITLE: SOAK PIT DETAILS	CARD CODE	DRAWING NO. 3-38144-00003	REV. 00				
		SHEET NO. 1	NO. OF SHEETS 1				

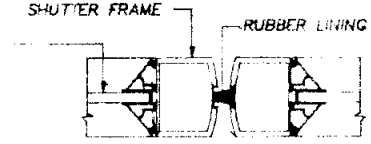
63



TYPICAL ELEVATION OF PARTITION



DETAIL AT (1)



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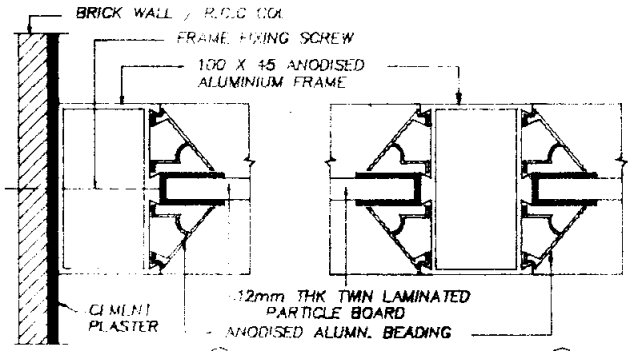

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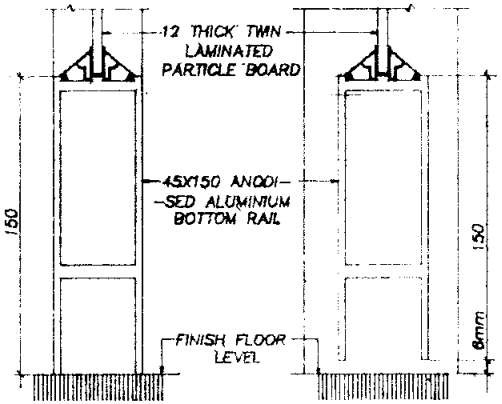
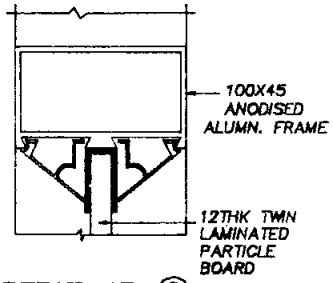


DETAIL AT (4)

DETAIL AT (5)

DETAIL AT (6)



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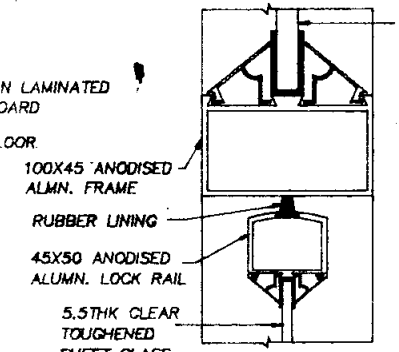

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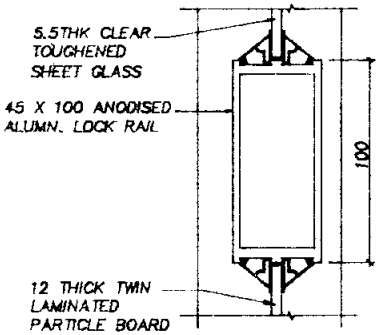


DETAIL AT (7)

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. THE ALUMINIUM HOLLOW SECTIONS SHOULD BE FILLED WITH TIMBER OF SILVER OAK.
3. ALTERNATE VERTICALS ARE TO BE TAKEN UP TO THE ROO SLAB / BEAM AND FIXED WITH CLEATS. ALL VERTICALS AR TO BE GROUTED 25mm INTO THE FLOOR FINISH , AT THE BOTTOM. HOWEVER , FOR MEASUREMENT , ONLY AREA OF PARTITION ABOVE FLOOR FINISH & BELOW FALSE CEILING WILL BE CONSIDERED.
4. THE MAXIMUM SPACING OF VERTICALS SHALL BE 900 MM.
5. TWIN LAMINATED PHENOL BONDED PARTICLE BOARD SHALL BE OF 'NOVAPAN' MAKE OR APPROVED EQUIVALENT.
6. TWIN LAMINATED PHENOL BONDED PARTICLE BOARD SHALL BE OF APPROVED SHADE.
7. FOR LAYOUT OF PARTION REF. DRG. NO. 1-38142-00532.
8. ALL ALUMINIUM HOLLOW SECTIONS ARE TO BE 3 MM THK.
9. DOORS SHALL BE PROVIDED WITH DOUBLE ACTING HEAVY DUTY FLOOR SPRINGS, APPROVED TYPE OF HANDLES, DOOR STOPS, 450 LONG TOWER BOLTS AT THE TOP AND 300 LONG TOWER BOLT AT THE BOTTOM FOR EACH SHUTT A MORTICE LOCK, GODREJ MAKE OR APPROVED EQUIVALEN SHALL BE PROVIDED FOR EACH DOOR

ARCHITECTURAL	NO	DATE	REVISION	DRN	CHD	APP.
	0	22-4-96	ISSUED AS STANDARD	M.R.J		

BHEL PROJECT ENGINEERING BHEL HYDERABAD

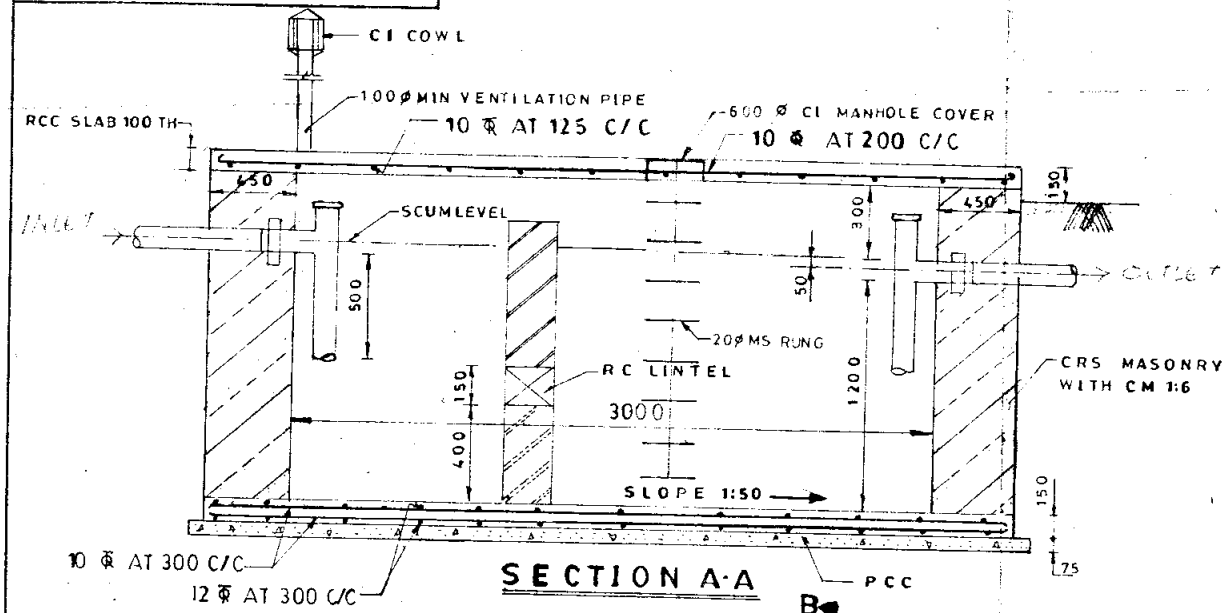
DETAILS OF ALUMINIUM PARTITIONS

DRG. NO 3-38144-00068 RE 0C

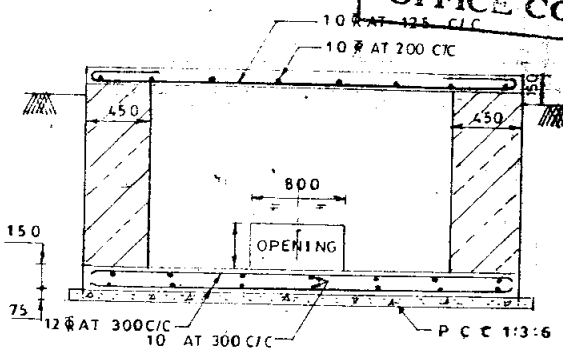
(ALL DIMENSIONS ARE IN mm)

OFFICE COPY

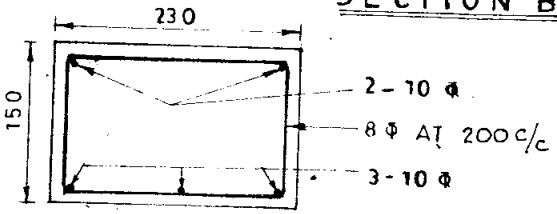
DRG NO 3-38144-00009



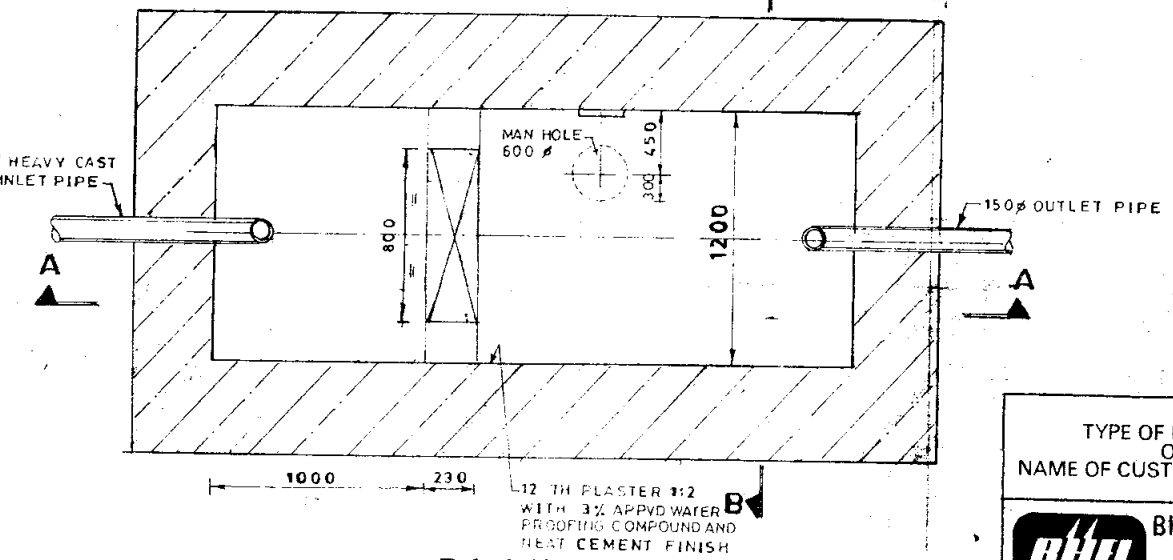
SECTION A-A



SECTION B-B



LINTELBEAM DETAIL



PLAN

NOTES

1 ALL DIMENSIONS ARE IN MM UOS.

STD.	DRAWING NO.	IT. NO.	MATL. CODE	A/C	UNIT WT.	GS	ZONE
		VAR.	MATL. SPCN.	UNIT	QTY.		

28 → CARD TYPE -1

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: **STANDARD**

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE
DRN.	Q.E.S		26/6/92
CHD.	S.SARKAR		9/7/92
APPD.	K.T.SAILESH		9/7/92

NO. OF VAR.

DEPT.	GRADE OF TOL. DIM. C/M/F	SCALE	WEIGHT (Kg)	REF. TO ASSY. DRG.	ITEM NO.	NO. OF ITEMS
PED		N.T.S				
CODE 450						

TITLE: **SEPTIC TANK (25 USERS)**

CARD CODE

DRAWING NO. **3-38144-00009** REV. **00**

SHEET NO. OF SHEETS

REV.	DATE	ALTERED / CHECKED	ZONE

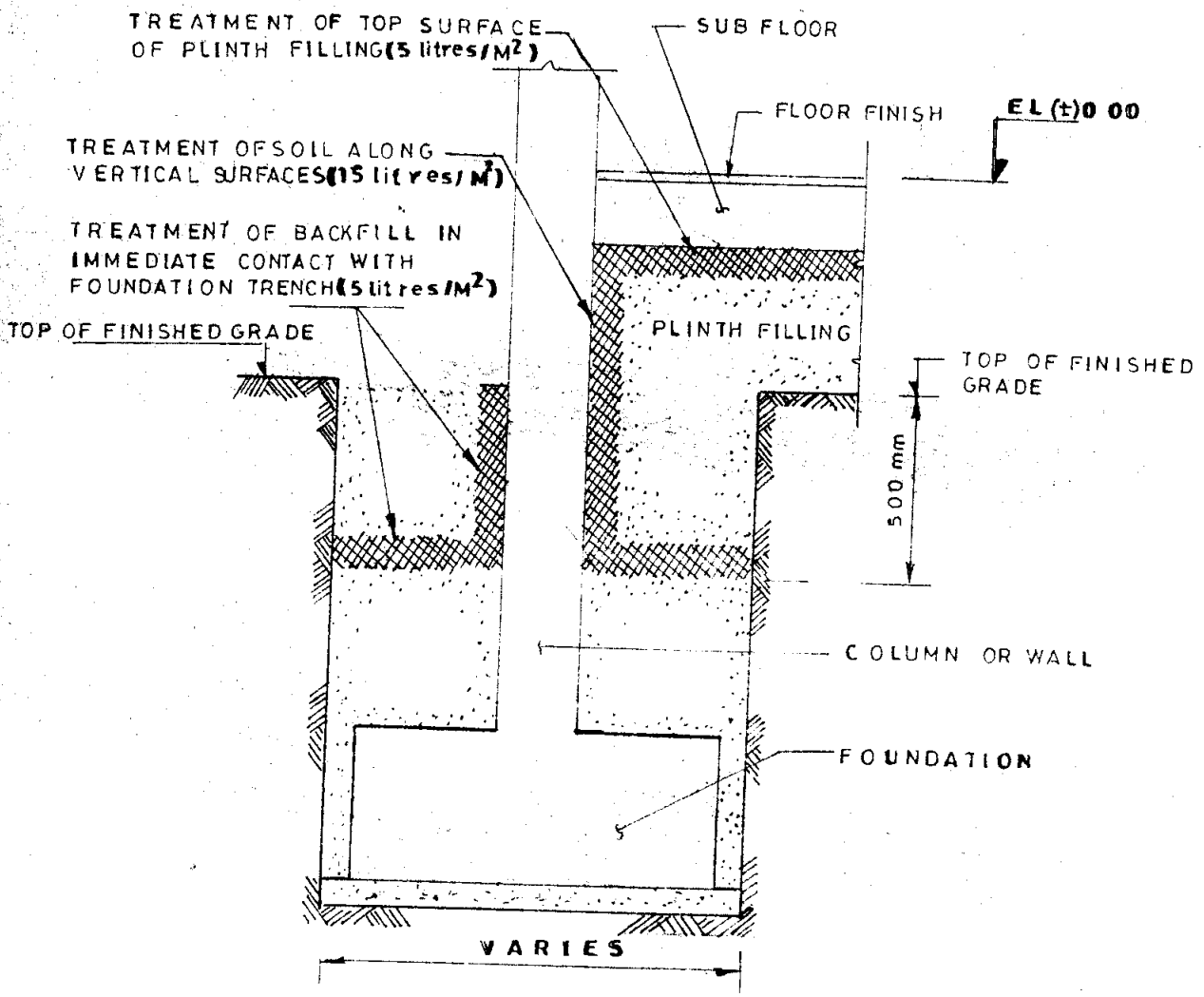
THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY

INVENTORY NO | SIGN & DATE | REF. DRG NO

ID 151, REV NO 2

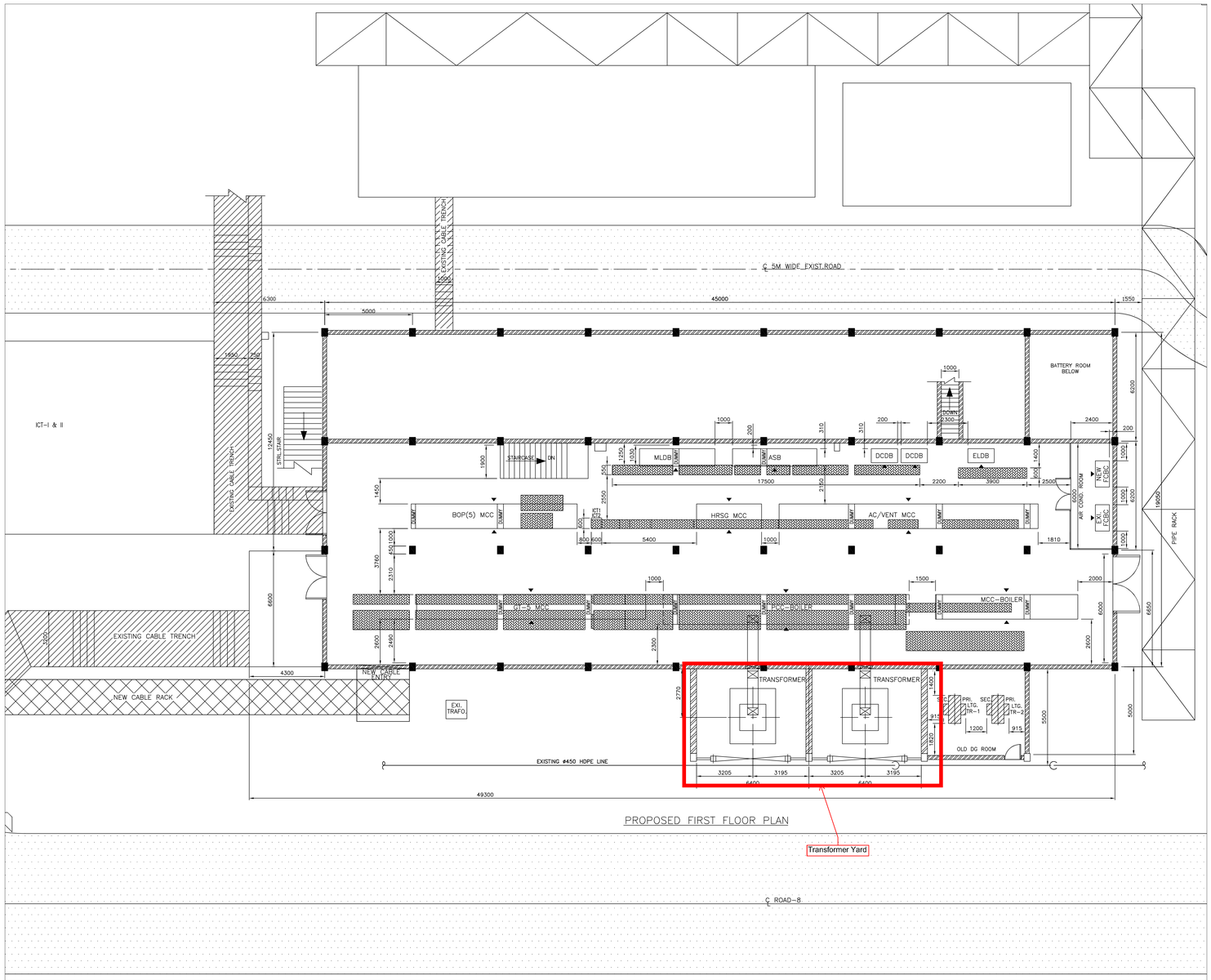
SIZE A2

ARCHITECTURAL	NO	DATE	REVISIONS	DRN	CHD	APPD
	0	05/02/93	ISSUED AS STANDARD			



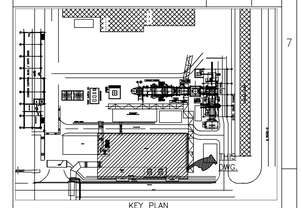
A TYPICAL SECTION

PROJECT ENGINEERING BHEL HYDERABAD	ANTI-TERMITE TREATMENT	DRAWING NO: 4-38144-00004	REV 0



.FOR TENDER PURPOSE ONLY

NORTH



KEY PLAN

NOTES :–

1. ALL DIMENSIONS ARE IN MM. AND ELEVATIONS ARE IN METERS UNLESS OTHERWISE NOTED.
2. ENTIRE INSTALLATION SHALL COMPLY WITH OISD, IE RULES & OTHER APPLICABLE STATUTORY REGULATIONS AND SAFETY CODES IN REFINERY.
3. ENABLING ACTIVITIES LISTED BELOW FOR NPH SUBSTATION SHALL BE CARRIED OUT BY CLIENT/OWNER:
   –REMOVAL OF DE–ENERGISED EXISTING PANELS, EXISTING CABLES ETC.
   –EXHAUST FANS IN SUBSTATION.
4. ADDITION OF FLOOR/WALL CUT–OUTS FOR CABLES AND DUCTS AS PER REQUIREMENT IN NPH SUBSTATION SHALL BE BY UTILITY BOILER PACKAGE VENDOR.
5. THIS IS AN INDICATIVE LAYOUT (GOOD FOR ESTIMATION) WITH PROPOSED LOCATIONS OF PANELS/EQUIPMENTS SUPPLIED BY UTILITY BOILER AND GT–5 PACKAGE VENDORS.
6. ENGINEERING AND CONSTRUCTION OF NEWLY ENVISAGED TRANSFORMER BAYS (2 Nos.) SHALL BE BY UTILITY BOILER PACKAGE VENDOR.
7. ADDITIONAL LIGHTING FIXTURES ARE NOT ENVISAGED IN NPH SUBSTATION SWITCH GEAR ROOM AND CABLE CELLAR. ADDITIONAL LIGHTING AS NECESSARY IN NEW TRANSFORMER BAYS SHALL BE FED FROM EXISTING LIGHTING PANEL CIRCUITS. SUPPLY, INSTALLATION AND WIRING OF THESE FIXTURES SHALL BE IN UTILITY BOILER PACKAGE VENDOR SCOPE.
8. SWITCH GEAR ROOM/TRANSFORMER BAYS SHALL BE PROVIDED WITH ALL SAFETY EQUIPMENT (SUCH AS BUT NOT LIMITED TO SAND BUCKETS, CO2 FIRE EXTINGUISHER, RUBBER MATS OF REQUIRED VOLTAGE GRADE, DANGER CAUTION BOARDS ON REAR AS WELL AS FRONT SIDE, FIRST AID BOX, ILLUMINATED SLDS ETC.) AS PER I.E. RULES & OTHER APPLICABLE STATUTORY REGULATIONS & SHALL BE SUPPLIED BY UTILITY BOILER PACKAGE VENDOR.
9. FOR ESTIMATION PURPOSES A CABLE CELLAR HEIGHT OF 3M CAN BE CONSIDERED.
10. TRANSFORMERS WHERE OIL CAPACITY EXCEEDS 2000 LITERS, SHALL BE PROVIDED WITH A LAYER OF 150mm DEEP PEBBLES OF ABOUT 40mm. GRANULATION, ALL AROUND THE TRANSFORMER.
11. TRANSFORMERS WHERE OIL CAPACITY EXCEEDS 2000 LITERS OF OIL IN ANY CHAMBER, SHALL BE PROVIDED WITH OIL CONTAINING PIT. OIL CONTAINING PIT SHALL BE ABLE TO CONTAIN A QUANTITY OF OIL EQUAL TO THAT OF OIL CONTAINED IN TRANSFORMER PLUS THE VOLUME OF THE WATER IN THE FIXED FIRE FIGHTING INSTALLATIONS PLUS CERTAIN MARGIN OF RAIN WATER.
12. FOR ESTIMATION PURPOSE, DIMENSIONS OF MCC's FOR GT–5 PACKAGE SHALL BE TAKEN SAME AS THAT OF GT–4 PACKAGE MCC's.
13. UNUSED EXISTING FLOOR CUTOUTS SHALL BE COVERED WITH CHEQUERED PLATES BY UTILITY BOILER PACKAGE VENDOR.

LEGEND :–

EXISTING FLOOR CUTOUT.

REV.NO.	REVISION DESCRIPTION	DRAWN	CHK	APPD.	DATE
D	ISSUED FOR ENQUIRY	VDP	DS	PPP	20.12.13
C	ISSUED FOR ENQUIRY	VDP	DS	PPP	20.11.13
B	REISSUED FOR APPROVAL	VDP	SSM/DS	PPP	04.10.13
A	ISSUED FOR APPROVAL	SDS	SSM	PPP	24.09.13

REVISIONS

DRAWING NO.	TITLE	REMARKS
44NC–4600–0000/L.01/0001/A0	OVERALL PLOT PLAN	

REFERENCE DRAWINGS

OWNER
CHENNAI PETROLEUM CORPORATION LIMITED
CHENNAI, INDIA
CPCL REFINERY - RESID UPGRADATION PROJECT

EPCM :
JACOBS ENGINEERING INDIA PVT. LTD.
H&G HOUSE, PLOT No. 12, SECTOR 11,
CENTRAL BUSINESS DISTRICT,
BELAPUR, NAVI MUMBAI – 400 614.
TEL. (91–22) 67562000 FAX (91–22) 27573049

JE DRAWING NO.: 44NC–4602–0000/E.01/0003/A0

DATE	13.09.13
SCALE	1:100
DEPT. :	E
DRN.BY :	SDS
CHK.BY :	DS
APP.BY :	PPP

TITLE : INDICATIVE EQUIPMENT LAYOUT NPH SUBSTATION

PROJ. : CPCL RESID
DWG. NO. 44NC–4602–0000/E.01/0003/A0
PVD NO. : –
CAD NO. : E0003RD0.DWG

SHT.NO. 1 OF 1
REV.NO. D

C OF ROAD-9

EXISTING PIPE RACK

EXIST.PIPE RACK

EXIST.PIPERACK

BY GT

BY OTHERS

5M ACCESS ROAD

NITROGEN COMPRESSOR SHED

BOOSTER COMPRESSOR SHED

FUEL FILTER SKID

NITROGEN RECEIVER

CBD

BFP / SWAS / CHEMICAL DOSING SKID BLDG. DEAERATOR ON PLATFORM

GT-5

SRR-VI (NOTE-11)

COMMON CONTROL BLDG. / NOPH SWGR.

GT-IV S/S

NEW CABLE ENTRY

GTG HALL

FUEL FILTER SKIDS AREA

PIPE SLEEPER

5M WIDE ROAD

5M WIDE EXIST.ROAD

BFP / SWAS / CHEMICAL DOSING SKID BLDG. DEAERATOR ON PLATFORM AT EL.14.15m

NPH SUB STATION (TO BE USED FOR RESID-GT-V, BOILER & STG LOAD)

ICT-I

ICT-II

DM WATER TANK

HOLD-1

EXISTING PIPE RACK

C OF ROAD-8

C OF ROAD-7

C OF ROAD-6

C OF ROAD-F

WTP

D.M.PLANT

AIR COMP.

PH

COOLING TOWER-I

OPH

BOILER PACKAGE AREA

CABLE TRAYS

CABLE TRENCH

CABLE RACK

GT-IV Substation. Existing swtichboards are located in this building. Cables shall be routed to PE&SD supplied AC/DC DB's from this building.

SRR-VI Building (DCS,PLC,HMI, UPSDB shall be placed in this building) SRR-VI building layout engineering in customer scope.

Existing NOPH Switchgear Building (Common Control Room) No PE&SD scope equipments shall be located in this building.

Existing NPH Substation. PE&SD-Elec scope switchboards i.e. Boiler PCC, Boiler MCC, Aux PDB, MLDB, DCDB-1&2, AC ELDB shall be located in this building. Layout Engineering is by Customer.

Transformer Yard Layout engineering by PE&SD-Elec.

Outdoor area cable tray / trench (Outside Boiler Package battery Limit) engineering is in Customer scope.

Boiler Package Area

.FOR TENDER PURPOSE ONLY

SECTION B-B
(SCALE-N.T.S.)

SECTION A-A
(SCALE-N.T.S.)

DETAIL 'A'
INSTRUMENT TRENCH
(REF. NOTE-13)

REMOVABLE COVER

INSTRUMENT CABLE DUCT

F.G.L. EL. XXX.XXX

NOTES:-

1) ALL DIMENSIONS ARE IN MM. UNLESS OTHERWISE SPECIFIED.
2) ALL DIMENSIONS TO BE CONFIRMED BY CONTRACTOR/VENDOR.
3) VARIOUS FACILITIES SHOWN IN THE DRAWING ARE MINIMUM ACTUAL FACILITIES TO MEET OPERATIONAL AND MAINTENANCE REQUIREMENT.
4) THIS SCOPE DRG. SHALL BE READ IN CONJUNCTION WITH PROCESS P & I D, SPECIFICATION, STANDARD ETC. ALL PIPING AND INSTRUMENTATION WORK SHALL MEET P & I D REQUIRMENTS.
5) CONTRACTOR TO CONSIDER MINIMUM 100m. CABLE LENGHT WITHIN SRR FOR ALL FIELD CABLES.
6) CONTRACTOR TO CONSIDER MINIMUM DISTANCE FROM SRR TO NPH SUBSTATION AS 250m.
7) ELECTRICAL AND INSTRUMENT CABLE TRENCH/TRAY INSIDE GT-V, BOILER & DM WATER UNIT BATTERY LIMIT IS IN RESPECTIVE CONTRACTOR SCOPE.
8) ELECTRICAL AND INSTRUMENT CABLE TRENCH/TRAY OUTSIDE GT-V, BOILER & DM WATER UNIT BATTERY LIMIT IS IN OSBL CONTRACTOR SCOPE.
9) CABLE ROUTE SHOWN ON DRAWING IS INDICATIVE ONLY.
10) REFER DWG. No. 44NC-4602-0000/EJ01/0003 FOR INDICATIVE EQUIPMENT LAYOUT NPH SUBSTATION
11) REFER DWG. No. 44NC-4602-0000/J01/0111 FOR SRR-VI BUILDING EQUIPMENT LAYOUT.
12) REFER DWG. No. 44NC-4602-0000/J01/0113 FOR INDICATIVE LAYOUT FOR BOILER VI.
13) CONTRACTOR TO REFER DETAIL 'A' FOR LAYING OF INSTRUMENT CABLES INSIDE TRENCH.

HOLD LIST:-

1) INSTRUMENT/ELECTRICAL CABLE RACK FOR DM WATER TANK ON HOLD.

LEGEND :-

- NEW
- EXISTING
- CABLE TRENCH
- CABLE RACK
- ELECTRICAL CABLE TRAY

KEY PLAN

WIND ROSE

REV.NO.	ISSUED FOR FEED / REVISION DESCRIPTION	DRAWN	CHK	APPD.	DATE
A	ISSUED FOR FEED	SSJ	MM/PSM	BSP	10/12/13
REV.NO.	REVISION DESCRIPTION	DRAWN	CHK	APPD.	DATE

REVISIONS

OWNER

CHENNAI PETROLEUM CORPORATION LIMITED

CHENNAI INDIA

CPCL REFINERY-RESID UPGRADATION PROJECT

EPCM :

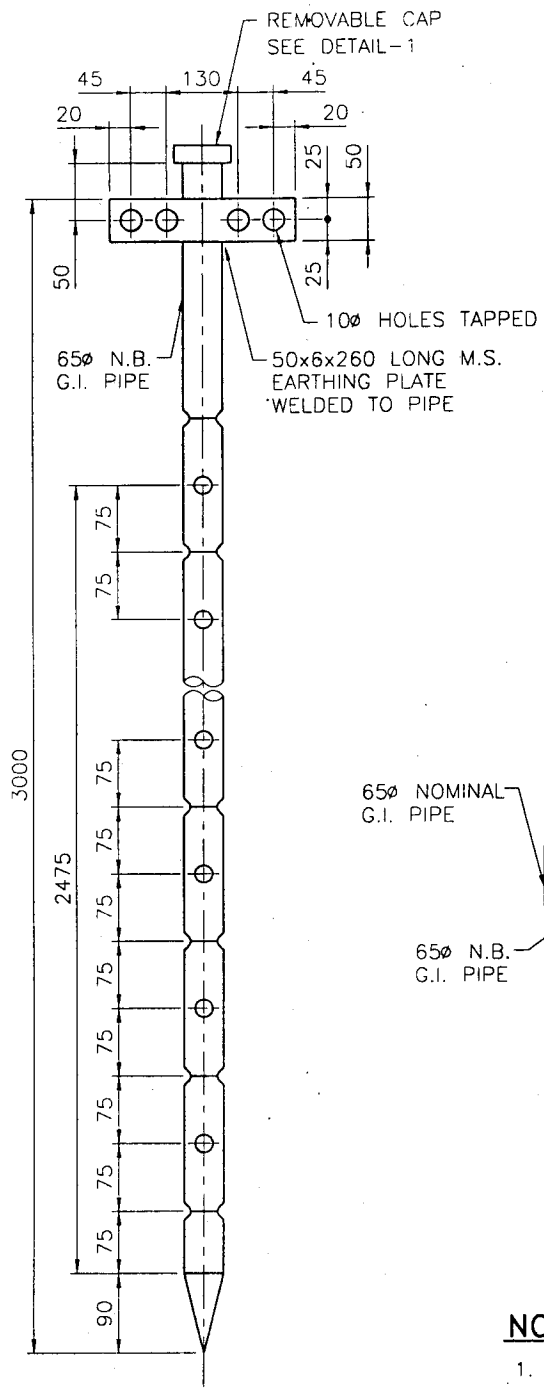
JACOBS ENGINEERING INDIA PVT. LTD.
HIGH GROUND, PLOT NO. 2, SECTOR 11,
CENTRAL BUSINESS DISTRICT,
BELAPUR, NAVI MUMBAI – 400 614.
TEL (91-22) 67562000 FAX (91-22) 27573049

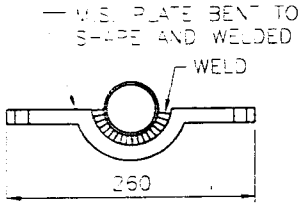
JACOBS

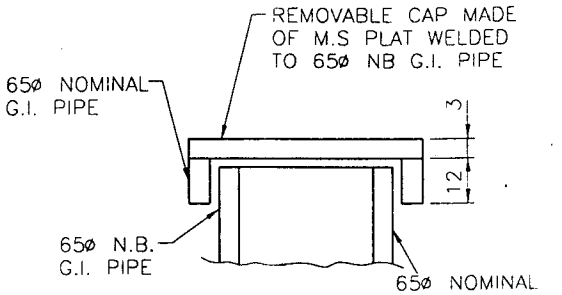
DRAWING NO.	44NC-4602-0000/J01/0111
TITLE	OVERALL PLOT PLAN
DRAWING NO.	44NC-4602-0000/ LO1/0001/A0
TITLE	REFERENCE DRAWINGS

JE DRAWING NO. :	44NC-4602-0000/J01/0122/A0
TITLE :	INDICATIVE CABLE ROUTING LAYOUT FOR GT-V, BOILER-VI
SCALE :	1:200
DATE :	31/10/13
DEPT. :	J
DRN.BY :	SSJ
PROJ. :	CPCL RESID
DWG. NO.	44NC-4602-0000/J01/0122
SHT.NO.	1 OF 1
REV.NO.	A
CHK.BY :	VMK/SPM
PID NO. :	
APP.BY :	BSP
CAD NO. :	J0122RA0

1.2 PIPE ELECTRODE







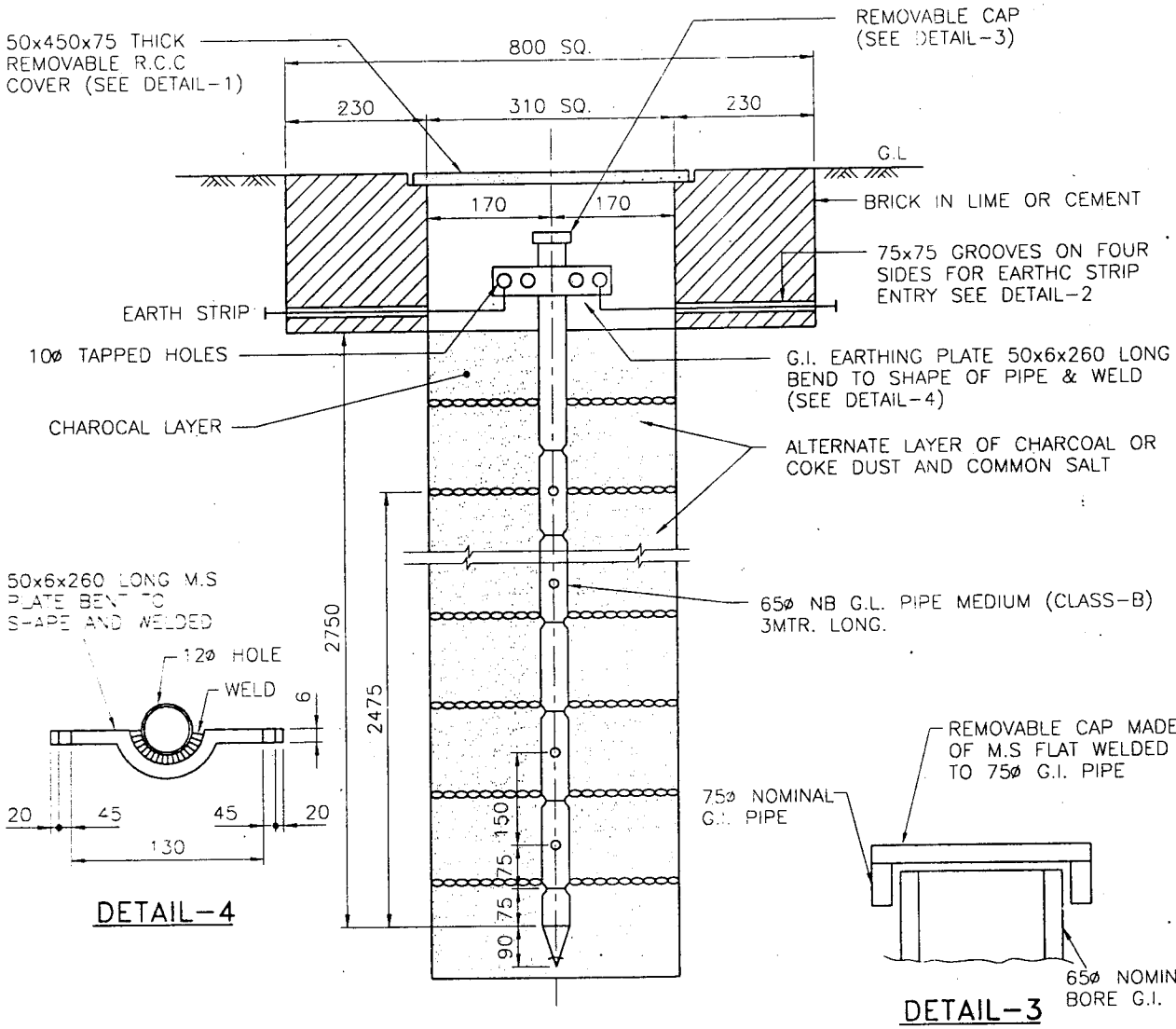
DETAIL-3

NOTE:-

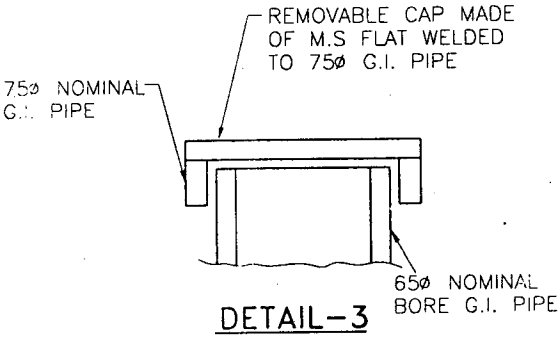
1. PIPE ASSEMBLY SHALL BE HOT DIP GALVANISED AFTER FABRICATION
3. AS PER IS:3043 (LATEST REVISION)

Ref. Doc

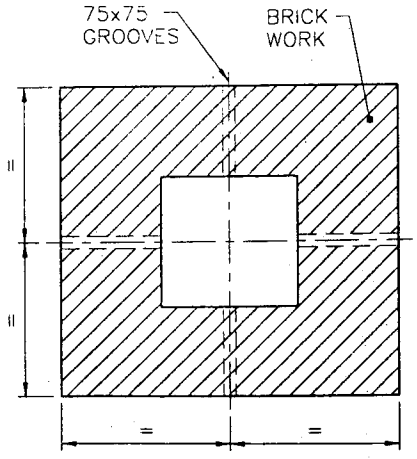
1.1 EARTH ELECTRODE IN TEST PIT



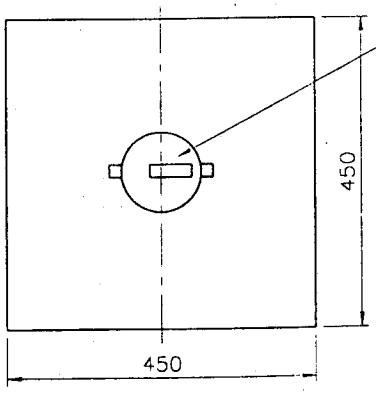
DETAIL-4



DETAIL-3



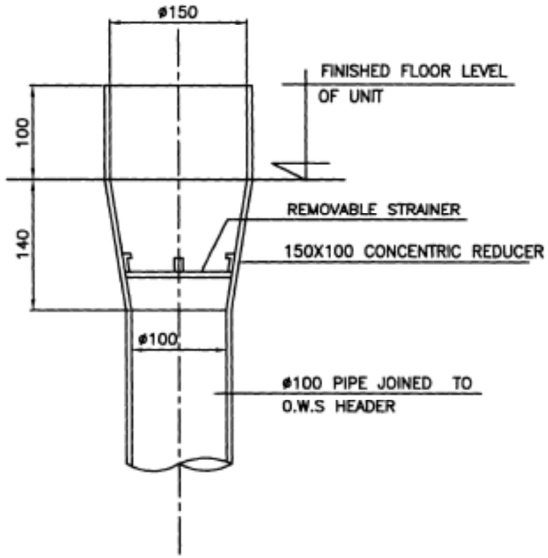
DETAIL-2



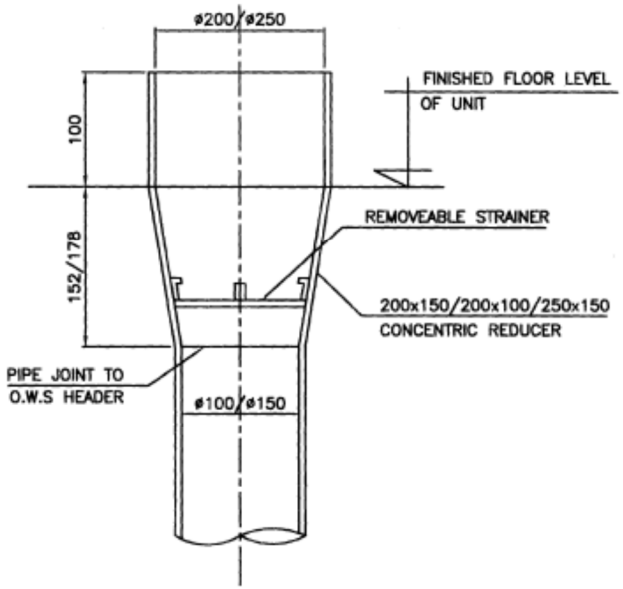
DETAIL-1

NOTE:-

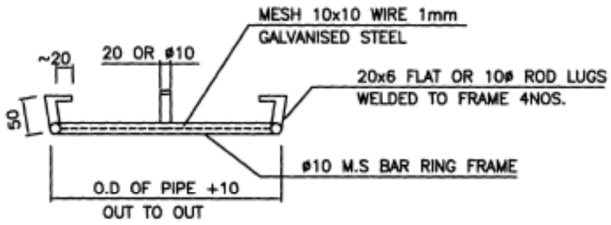
1. PIPE ASSEMBLY SHALL BE HOT DIP GALVANISED AFTER FABRICATION
2. CONDUCTOR SIZES & MATERIAL ARE AS PER ANNEXURE-A OF THIS SPECIFICATION.
3. AS PER IS:3043 (LATEST REVISION)



STANDARD EQUIPMENT
DRAIN FUNNEL

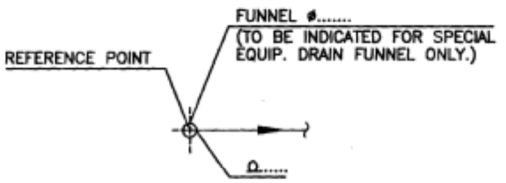


SPECIAL EQUIPMENT
DRAIN FUNNEL



DETAILS OF STRAINER

ISOMETRIC VEIW OF STRAINER



REPRESENTATION ON UNIT AREA DRG

NOTES:–

1. ALL DIMENSIONS ARE IN MM.

STD DWG FOR OWS FUNNELS

2. Soil Report – 32 Pages

GT-V DPI PLANT AREA

NAGADI

CIVIL
PROJ

Inputs Recd From
Client On 06.04.10

ISSUED BY DCG
DATE 19.4.2010.

NAGADI
REPORT

Nagadi's Code of Ethics *

As ours is purely a specialist consultancy organisation, we recognize that honesty, integrity, courtesy and mutual **"Confidence and respect between client and consultants"** form a moral philosophy which constitutes the foundation of professional ethics. As a measure of self-discipline, therefore we agree to abide by the following code of ethics :

1. Will keep the interest of the project and the client as the sole guide while giving our unbiased recommendations.
2. Will utilise all the available knowledge and experience including relevant international and national codes in our specialised field for the benefit of our clients.
3. Will not maintain any direct or indirect tie-ups or financial interest with contracting or manufacturing and supply organisations which may influence our recommendations.
4. Will express opinion only when it is founded on adequate knowledge and honest conviction.
5. Shall not act so as to injure or attempt to injure, whether directly or indirectly the professional reputation, prospects or business of another consultant organisation provided that this rule shall not be taken as prohibiting expression of technical opinion on behalf of the client before a tribunal or in a commissioned report.
6. Will present clearly, when called for, the consequences to be expected from deviations proposed if our engineering judgement is overruled in cases where we are responsible for the technical adequacy of engineering work.
7. Will engage or advise the client to engage and will co-operate with other experts and specialists wherever the client's or employer's interests are best served by such services.
8. Will not, directly or indirectly intervene or attempt to intervene in connection with engineering work of any kind which to our knowledge has already been entrusted to another similar organisation.
9. Will not disclose information concerning the business affairs or technical processes of clients or employers without their consent. This shall also include such portions of the work as are undertaken by us on behalf of the client.
10. We shall not associate in work with an engineer who does not conform to the ethical practices laid down by professional organisations like CDC.

Dr. V. V. S. RAO

* Based on code of ethics for consultancy organisations formulated by International Federation of Consulting Engineers and Consultancy Development Centre.

NAGADI

REGISTERED OFFICE
Bangalore:

REGIONAL OFFICE
New Delhi:

Chennai:

Secunderabad:

Web Site: nagadi.co.in

Member of:

GEOTECHNICAL REPORT FOR

CAPTIVE C0-GENERATION PLANT AT CPCL, MANALI, CHENNAI

Client :

M/s. Chennai Petroleum Corporation Ltd.,
Chennai.

Architect :

M/s. T C E,
Bangalore.

Consultant :

Structural Consultant :

Job No. : G(C)7018 Date :

NAGADI CONSULTANTS PRIVATE LIMITED

Branch:

Chennai

Project : **CAPTIVE C0-GENERATION PLANT AT CPCL, MANALI, CHENNAI**

CONTENTS

Job No. : G(C)7018 **Date :**

GEOTECHNICAL INVESTIGATION REPORT

for Captive Co-generation Plant at CPCL, Manali, Chennai

EXECUTIVE SUMMARY

M/s. Chennai Petroleum Corporation Limited, Chennai are proposing to construct a Captive Co-generation Plant at their existing premises at Manali, Chennai.

M/s. T C E, Bangalore, are the Consultants for the proposed project.

The site for the proposed project is situated within the existing premises of M/s CPCL at Manali, Chennai. The site is almost rectangular in shape and fairly level. During the field investigations the existing foundations and few pipe lines were being removed. Vegetation in the form of grass and bushes are grown within the site.

The proposed structure comprises of constructing a Captive Co-generation Plant.

Detailed geotechnical investigations have been conducted at twelve locations down to 30.0m depth within the site as per the directions of the client.

Broadly, the substrata consists of filled up soil (comprising of old foundation) down to a depth of 1.5 to 2m below which clayey silty sand/silty sand/sandy silty clay in a loose state down to a depth of 6m followed by clayey silty sand/silty sand/sandy silty clay in a stiff/medium dense state to a depth of 20.1 and 23.78m. Underneath these layers weathered rock strata (charnockites based - without core recovery) is encountered down to a depth of 25.0 and 28.5m followed by weathered rock strata (charnockites based - with core recovery) down to the termination depths of 26.45 and 30.75m.

Water table was encountered between 1.1 and 1.5m depth in the boreholes during the period of field investigations i.e during last week of April to 2nd week of June 2009.

For these subsoil conditions the lightly loaded superstructure can be safely rested on open foundations. The foundations may be laid at 1.5m depth on a hard core layer of 100cm

thick made of aggregates (20-40mm size) and gravel compacted in layers of 25cm each. The allowable bearing pressure of 5t/m² may be adopted. Also provide stiff tie beams between the columns which will provide additional rigidity to the structure. Medium to heavily loaded superstructures can be safely rested on Pile foundations. The piles may terminated after resting the piles in weathered rock strata (Charnockites- with core recovery). Considering the cutoff level of piles as 2-3m from the existing ground level, and since weathered rock strata (with core recovery) was encountered at about 27m from the existing ground level; the effective length of the piles will be about 24m. The socketing length will be about 2m in weathered rock. The safe capacity of the piles are given below:

Dia (cm)	Load carrying capacity(tons)	Uplift Capacity (t)	Lateral Load Capacity(t) for M-35 concrete plie
45	75	20	2.5
50	95	25	3.0
60	135	35	4.0
80	245	65	6.5

The excavated soil cannot be used for backfilling purposes.

A CBR value of 2 can be adopted for designing of the pavements.

The chemical properties of the water indicate that the sample can be used for construction purposes. However, the cover for the reinforcement will be a minimum of 50mm as per IS 456-2000 for severe conditions. The chemical properties of soil indicate that ordinary portland cement can be used for construction purposes.

Test No.	Earth Resistivity (ohm-m)	Test No.	Earth Resistivity (ohm-m)
1	23.45	6	18.33
2	21.66	7	23.56
3	16.96	8	10.65
4	39.46	9	19.11
5	24.60		

REPORT ON GEOTECHNICAL INVESTIGATION FOR

CAPTIVE CO-GENERATION PLANT AT CPCL, MANALI, CHENNAI

1.0 INTRODUCTION

1.1 Overview

1.1.1 The geotechnical investigation has been done to ascertain the soil properties and to aid the design of viable foundations for the proposed co-generation plant.

1.1.2 M/s. Chennai Petroleum Corporation Limited, Chennai are proposing to construct a Captive Co-generation Plant at their existing premises at Manali, Chennai.

1.1.3 M/s. T C E, Bangalore, are the Consultants for the proposed project.

1.2 Authority

1.2.1 A comprehensive soil investigation programme has been conducted as per the authorisation by M/s. Chennai Petroleum Corporation Limited, Chennai vide Work Order No.1035/W/050 dated 1.04.09.

2.0 OBJECT AND SCOPE OF WORK

2.1 Object of Investigations

2.1.1 For designing the foundation system of the proposed structures, the following data are required:

a) Type of foundation system.

b) Depth below the ground level at which the foundation system is to be laid.

c) Allowable bearing pressure on the foundations levels.

2.1.2 To determine above factors, the following information would be required:

a) The sub soil profile indicating thickness of the various soil strata, to a depth down to the influence zone below the foundations.

b) Engineering properties of the soil strata at various levels.

c) Physical characteristics of the soil strata.

d) Variation of the strength of the strata with depth.

2.1.3 The object of conducting field and laboratory investigations and analysis is to get data for the parameters mentioned in 2.1.2 and providing the recommendations.

2.2 Scope of Investigations

2.2.1 Scope of investigations as given in the work order:

a) Sinking 12 boreholes down to 30.0m depth or refusal strata (where N value is more than 100 for 5 consecutive times) as required by the client.

b) Conducting standard penetration tests at 1.5m intervals.

c) Recovering undisturbed soil samples from various levels of the sub soil strata.

d) Recording ground water table levels, if met with.

e) Conducting 4 plate load tests at 3m depth upto a maximum loading intensity of 10kg/cm^2 or a plate settlement of 25mm on a 60x60cm plate whichever occurs earlier.

f) Conducting 10 Earth Resistivity Tests.

g) Conducting 10 field CBR tests.

h) Conducting 2 permeability tests by constant/falling head method.

i) Observing water table at 2 locations.

j) Conducting 5 nos of Static Cone Penetration Test.

k) Excavating 10no of Trial Pits upto specified depths.

l) Conducting 1 Cross Hole Shear test down to 15m depth.

m) Conducting relevant laboratory tests on soil samples recovered.

n) Preparation and submission of a technical report containing the details of the tests carried out, their analysis and recommendations regarding the foundation system to be adopted. Eleven copies of the report are to be submitted.

3.0 PROJECT DETAILS

3.1 Site Location

3.1.1 The site for the proposed project is situated within the existing premises of M/s CPCL at Manali, Chennai. The key map showing the location of the site is given in Fig. No.1.

3.2 Site Layout and Topography

3.2.1 The site is almost rectangular in shape and fairly level. During the field investigations the existing foundations and few pipe lines were being removed. Vegetation in the form of grass and bushes are grown within the site.

3.2.2 The colour of the exposed soil surface is Brown/Brownish red/Grey.

3.3 The Structure

3.3.1 As per the client's information, the proposed project comprises of constructing a Captive Co-generation Plant.

3.4 Seismic Zone

3.4.1 Site for the proposed project is situated in Manali, Chennai which falls under Seismic Zone III as per IS 1893 (Part 1) - 2002.

3.5 Geographical Information

3.5.1 The proposed site lies in:

a) Latitude : 13°05'

b) Longitude : 80°18'

4.0 FIELD INVESTIGATIONS

4.1 General Details

4.1.1 *Weather Conditions*

a) Weather was clear during field investigations which was carried out during last week of April and 2nd week of june 2009.

4.1.2 *Locations of Tests*

a) The location of the boreholes were shown at site by the client. A Schematic site plan showing the location of the test points marked by the client is given in Fig.No.1.

4.2 **Boreholes**

4.2.1 The boreholes were progressed by mechanically operated rotary core drill calyx method as per IS 1892 - 1979.

4.2.2 The diameter of the boreholes was 150mm in soil strata and NX size in weathered rock strata. Casing pipe of about 3m depth was used during the drilling of the borehole. All the 12 boreholes were terminated after 5 constitutive N-values were >100.

4.2.3 The termination depth of boreholes, their co-ordinates, RL (in M) and depth of water table encountered in boreholes in tabular form are given below:

BH No.	Co-Ordinates		Reduced Level (m)	Termination Depth from Existing G L (m)	Depth of Water Table from Existing G L (m)
	North-South	East-West			
1	1890.9N	886.4W	9.866	26.45	1.3
2	1876.0N	885.5W	9.864	26.5	1.2
3	1839.0N	888.1W	9.778	26.7	1.3
4	1883.5N	895.6W	9.931	26.5	1.3
5	1888.8N	909.5W	9.844	26.73	1.2
6	1868.5N	909.1W	9.829	26.55	1.5
7	1875.8N	927.0W	9.914	26.72	1.2
8	1908.0N	935.7W	9.734	27.12	1.4
9	1883.9N	933.2W	9.711	27.57	1.3
10	1883.7N	944.8W	9.924	30.07	1.1

BH No.	Co-Ordinates		Reduced Level (m)	Termination Depth from Existing G L (m)	Depth of Water Table from Existing G L (m)
	North-South	East-West			
11	1876.6N	961.7W	9.998	30.75	1.1
12	1893.2N	992.1W	9.851	30.06	1.2

4.2.4 Standard penetration tests were conducted at 1.5m intervals. Disturbed soil samples recovered from split spoon samples were packed in polythene bags, labelled and retained for identification purposes.

4.2.5 Undisturbed soil samples were recovered by thin walled tubes conforming to IS 2132. These tubes had an area ratio of less than 10%. The diameter of soil samples were 90mm and its length was 45cm. The ends of sample tubes were sealed by wax to prevent loss/ingress of moisture and labelled.

4.3 **Ground water table**

4.3.1 Ground water table was encountered at a depth between 1.1 to 1.5m in the boreholes during the period of field investigation.

4.3.2 Water table was observed at 2 locatios for 7 days. The co-ordinates of the test locations and reduced levels are given in table below:

Test No.	Co-Ordinates		Reduced Level (m)
	North-South	East-West	
1	1884.8N	886.5W	9.873
2	1878.1N	954.10W	9.765

4.3.3 The level of water table observed for 7 days are given in Appendix A.

4.4 **Plate Load Test**

4.4.1 Four Plate Load Tests were conducted at the specified locations as shown by the Client. The co-ordinates and reduced level (in M) are given in table below:

Test No.	Co-Ordinates		Reduced Level (m)	Depth of Plate from Existing G L (m)
	North-South	East-West		
1	1886.3N	834.8W	9.069	3.0
2	1906.7N	926.7W	9.988	3.0
3	1868.3N	928.1W	9.753	3.0
4	1886.5N	990.1W	9.913	3.0

4.4.2 The size of the plate used for the test was 60x60cm. The load on the plate was applied using the method of reaction loading by jacking against a kenteledge. The kenteledge comprised of wooden sleepers/steel girders on which sand/soil bags were placed to provide the dead load. The settlement of the plate was recorded using 2 dial gauges placed diagonally each with a sensitivity of 0.01mm.

4.4.3 During the test the plate settled by more than 25mm on trying to apply the first increment of load of 1kg/cm^2.

4.5 **Earth Resistivity Test**

4.5.1 Ten Earth resistivity tests were to be conducted at the specified locations by Wenner 4 electrode method as per IS 3043. Out of which one test was cancelled at the site during the field investigations.

4.5.2 During the field investigations at some of the directions; due to the space constraint the test could be conducted only upto electrode spacing of 0.5m.

4.5.3 The co-ordinates of the test locations along with reduced levels and earth resistivity are in the table below:

Test No.	Co-Ordinates		Reduced Level (m)	Earth Resistivity (ohm-m)
	North-South	East-West		
1	1888.8N	888.5W	9.866	23.45
2	1877.8N	886.9W	9.889	21.66
3	1912.4N	907.7W	9.954	16.96
4	1916.8N	888.6W	9.998	39.46
5	1898.8N	922.4W	10.015	24.6
6	1912.4N	937.7W	9.734	18.33
7	1882.4N	928.5W	9.797	23.56
8	1898.8N	952.9W	9.721	10.65
9	1912.4N	968.2W	9.859	19.11
10	1894.4N	988.7W	9.927	Test Cancelled

4.5.4 The Earth resistivity is calculated using the following equation

$\rho = 2 \pi s R$

where

ρ is resistivity of soil in Ohm-m

s is spacing of electrodes is m

R is resistivity reading in the meger in ohms.

4.5.5 The resistance in different directions for different electrode spacing along with resistivity values are given in Appendix B. The polar curve of each test is given in Fig No.12 to Fig No. 20.

4.6 **Trial Pits**

4.6.1 Ten trial pits were excavated at specified locations. The co-ordinates of the pit locations along with reduced levels are in the table below:

Test No.	Co-Ordinates		Reduced Level (m)	Bottom of trial pit from existing Ground Level (m)
	North-South	East-West		
1	1923.5N	885.2W	9.967	2
2	1908.6N	885.0W	9.964	1.95
3	1846.6N	892.2W	9.798	2.07
4	1895.0N	896.5W	9.89	1.94
5	1866.7N	902.5W	10.104	2.1
6	1885.3N	905.9W	9.761	2.2
7	1900.0N	908.3W	10.029	2.2
8	1867.4N	935.5W	9.566	2.05
9	1881.8N	958.5W	10.168	2.13
10	1911.8N	963.1W	10.014	2.18

4.7 **Field Permeability Tests**

4.7.1 Two permeability tests were conducted at the specified locations. The co-ordinates of the test locations along with the reduced levels are given in table below:

Test No.	Co-Ordinates		Reduced Level (m)	Permeability (cm/sec)
	North-South	East-West		
1	1906.5N	994.3W	9.668	6.08×10^{-4}
2	1871.7N	914.5W	9.756	1.11×10^{-3}

4.7.2 The permeability tests have been conducted by falling head method. The tests have been conducted above the water table level. shows Fig No. 21 and Fig No.22.

4.7.3 In this method, a borehole had been drilled up to 15m level at which test had been performed. The casing had been simultaneously sunk down to the full drilled depth of the borehole as the drilling or boring of the borehole was in progress. After the required

level had been reached, the borehole had been properly cleaned. After the borehole had been cleaned, the borehole had been filled with water upto a fixed level and the fall in level against time had been recorded.

4.7.4 Sample calculation of permeability is given in appendix C.

4.8 **Field CBR**

4.8.1 Out of ten field CBR tests; Nine field CBR were conducted at the specified locations. One of the test was cancelled at the site during the execution of field work.

4.8.2 The co-ordinates of the pit locations along with reduced levels are in the following table.

4.8.3 The load was applied through a screw jack using the weight of a kenteledge of wooden sleepers/steel girders on which sand/soil bags were placed to provide the dead load. The surcharge weights of 5kg is placed in position and load is applied on the plunger. The deflection of plunger is recorded using a dial gauge and the load applied for the corresponding deflection is measured using a proving ring.

4.8.4 The curve showing the penetration of plunger and load applied on it are given in Fig No. 3 to Fig No.11. The results of field CBR are given in table below:

Test No.	Co-Ordinates		Reduced Level (m)	CBR value (%) for penetration of		Field Density (gm/cm^3)	Moisture Content (%)
	North-South	East-West		2.5mm	5.0mm		
1	1928.9N	876.8W	9.943	Test cancelled		Test cancelled	
2	1901.6N	880.7W	10.135	1.4	1.7	1.703	17.1
3	1886.8N	892.9W	9.856	7.1	9.1	1.905	7.5
4	1904.7N	894.7W	10.921	2.8	2.6	1.477	6.5
5	1865.5N	897.5W	9.897	6.8	6.2	1.296	13.6
6	1892.9N	903.3W	10.139	5.4	7.9	1.851	4.99

Test No.	Co-Ordinates		Reduced Level (m)	CBR value (%) for penetration of		Field Density (gm/cm^3)	Moisture Content (%)
	North-South	East-West		2.5mm	5.0mm		
7	1880.9N	920.8W	9.816	7.1	9.7	1.956	5.28
8	1895.7N	925.0W	9.953	15.1	12.7	1.561	1.85
9	1892.9N	947.0W	9.72	1.7	1.9	1.666	8.31
10	1895.7N	969.4W	9.73	21.4	32.1	2.081	5.99

4.8.5 A CBR value of 2 can be adopted for designing of the pavements.

4.9 **Static Cone Penetration Test**

4.9.1 Five Static Cone Penetration Test were conducted at the specified locations. The co-ordinates of the test locations along with reduced levels are in the following table.

4.9.2 The test comprises of driving a cone assembly basically consisting of a steel cone with 60 degrees apex angle and a base diameter of 35.7mm giving a cross sectional area of about 10cm^2 and an independent cylindrical friction jacket of a slightly larger diameter than that of the cone and length 10cm giving a surface area of about 115cm^2.

4.9.3 The test is conducted at depth intervals of 10cm. At each depth first the cone alone and subsequently the cone and friction jacket combined are pushed into the ground via sounding rods and the corresponding loads required for penetration are recorded. In this process the cone assembly gets extended out fully. Thereafter, for conducting the test at the next depth, the cone assembly has to closed up to the initial state which is achieved by pushing the mantle tube till the cone reaches the next intended depth of test. The above procedure is then repeated at the next depth and so on. In this manner, a continuous penetration of the cone assembly into the ground, is achieved.

4.9.4 The test is conducted using a mechanical/hydraulic machine of required capacity which is loaded with adequate number of sand bags to provide the necessary reaction for pushing the cone assembly into the ground.

4.9.5 The cone resistance and sleeve friction are obtained from recorded loads required for pushing only the cone and the cone together with friction jacket. Such readings have been recorded using a load cell, at intervals of 10cm.

4.9.6 The values of cone resistance, friction resistance and friction ratio at different depths are given in Appendix H. The plots showing the variation in cone resistance vs depth, friction resistance vs depth and friction ration vs depth are given in fig no.41 to fig no.45.

4.10 **Cross Hole Seismic Test**

4.10.1 For designing the foundation system of the proposed project, the dynamic elastic modulus of the subsoil has to be determined as the same is required to perform a detailed dynamic analysis of the foundation system under various kinds of dynamic loads.

4.10.2 For evaluating the dynamic elastic modulus of the subsoil, one cross hole test has been carried out at the co-ordinates are 1.888.10 North to South and 886.40 East to West.

4.10.3 The scope of the cross hole test consisted of progressing 2 boreholes required for conducting the test, down to a depth of 15m below the existing ground level and conducting the cross hole test at regular depth intervals of 1m.

4.10.4 The results of the cross hole test have been analysed to provide the dynamic elastic moduli of the subsoil at different depths.

4.10.5 The test involved installation of a three component vibration pick-up (i.e. geophone) having one vertical component and two horizontal components mounted in orthogonal directions, in a prebored borehole at a desired depth and generation of a vibration impulse in the soil by use of suitable seismic source at the same desired depth as above in second borehole at a distance of 5m from the borehole in which the geophone had

been installed. A single component geophone had also been attached to the seismic source to provide the trigger point.

4.10.6 At each depth interval, the vibration impulse generated in the source borehole is received by the three component geophone installed in the prebored borehole, waveform signals from which are recorded on a laptop computer to which the geophone is attached through a high speed data acquisition card. The analysis of the vibration waveforms recorded by the geophone gives the time taken for the vibration impulse to travel from the source borehole to the geophone installed in the prebored borehole.

4.10.7 The test was repeated at 1m depth intervals down to the desired depth of 15m.

4.10.8 As the top soil is loose in nature and with high water table; casing pipes had been used in the prebored borehole to stabilise the hole.

4.10.9 The seismic source used in the test had been a hammer blow given by a 65kg hammer falling through a height of 0.75m onto a 50mm dia, 60° angle cone resting at the desired depth in borehole through a string of rods.

4.10.10 The results of the cross hole test have been presented in the form of a plot of wave velocities vs depth in fig no. 46.

4.10.11 The shear wave velocity 'V_s' and the compression wave velocity 'V_p' have been determined as the ratio of the known distance between the boreholes and the respective travel times for the different waves as determined from the analysis of the recorded signals.

4.10.12 The dynamic shear modulus 'G_d', dynamic Poisson's ratio 'μ_d' and dynamic elastic modulus 'E_d' at each depth interval are determined from the shear and compression wave velocities determined as above.

4.10.13 Sample calculations are given in appendix G.

4.10.14 The results of the test are given in table below considering the submerged density:

Depth (m)	V_s (m/s)	V_p (m/s)	G_d (kg/cm^2)	μ_d	E_d (kg/cm^2)
2	95	166	79	0.25	168
3	78	177	52	0.38	119
4	67	158	39	0.39	89
5	60	120	32	0.33	70
6	75	130	49	0.25	104
7	64	148	35	0.39	81
8	84	170	61	0.34	136
9	79	193	54	0.4	125
10	85	203	62	0.4	144
11	87	169	65	0.32	144
12	104	183	94	0.26	200
13	104	201	95	0.31	208
14	103	201	91	0.32	201
15	104	192	94	0.29	203

5.0 LABORATORY INVESTIGATIONS

5.1 The undisturbed and disturbed soil samples brought to the laboratory were used for the tests, as appropriate.

5.2 The soil/rock samples were subjected to various tests to determine the following properties

a) Type of soil and its gradation

b) Consistency limits

c) Natural density

d) Natural water content

e) Shear strength properties

f) Water absorption of core samples

g) Point Load test to determine compressive strength of core samples

5.3 In order to determine the above properties listed in 5.2, the following tests were conducted.

a) Sieve analysis on the coarse grained soil fraction

b) Hydrometer analysis on the fine grained soil fraction

c) Liquid and plastic limits

d) Natural Density and Water Content tests

e) Triaxial and Direct Shear tests

f) Specific Gravity

g) Free Swell Index tests

h) Water absorption tests on core samples

i) Point Load Tests

6.0 RESULTS OF INVESTIGATION AND ANALYSIS

6.1 Presentation of Results

6.1.1 The results of borehole investigations and of the laboratory investigations conducted on the soil samples collected from the boreholes have been presented in the form of tables. Table No 1 to 24 give the details of borehole no 1 to 12 respectively.

6.1.2 The soil profile tables indicate the following:

a) Standard Penetration Test Values (i.e. N- values observed) at various depths

b) Description identifying the type of soil/rock

c) Grain size analysis indicating composition of sub soil

d) Atterberg limits

e) In-situ bulk density and Water content

f) Triaxial and Direct shear test results

g) Water absorption of core samples

h) Compressive strength of core samples derived from Point load tests

6.2 **Analysis of Soil Profile**

6.2.1 A perusal of the data presented in the soil profile tables indicate the presence of the following strata.

a) Stratum I : Filled up soil (sand with old foundation)

b) Stratum II : Grey/Dark grey clayey silty sand

c) Stratum III : Grey/Brownish grey silty sand

d) Stratum IV : Dark grey/Brownish grey/Grey/Brown/Brownish red/Greyish green sandy silty clay

e) Stratum V : Weathered rock - Charnockites based (no core recovery)

f) Stratum VI : Weathered rock - Charnockites based with core recovery

6.2.2 The thicknesses in each borehole of each strata described in 6.2.1 is given in the table below:

BH NO.	(depth in m : from - to)					
	Stratum I	Stratum II	Stratum III	Stratum IV	Stratum V	Stratum VI
1	0.0-2.0	2.0-6.3 10.6-14.5	6.3-10.6 14.5-21.1	-	21.1-25.5	25.5-26.45
2	0.0-1.5	1.5-4.25	4.25-21.9	-	21.9-26.2	26.2-26.5
3	0.0-1.5	1.5-3.4 6.9-21.0	-	3.4-6.9	21.0-25.6	25.6-26.7
4	0.0-1.0	17.5-21.6	3.6-17.5	1.0-3.6	21.6-25.3	25.3-26.5
5	0.0-1.0	4.2-5.6 14.5-20.1	5.6-14.5	1.0-4.2	20.1-25.0	25.0-26.73

BH NO.	(depth in m : from - to)					
	Stratum I	Stratum II	Stratum III	Stratum IV	Stratum V	Stratum VI
6	0.0-1.4	1.4-2.1 3.6-9.4	10.5-21.3	2.1-3.6 9.4-10.5	21.3-25.5	25.5-26.55
7	0.0-1.3	12.0-13.4	4.6-12.0 17.5-21.28	1.3-4.6 13.4-17.5	21.28-25.2	25.2-26.72
8	0.0-1.3	1.8-2.6 3.4-6.4 13.5-22.1	6.4-13.5	1.3-1.8 2.6-3.4	22.1-26.6	26.6-27.12
9	0.0-1.5	1.5-2.5 16.0-21.0	2.5-16.0	-	21.0-26.0	26.0-27.57
10	0.0-1.4	-	6.7-21.3	1.4-6.7	21.3-28.0	28.0-30.07
11	0.0-1.5	1.5-12.0 21.0-23.69	12.0-21.0	-	23.69-28.5	28.5-30.75
12	0.0-1.5	4.2-15.1	2.0-4.2 15.1-23.78	1.5-2.0	23.78-27.0	27.0-30.06

6.3 Soil Composition

6.3.1 The grain size distribution of the soil samples at various depths, as determined in the laboratory have been presented in the form of grain size analysis curves, as Fig. No 26 to Fig. No 40 and in tables below them.

6.3.2 The variations in the grain size distribution - strata wise across the boreholes are as follows:

a) Stratum II : Grey/Dark grey clayey silty sand

BH NO.	Gravel %	Sand %	Silt %	Clay %
1	0	46-58	24-30	18-24
2	0	50	26	24
3	0	50-60	25-29	15-21
4	0	52	27	21
5	0	38-51	28-34	21-28
6	0	39-51	29-34	20-27

BH NO.	Gravel %	Sand %	Silt %	Clay %
7	0	55	29	16
8	0	40-49	30-35	20-28
9	0	50-61	22-29	17-22
11	0	41-55	27-33	18-26
12	0	51-65	23-31	12-18

This stratum was not encountered in borehole 10.

b) Stratum III : Grey/Brownish grey silty sand

BH NO.	Gravel %	Sand %	Silt %	Clay %
1	0	80-83	17-20	0
2	0	80-85	15-20	0
4	0	78-84	16-22	0
5	0	82-86	14-18	0
6	0	81-88	12-19	0
7	0	79-87	13-21	0
8	0	80-88	12-20	0
9	0	78-89	11-22	0
10	0	77-87	13-23	0
11	0	81-88	12-19	0
12	0	82-89	11-18	0

This stratum was not encountered in borehole 3.

c) Stratum IV : Dark grey/Brownish grey/Grey/Brown/Brownish red/Greyish green sandy silty clay

BH NO.	Gravel %	Sand %	Silt %	Clay %
3	0	26	30	44
4	0	24	33	43

BH NO.	Gravel %	Sand %	Silt %	Clay %
5	0	24-26	32-34	40-44
6	0	22-24	30	46-48
7	0	18-25	29-34	41-53
8	0	23-26	32	42-45
10	0	23-28	32-35	37-45
12	0	22	34	44

This stratum was not encountered in borehole 1, 2, 9 & 11.

6.4 **In-situ Bulk Density, Water Content and Dry density**

6.4.1 The In-situ bulk density of the sub soil stratum varies between 1.86 and 1.91g/cm^3, water content varies between 15.62 and 23.84% and In-situ dry density of the sub soil stratum varies between 1.51 and 1.63g/cm^3.

BH No	Depth (m)	Water Content (%)	In-situ Bulk Density (g/cm^3)	Dry Density (g/cm^3)
3	6	21.34	1.86	1.53
5	17	19.02	1.89	1.59
6	8	15.62	1.89	1.63
	10	23.84	1.91	1.54
7	14	23.01	1.86	1.51
8	17	18.72	1.91	1.61
11	9	15.91	1.87	1.61

6.5 **Atterberg Limits:**

6.5.1 The Atterberg Limits in Stratum II (Grey/Dark grey clayey silty sand) are given below:

BH No	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
1	22-30	14-17	8-13
2	34	19	15

BH No	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
3	20-24	13-15	7-9
4	24	15	9
5	24-33	15-18	9-15
6	22-34	15-18	7-16
7	22	14	8
8	22-34	15-19	7-15
9	23-28	13-16	10-12
11	23-32	15-18	8-14
12	19-22	13-14	6-8

6.5.2 The liquid limit and plastic limit tests conducted on the soil samples in Stratum III (Grey/Brownish grey silty sand) indicate the soil composition is non-plastic in nature which is shown in our soil profile tables.

6.5.3 The Atterberg Limits in Stratum IV (Dark grey/Brownish grey/Grey/Brown/Brownish red/Greyish green sandy silty clay) are given below:

BH No	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
3	42	21	21
4	40	21	19
5	37-41	20-22	17-19
6	42-43	23-24	19
7	39-45	20-26	19
8	40	22	18
10	39-41	20-22	19
12	40	22	18

6.6 Standard Penetration Tests

6.6.1 Standard Penetration Test values (N-values observed) are presented in the soil profile table no 1 to 24. The curve showing relation N - values (observed) vs depth is shown

in Fig. No. 23 to Fig. No. 25. The N values indicate the soil to be in a soft/loose state down to a depth of 5-6m and in a medium dense state/stiff state beyond 5-6m.

6.7 **Chemical Analysis of Soil**

6.7.1 The results of chemical analysis of soil is given in Appendix D.

6.7.2 The test results indicate that the sulphate content is less than 0.2mg/l. Hence Ordinary Portland Cement may be used for construction purposes as per IS 456-2000.

6.8 **Chemical Analysis of Water**

6.8.1 The results of chemical analysis of water is given in Appendix E.

6.8.2 The test results indicate that the water samples can be used for construction purposes as per IS 456-2000. However, the cover for the reinforcement will be a minimum of 50mm as per IS 456-2000 for severe conditions.

6.9 **Shear Test Results**

6.9.1 The cohesion obtained from consolidated drained triaxial shear test varies between 0.18kg/cm² and 0.31kg/cm² and the angle of shearing resistance ϕ of the soil varies between 15° and 25°.

6.9.2 The angle of shearing resistance ϕ of the naturally powdered weathered rock samples obtained from drained direct shear test varies between 38° and 44°.

6.10 **Specific Gravity**

6.10.1 The specific gravity of the soil particles are given below:

BH. No.	Specific Gravity at Depth (m)						
	1.5	2	3	4	4.5	6	7.5
1	-	-	-	-	2.53	-	2.49
2	-	-	2.61	-	-	2.52	-
3	-	-	-	-	2.66	-	2.59

BH. No.	Specific Gravity at Depth (m)						
	1.5	2	3	4	4.5	6	7.5
4	-	2.59	-	2.51	-	-	-
5	2.65	-	2.61	-	-	-	-
6	2.56	-	2.61	-	-	-	-
7	2.68	-	2.61	-	-	-	-
8	-	-	2.65	-	-	2.57	-
9	-	2.54	-	2.48	-	-	-
10	-	2.68	-	2.62	-	-	-
11	-	-	-	-	2.54	-	2.57
12	-	-	2.51	-	-	2.57	-

6.11 **Free Swell Index**

6.11.1 The free swell index of the soil particles are given below:

BH NO	Free Swell Index (%) at depth (m)						
	1.5	2	3	4	4.5	6	7.5
1	-	-	-	-	16.66	-	5
2	-	-	21.11	-	-	4.44	-
3	-	-	-	-	48.5	-	16.66
4	-	43.33	-	6	-	-	-
5	37	-	33.6	-	-	-	-
6	26.4	-	37.7	-	-	-	-
7	44	-	38.8	-	-	-	-
8	-	-	35.5	-	-	18.8	-
9	-	15.8	-	7.5	-	-	-
10	-	34.8	-	32	-	-	-
11	-	-	-	-	29.6	-	18.4
12	-	-	4	-	-	16.66	-

6.11.2 The above results indicate that the soil is predominantly medium swelling nature. Hence, the excavated soil cannot be used for backfilling purposes.

6.12 **Compiled Soil Profile**

6.12.1 An overview of the results and their analysis has been presented in the form of compiled soil profile in Fig. Nos. 2, 2A, 2B & 2C.

7.0 DESIGN CRITERIA - A DISCUSSION

7.1 **Primary Parameters**

7.1.1 The parameters required for the design of foundation system for the proposed structure are:

a) Type of foundation to be adopted

b) Depth at which the foundations have to be laid/piles have to be terminated.

c) Allowable bearing pressure on the soil at the foundation level/load carrying capacity of piles.

7.1.2 On the basis of the analysis of the results of investigations, the required design parameters have been arrived at and these are given in paras 7.2 to 7.4.

7.2 **Type of Foundations**

7.2.1 The type of foundation depends on the following:

a) Sub soil conditions

b) Type of structure

c) Configuration at loading points

d) Loading intensity on each sub-structure/structural element.

7.2.2 As per the client's information, the proposed structure comprises of constructing a Captive Co-generation Plant.

7.2.3 As seen from the investigations the soil is in a soft/loose state down to a depth of 6m with N values varying between 4 to 8.

7.2.4 For the above conditions, Open foundation (isolated) can be used for lightly loaded structures and Pile foundations (bored cast insitu) can be adopted for medium to heavy loaded structures.

7.3 Open Foundations

7.3.1 *Depth of Foundation*

The depth at which foundations should be laid will be governed by the following criteria.

a) There should be sufficient thickness of soil above the footings/foundations so that they are neither exposed or undermined by natural/manmade forces in the future.

b) There should be sufficient thickness of soil above the footing/foundations so that the bearing capacity of the soil can be fully mobilised.

c) Soil below the level of footings/foundations should have the requisite strength to support the anticipated bearing pressures on the foundations without allowing the settlement of footings/foundations to exceed the acceptable limits.

d) Requirements of the type of structure.

In view of the above, the open foundations may be laid at a depth of 1.5m from the existing ground level.

7.3.2 *Allowable Bearing Pressure*

An allowable settlement of 25mm has been considered to evaluate the allowable bearing pressure for Isolated foundations.

Allowable bearing pressure has been evaluated by:

a) Shear failure criteria taking the average soil data

b) Settlement criteria taking SPT values (N-values)

c) Settlement criteria based on deformation modulus

A water table correction factor of 0.5 has been considered.

The allowable bearing pressure of 5t/m² may be adopted. Provide a hard core layer which is extending the footing by 15-20cm. The hard core layer may be of 100cm thick made of aggregates (20-40mm size) and gravel compacted in layers of 25cm each. Also provide stiff tie beams between the columns which will provide additional rigidity to the structure.

7.4 Pile Foundations

7.4.1 *Termination Criteria*

The piles may terminated after embedding in weathered rock strata (Charnockites-with core recovery). Considering the cutoff level of piles as 2-3m from the existing ground level, and since weathered rock strata (with core recovery) was encountered at about 27m from the existing ground level; the effective length of the piles will be about 24m. The socketing length in weathered rock strata will be about 2m.

The safe capacity of the piles are given in para 8.0.

Sample calculation of pile capacities are given in Appendix F.

8.0 RECOMMENDATIONS

8.1 The recommendations for the proposed structures (constructing a Captive Co-generation Plant) are given below:

a) Type of Foundations : Open (isolated) for lightly load structure and Pile foundation (bored cast insitu) for medium and heavy loaded structure.

b) The open foundation may be provided at 1.5m depth from the existing ground level. The allowable bearing pressure of 5t/m² may be adopted. Provide a hard

core layer extending by 15-20cm all round the footing. The hard core layer may be 100cm thick made of aggregates (20-40mm size) and gravel compacted in layers of 25cm each. Also provide stiff tie beams between the columns which will provide additional rigidity to the structure.

c) The piles may terminated after embedding in weathered rock strata (Charnockites-with core recovery). Considering the cutoff level of piles as 2-3m from the existing ground level, and since weathered rock strata (with core recovery) was encountered at about 27m from the existing ground level; the effective length of the piles will be about 24m. The socketing length will be about 2m in weathered rock strata.

Dia (cm)	Load carrying capacity(tons)	Uplift Capacity (t)	Lateral Load Capacity(t) for M-35 concrete plie
45	75	20	2.5
50	95	25	3
60	135	35	4
80	245	65	6.5

8.2 The chemical properties of the water indicate that the sample can be used for construction purposes. However, the cover for the reinforcement will be a minimum of 50mm as per IS 456-2000 for severe conditions. The chemical properties of soil indicate that ordinary portland cement can be used for construction purposes.

8.3 A CBR value of 2 may be adopted for designing the pavements.

8.4 The excavated soil cannot be used for backfilling purposes.

8.5 The Earth resistivity at different locations are given below:

Test No.	Earth Resistivity (ohm-m)	Test No.	Earth Resistivity (ohm-m)
1	23.45	6	18.33
2	21.66	7	23.56
3	16.96	8	10.65
4	39.46	9	19.11
5	24.60		

9.0 CONSTRUCTION ADVISORY

9.1 The soil of each strata has been described with name, colour etc. During excavation any variation in the nature of the soil and its condition from those given in this Report should be noted and appropriate action should be taken.

10.0 REFERENCES

10.1 A list of IS codes referred for providing the recommendations and that which might be required to implement the same has been given in Appendix I.

11.0 LIMITATIONS

11.1 This Geotechnical investigation has been carried out at locations in the site chosen by the client as representing the entire site. The recommendations provided in this Report are hence valid only for those test locations. However, if there is any change in sub-soil conditions and properties at places between or beyond the chosen test locations, Nagadi may be contacted for further actions. Fresh investigations will have to be carried out at such locations.

M L SHANKAR

For NAGADI CONSULTANTS PVT. LTD.

3. Engineering design basis – Electrical – 49 Pages

JACOBS

SPECIFICATION NO: 44NC-4600-0000/E.02/0001/A4

TITLE: ENGINEERING DESIGN BASIS - ELECTRICAL

PROJECT REFERENCE:

- **Project No:** 44NC-4600
- **Project Location:** Manali, Chennai
- **Project Title:** RESID UPGRADATION PROJECT
- **Client:** Chennai Petroleum Corporation Limited
- **Project Manager Authorization:** R.P.GAIKWAD **Date:** 21.08. 13
- **Client Authorization:** **Date:**

				APPROVALS		
Rev. No.	Issue Date	Pages	Revision Description	By	Check	Approve
F	21.08.2013	43	Issued for Engineering	DS	PPP	MSJ
E	12.07.2010	43	Issued for Engineering	ASR	PPP	RBD
D	04.06.2010	43	Issued for Engineering	ASR	PPP	RBD
C	01.05.2010	44	Client's comments incorporated & Issued for Engineering	ASR	PPP	RBD
B	27.04.2010	44	Client's comments incorporated & Issued for Engineering	PPP	VDV	RBD
A	04.03.2010	49	Issued for comments	PPP	VDV	RBD

		SPECIFICATION ISSUED FOR:			
☑	Entire Specification Issued this Revision	☐	In-house Review	☐	Purchase
☐	Revised Pages Only Issued this Revision	☐	Client Approval	☐	Construction
		☐	Enquiry	☑	Engineering

CONTENTS LIST

1. **This document shall be read in conjunction with Engineering Design Guidelines (44NC-4600-0000/E.02/0002/A4).**
2. **This comprehensive design basis shall be referred by respective LSTK contractors for applicable / relevant equipment in their scope of package.**
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A	GENERAL INFORMATION	
1.0	**SITE CONDITIONS**	
1.1	ALTITUDE: Above MSL	3.5 M
1.2	AMBIENT TEMP.	
1.2.1	MAXIMUM:	45 ^{0}C
1.2.2	MINIMUM:	18 ^{0}C
1.3	RECOMMENDED DESIGN TEMP. FOR ELECTRICAL EQUIPMENT'S (IS 9676)	45 ^{0}C
1.4	SOIL RESISTIVITY	LATER
1.5	SEISMIC ZONE (IS-1893 Part-1)	Zone –III
1.6	RELATIVE HUMIDITY	80 % at t_{max}
1.7	SITE ENVIRONMENT	Corrosive
2.0	**ELECTRICAL DETAILS OF EXISTING GRID INCOMING SUPPLY**	
2.1	NAME OF SOURCE SUBSTATION	**New Power Plant (SS No. from CPCL)**
2.2	NUMBER OF FEEDERS	Two
2.3	VOLTAGE & FREQUENCY AT POINT OF SUPPLY	6.6 kV, 50 Hz, TP
2.4	FLUCTUATION AT POINT OF SUPPLY	
2.4.1	VOLTAGE	$\pm$ 10 %
2.4.2	FREQUENCY	$\pm$ 3 %
2.5	FAULT LEVEL (SYMM) AT RECEIVING END.	Design Fault level – 40 kA for 1 sec.
2.5.1	MINIMUM (ACTUAL)	*
2.5.2	MAXIMUM (ACTUAL)	*
2.6	NEUTRAL EARTHING	Resistive grounding
2.7	EARTH FAULT CURRENT LIMITED TO	200 A
2.8	MINIMUM LOAD POWER FACTOR STIPULATED BY SUPPLY AUTHORITY	0.9
2.9	PARALLEL OPERATION OF INCOMERS	Momentary paralleling during change over only.

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A	GENERAL INFORMATION	
3.0	**DETAILS OF ELECTRICAL DISTRIBUTION SYSTEM:**	
3.1	**PRIMARY DISTRIBUTION VOLTAGE LEVEL:**	
3.1.1	VOLTAGE	6.6 kV, TP
3.1.2	FREQUENCY	50 Hz
3.1.3	PRIMARY DISTRIBUTION SYSTEM NEUTRAL EARTHING	Resistance Grounded
3.1.4	PARALLEL OPERATION OF INCOMERS	Refer 2.9 above.
3.2	**INTERMEDIATE DISTRIBUTION VOLTAGE LEVEL**	
3.2.1	VOLTAGE	6.6 kV
3.2.2	INTERMEDIATE DISTRIBUTION SYSTEM NEUTRAL EARTHING	Resistance Grounded
3.2.3	PARALLEL OPERATION OF INCOMERS	Refer 2.9 above.
3.3	**L.T DISTRIBUTION VOLTAGE LEVEL**	
3.3.1	VOLTAGE	415 V AC, TPN.
3.3.2	NEUTRAL EARTHING	Solidly Earthed
3.3.3	PARALLEL OPERATION OF INCOMERS	Momentary paralleling during change over only.
3.4	VOLTAGE AND FREQUENCY VARIATION	
3.4.1	A.C SYSTEM	
	a) VOLTAGE	± 10%
	b) FREQUENCY	± 3 %
3.4.2	**D.C SYSTEM VOLTAGE**	
	a) ELECTRICAL CONTROL, CRITICAL LIGHTING ETC.	110 V DC / 125 V for Critical Drives in GT-V
	b) CRITICAL DRIVES	As per Licenser's package requirement.
	c) INSTRUMENTATION.	Refer Instrumentation Design Basis.
	d) VARIATION (AT SYSTEM OUTPUT TERMINALS)	± 5%
3.5	**VOLTAGE DROPS**	
3.5.1	BUSDUCT TRANSFORMER SECONDARY & SWITCHGEAR	0.5 %

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A	GENERAL INFORMATION	
3.5.2	CABLE BETWEEN PMCC & MCC OR BETWEEN PMCC AND ASB	
	• MCC OR ASB LOCATED NEAR PMCC	0.5 %
	• MCC OR ASB LOCATED REMOTE FROM PMCC	3 %
3.5.3	CABLE BETWEEN MCC & MOTOR	
	• MCC LOCATED NEAR PMCC	4.5 %
	• MCC LOCATED REMOTE FROM PMCC	2 %
3.5.4	MAX. VOLTAGE DROP UPTO LV MOTOR TERMINAL	
	DURING RUNNING	5 %
	DURING STARTING	15 %
3.5.5	MAX. VOLTAGE DROP UPTO HV MOTOR TERMINAL	
	• DURING RUNNING	3 %
	• DURING STARTING	10 %
3.5.6	CABLE BETWEEN AUXILIARY SWITCHBOARDS AND POWER & LIGHTING DISTRIBUTION BOARD AND LIGHTING PANELS	2 %
3.5.7	CIRCUIT BETWEEN LIGHTING PANELS AND LIGHTING POINT FIXTURES	3 %
3.5.8	DC SUPPLY CIRCUITS / UPS CIRCUITS	5 % (For DC system) & 3% (For UPS circuits)
		Minimum Voltage available across any instrument in the field shall be as per instrumentation design basis. Distribution system for instrumentation supplies shall be designed accordingly. In case of any conflict between Electrical Design Basis and instrumentation design basis, the later shall govern regarding instrumentation power supply requirements.
4.0	**VOLTAGE FOR LIGHTING DISTRIBUTION**	(Through 0.415 kV / 0.433 kV Auxiliary Transformer for utility power & Lighting Circuits.).
4.1	**NORMAL LIGHTING**	
	a) VOLTAGE	240 V A.C. SPN
	b) FREQUENCY	50 Hz
	c) SOURCE	From LDB in Unit S/S.

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A	GENERAL INFORMATION	
4.2	**EMERGENCY LIGHTING**	20 – 25 % of Normal Lighting
	a) VOLTAGE	240 V A.C. SPN
	b) FREQUENCY	50 Hz
	c) SOURCE	EPCC (Emergency power from DG set for respective Unit).
4.3	**CRITICAL LIGHTING**	
	a) VOLTAGE	110 V DC
	b) SOURCE	Battery Charger
	c) LOCATIONS	Escape Routes, Substations, Control rooms, Plant Area
4.4	LIGHTING TRANSFORMER TO BE PROVIDED	Yes (Common Δ / Y 415 V / 433 V Auxiliary transformer with star side solidly earthed through separate dedicated earth pit)
5.0	**CONTROL SUPPLY FOR ELECTRICAL SYSTEM**	
5.1	HIGH TENSION CIRCUIT BREAKERS	110 V DC
	a) SPRING CHARGING MOTORS	110 V DC
	b) CLOSING CIRCUITS	110 V DC
	c) TRIP CIRCUITS	110 V DC
	d) ALARM	110 V DC
	e) INDICATION	110 V DC
	f) RELAY AUXILIARY CIRCUIT	110 V DC
	g) HEATERS IN PANELS	240 V AC
	h) CONTROL CIRCUIT	110 V DC
	i) INCOMING SUPPLY HEALTHY	110 V AC (PT Sec.)
5.2	LOW TENSION CIRCUIT BREAKERS	110 V DC
	a) SPRING CHARGING MOTORS	110 V DC
	b) CLOSING CIRCUITS	110 V DC
	c) TRIP CIRCUITS	110 V DC
	d) ALARM	110 V DC
	e) INDICATION	110 V DC

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A	GENERAL INFORMATION	
	f) RELAY AUXILIARY CIRCUIT	110 V DC
	g) HEATERS IN PANELS	240 V AC
	h) CONTROL CIRCUIT	110 V DC
	i) INCOMING SUPPLY HEALTHY	110 V AC (PT Sec.)
5.3	LOW TENSION MOTORS CONTROLLED BY CONTACTORS	(Control Transformer with centre tap earthed.)
	a) COIL CIRCUIT VOLTAGE	240 V AC
	b) INDICATIONS	240 V AC
	c) ALARM	240 V AC
	d) SPACE HEATER CIRCUIT	240 V AC
6.0	**POWER SUPPLY TO LOCAL CONTROL PANELS FOR PACKAGE UNITS**	415 V A.C, 50 Hz, 3 Phase 240 V AC, 50 Hz, 1 Phase - As Required
7.0	**SOURCE OF SUPPLY FOR CRITICAL LOADS INCLUDING VFD**	UPS: 110V AC
8.0	**PAINTING FOR ELECTRICAL EQUIPMENT & STRUCTURES**	
8.1	OUTDOOR EQUIPMENT	Epoxy based powder coated.
8.2	INDOOR EQUIPMENT	Epoxy based powder coated.
8.3	CABLE TRAY & STRUCTURAL STEEL	Epoxy based powder coated, Prefabricated, GI Ladder type / GI Perforated.
8.4	SHADES	RAL 7032 for SS Equipment. For ISBL Area Equipment – 632 as per IS:5.
9.0	**GENERAL**	
9.1	CORPORATE STANDARDS TO BE FOLLOWED	JACOBS Standard Specifications.
9.2	STANDARDS OTHER THAN 'IS' IF TO BE FOLLOWED	BS, IEC, OISD, IEEE, as applicable.
9.3	TIE UP WITH EXISTING SYSTEM IF APPLICABLE	New power plant to be hooked up with existing power plant at 6.6 kV/ 110 kV.

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A	GENERAL INFORMATION	
10.0	**TYPE OF ELECTRICAL EQUIPMENT TO BE USED IN HAZARDOUS AREAS**	
	a) ZONE 0	No electrical equipment
	b) ZONE 1	Ex'd' / Ex'p'
	c) ZONE 2	Ex'n'
11.0	**ACCURACY CLASS OF METERS**	
	a) REVENUE METERS	CL. 0.5
	b) kW METER	CL. 0.5
	c) AMMETER	CL. 1.0
12.0	**MOTORS**	Up to & including 160 kW – 415 V A.C, 50 Hz, 3 Phase, 3 wires Above 160 kW – 6.6 kV A.C, 50 Hz, 3 Phase, 3 wire
13.0	**INTERFACES**	
	PROCESS UNIT CONTROL ROOM	
	ALARM SIGNALS	**HMI Interface** : Max. HMI Interface through soft link. Communication protocol – IEC 61850 / Modbus. Refer I/O list (Annexure – 1) for detailed signal (monitoring / control) communication requirement. • Normal supply failure • Feeder Trip, Motor Trip, Transformer Wdg. & / or Oil Temp. Alarm / Trip. • Load shedding operated. • VFD Trouble and critical VFD Alarms. • UPS trouble and critical UPS Alarms. • Battery charger fail / boost charging / critical battery charger Alarms.

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A	GENERAL INFORMATION	
		DCS Interface : As per process requirement. Generally following interface is envisaged: • HT / LT Motors : Run / Stop / Trip indication • HT Motors : Current Status, Motor Ready to Start from DCS, Stop Command • VSD : Reference signal from DCS, Speed / Current signal from VFD to DCS. • Auto Start as per process requirement
	MARSHALLING CABINET	In each bus section / shipping section of switchboard for DCS & HMI interface.
	LOCATION OF CURRENT TRANDUCERS FOR 4 – 20 mA MOTOR CURRENT FEEDBACK REQUIRED IN DCS	DCS

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	110 KV SWITCHYARD	
1.0	**EQUIPMENT'S TO BE INSTALLED BY ELECTRIC AUTHORITY**	
1.1	LIST OF EQUIPMENT'S TO BE SUPPLIED BY ELECTRIC AUTHORITY	CT / PT/ TVM
1.2	INSTALLATION (OUTDOOR / INDOOR)	OUTDOOR
1.3	REQUIREMENT OF ROOM FOR INSTALLING CIRCUIT BREAKER / RELAY PANEL / METERING PANEL	NA
1.4	AREA REQUIRED FOR RECEIVING YARD TO ACCOMMODATE EQUIPMENT'S SUPPLIED BY ELECTRIC AUTHORITY	NA
1.5	INCASE METERING EQUIPMENT TO BE SUPPLIED BY CLIENT, DETAILS OF THE SAME	NA
2.0	**INCOMING LINE**	
	WITH CABLES	NA
	OVERHEAD LINES – **SINGLE CIRCUIT** **DOUBLE CIRCUIT**	NA
2.1	IN CASE OF DOUBLE CIRCUIT a) OPERATION b) BUS COUPLER c) NO. OF OUTGOING BAYS d) PROVISION FOR FUTURE	NA
3.0	**SYSTEM DESIGN PARTICULARS**	
	1. NOMINAL SYSTEM VOLTAGE	110 KV
	2. HIGHEST SYSTEM VOLTAGE	123 KV
	3. SYM. FAULT LEVEL AT NOMINAL VOLTAGE	* MVA
	4. BASIC INSULATION LEVEL	650 KVP
	5. AUXILIARY POWER	415 V AC
	CONTROL	110 V DC
	LIGHTING	240 V AC
	6. CREEPAGE DISTANCE	
	6.1 FOR ENCLOSED INSULATORS	12 mm / kV

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	110 KV SWITCHYARD	
	6.2 FOR EXPOSED INSULATORS	31 mm / kV
	7. MINIMUM CLEARANCES i) PHASE TO PHASE ii) SECTIONAL	LATER
	8. OPERATING MECHANISM	~~COMMON~~ / SEPARATE
	8.1 DISCONNECT AND GROUNDING SWITCHES	MOTORISED
	8.2 CIRCUIT BREAKER	MOTORISED
	8.3 OFF CIRCUIT ISOLATOR	MOTORISED
4.0	**GROUNDING SYSTEM**	IEEE 80 & IEEE 367
4.1	GROUNDING MATERIAL	GI
4.2	MAGNITUDE OF FAULT CURRENT	* KA
4.3	DURATION	1.0 sec. for grounding material size & 0.6 sec for step / touch potential calculations
4.4	CONNECTION WITH EXISTING SYSTEM	REQUIRED
5.0	**SWITCHYARD LIGHTING**	
5.1	ILLUMINATION LEVEL REQUIRED	20 LUX with additional lighting at local operating Areas.
5.2	TYPE OF LIGHTING FITTING	Flood Lights
5.3	TYPE OF LAMPS	HPSV
6.0	**CABLE TRENCHES**	
	TYPE	RCC
	COVER	RCC
7.0	**CABLE TRAYS WITHIN TRENCH**	~~REQUIRED~~ / NOT REQUIRED. However, Angular supports at equal interval shall be provided for cable laying.
	NECESSARY MODIFICATIONS IN EQUIPMENT FOUNDATIONS SHALL BE DONE FOR NEW EQUIPMENT (TRANSFORMER) MOUNTING. REST OF THE BAY EQUIPMENT CAN BE USED FOR GTG 5 HOOK UP.	

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	EMERGENCY DG SET	
1.0	**GENERATION VOLTAGE**	415 V
2.0	**PRIME MOVER TYPE**	EMERGENCY DG SET
3.0	**TYPE OF STARTING**	AMF
4.0	**NO. OF SETS**	1 NO.
5.0	**MODE OF OPERATION**	
5.1	INDEPENDENT	-
5.2	SYNCHRONIZED	REQUIRED
6.0	**PARALLELING WITH GRID**	NA
7.0	**NEUTRAL EARTHING**	SOLID
8.0	**SERVICE**	
8.1	UNDER MAINS FAILURE ONLY CHANGE OVER SCHEME	REQUIRED
8.2	POWER CUT	NA
8.3	CONTINUOUS	NA

NOTES :

1) COMMON EMERGENCY DG SET SHALL BE PROVIDED FOR PROVIDING EMERGENCY LIGHTING IN SUBSTATION, CONTROL ROOM / SRR, ISBL AREAS AND FOR EMERGENCY DRIVES IN ISBL AREA AS PER PROCESS REQUIREMENT. EMERGENCY DG SHALL SUPPLY POWER TO EMERGENCY PCC. SWITCH FUSE FEEDERS SHALL BE PROVIDED IN EMERGENCY PCC FOR GIVING SUPPLY TO EMERGENCY BUS OF LIGHTING DISTRIBUTION BOARDS AND STARTER FEEDERS FOR EMEGNCY DRIVES IN ISBL AREA.

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	HT SWITCHGEAR	
1.0	TYPE OF CIRCUIT BREAKER BASED ON QUENCHING MEDIUM (VACUUM, SF6, OIL, AIR)	Vacuum
2.0	**BUS BAR**	6.6kV, 50 Hz, TP
2.1	MATERIAL	Electrolytic, Heavy Duty, Tinned Copper
2.2	SUPPORT INSULATION SUCH AS CAST RESIN	Required. F
2.3	FAULT LEVEL AND DURATION	
	6.6 kV	40 kA for 1 sec.
3.0	**PROTECTIVE RELAYS**	Comprehensive numerical protections cum metering relay on IEC 61850 protocol.
3.1	INCOMING FEEDER	Refer Clause 5.15 from document no 44NC-4600-0000/E.02/0002/A4. F
3.2	BUS COUPLER	
3.3	OUTGOING FEEDERS	
3.3.1	TRANSFORMER FEEDER	
3.3.2	TIE FEEDER	
3.3.3	MOTOR FEEDERS	
3.3.4	CAPACITOR FEEDER	
4.0	**METERING**	
4.1	INCOMING FEEDER	Refer Clause 5.15 from document no 44NC-4600-0000/E.02/0002/A4. F
4.2	BUS COUPLER	
4.3	OUTGOING FEEDERS	
4.3.1	TRANSFORMER FEEDER	
4.3.2	TIE FEEDER	
4.3.3	MOTOR FEEDERS	
4.3.4	CAPACITOR FEEDER	
5.0	TYPE OF CABLE TERMINATION	Heat Shrinkable
6.0	**PROVISION FOR EXTENSION**	Required / ~~Not Required~~

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	HT SWITCHGEAR	
7.0	**EXECUTION**	Draw out
8.0	**SWITCHGEAR FOR MOTOR CONTROL FEEDERS**	Vacuum Circuit breaker
9.0	**AUTO CHANGEOVER SCHEME**	Required / ~~Not Required~~. (Auto mode operation to be blocked).
10.0	**PROVISION OF ALARM / ANNUNCIATOR PANEL FOR HT SWITCHGEAR**	Required (Annunciations also to be provided at HMI system)

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	TRANSFORMERS (POWER / DISTRIBUTION / AUXILIARY)	
1.0	**SELECTION OF TRANSFORMERS**	
1.1	SPARE CAPACITY TO BE CONSIDERED	20 %
1.2	STANDBY TRANSFORMERS	100% (Parallel Redundant)
1.3	NORMAL LOADING OF EACH TRANSFORMER	40 % of the capacity
1.4	TYPE OF COOLING	ONAN / ONAF AN for Auxiliary Transformers
2.0	**VOLTAGE RATIO AT NO LOAD**	110 kV/ 7.07 kV, 6.6 kV / 0.433 kV, 0.415 kV/ 0.433 kV
3.0	**TAP CHANGER**	
3.1	OFF CIRCUIT	Required
3.2	ON LOAD	Required for Power Transformer
4.0	**RANGE OF TAP CHANGING**	**+10% to -10% in steps of 2.5%**
5.0	**PRIMARY AND SECONDARY TERMINAL ARRANGEMENT**	
5.1	OVERHEAD CONDUCTOR	NOT APPLICABLE.
5.2	CABLE	PRIMARY: Cable SECONDARY: Cable for lighting transformers
5.3	BUS DUCT	Distribution transformers secondary.
6.0	**NEUTRAL EARTH ARRANGEMENT**	Solidly Grounded for Distribution and Auxiliary Transformers, Resistance Grounded for Power Transformers.
6.1	NEUTRAL CT	Required for Power & Distribution Transformers. Cl. 5P20 for 51G protection & PS Cl. For 64R protection.
7.0	**VECTOR GROUP**	Dyn11
8.0	**PUSH BUTTON IN TRANSFORMER BAY FOR TRIPPING FEEDER BREAKER**	Required. (Break Glass Type)

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	BUSDUCT	
1.0	**BUSBAR RATING**	415 V, 50 Hz, TPN, 50 kA for 1 sec.
2.0	**VOLTAGE RATING**	0.415 kV
3.0	**PHASE SEGREGATION**	Non Phase Segregated
4.0	**BUSBAR MATERIAL**	Electrolytic Grade Aluminium
5.0	**SHORT CIRCUIT RATING**	50 kA for 1 Second
6.0	**CANOPY**	Required for Outdoor bus duct.
7.0	**SEAL OFF BUSHINGS**	Required
8.0	**PHASE CROSS OVER CHAMBER**	As per the layout requirement.
9.0	**FLEXIBLE CONNECTORS**	Required at both ends and at intermediate locations based on the layout / length of the duct.
7.0	**MAINTENANCE ACCESS**	Required
8.0	**ADDITIONAL REQUIREMENTS**	• Silica gel breather shall be provided in the Bus duct. • Drain Plug shall be provided at lowest point

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	POWER CONTROL CENTRE	
1.0	**TYPE OF CIRCUIT BREAKER**	
1.1	DRAWOUT / NON DRAWOUT	Draw Out
1.2	TPN / 4 POLE	4 Pole for I/C and B/C for I/C power supply from different source, 3 Pole Neutral (TPN) for I/C & B/C with same source & for O/G feeders
2.0	**BUS BAR**	415 V, 50 Hz, TPN, 50 kA for 1 sec.
2.1	MATERIAL	Aluminium.
2.2	MAXIMUM RATING	3200 A / 4000 A
2.3	PVC SLEEVING	Required
2.4	BUS BAR SUPPORT	SMC / DMC
3.0	**CONSTRUCTION**	
3.1	COMPARTMETALISED / NON COMPARMENTALISED	Compartmentalized.
3.2	OUTGOING FEEDERS	Draw out / ~~Non Draw out~~ ACB controlled for feeders above 630 A. FSU controlled for Power feeders ≤ 630 A. FSU with contactor and MPR for Motor Feeders.
3.3	BUS BAR LOCATION	Top / ~~Bottom~~
3.4	PAD LOCKING FOR OUTGOING FEEDERS	Required / ~~Not Required~~
3.5	SIZE OF INSTRUMENTS	Minimum 96 X 96 Sq. mm for I/C and Minimum 72 X 72 Sq. mm for O/G (Applicable for Analogue Instruments only)
3.6	ENCLOSURE	
	a) MATERIAL (SHEET STEEL, CAST IRON)	CRCA Sheet Steel
	b) PROTECTION CLASS	Min IP 4X
3.7	BUSDUCT ENTRY	Top
4.0	**EQUIPMENT SELECTION**	
4.1	RATING UPTO WHICH SWITCH DISCONNECTOR FUSE TO BE USED	Power feeders ≤ 630 A
4.2	RATINGS ABOVE WHICH ACB TO BE USED	800 A and above.

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	POWER CONTROL CENTRE	
5.0	**PROTECTIVE RELAYS**	Comprehensive numerical protection cum metering relay on IEC 61850 protocol.
5.1	INCOMING FEEDERS	
5.2	BUS COUPLER	
5.3	POWER FEEDERS	Refer Clause 5.15 from document no 44NC-4600-0000/E.02/0002/A4. F
5.4	FEEDER TO MCC	
5.5	FEEDER TO MLDB	
5.6	FEEDER TO CAPACITOR BOARD	
5.7	FEEDER TO MOTORS	
6.0	**METERING**	
6.1	INCOMING FEEDERS	
6.2	BUS COUPLER	Refer Clause 5.15 from document no 44NC-4600-0000/E.02/0002/A4 F
6.3	POWER FEEDERS	
6.4	FEEDER TO MCC	
6.5	FEEDER TO ASB	
6.6	FEEDER TO CAPACITOR BOARD	
6.7	FEEDER TO MOTOR	
7.0	**INDICATING LAMPS**	
7.1	INCOMERS	R,G,A,W,B
7.2	POWER FEEDERS / POWER FEEDERS WITH CONTACTOR, O/L RELAY	R,G, A
7.3	MOTOR FEEDERS	R,G,A,W,B
8.0	**CURRENT TRANSFORMER SECONDARY**	
8.1	PROTECTION	1 A
8.2	METERING	1 A
9.0	**POTENTIAL TRANSFORMER SECONDARY**	110/√3 V A.C

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	POWER CONTROL CENTRE	
10.0	**NO. OF FRONTS**	Single Front for Breaker feeders Double front for FSU / FSU with Contactor controlled feeders
11.0	**415 V MOTORS RATED 75 KW AND ABOVE & UPTO 160 KW**	To be controlled from PCC through FSU, contactor and protection relay.
12.0	**415 V POWER SUPPLY FEEDER FOR MCCs, LDB, ASBs, UPS etc.**	To be controlled from PCC through ACB / FSU
13.0	**AUTO CHANGEOVER SYSTEM**	Required / ~~Not Required.~~

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	MOTOR CONTROL CENTRE	
1.0	**TYPE**	Double Front
2.0	**EXECUTION**	Draw out / ~~Fixed~~
3.0	**BUSBARS**	415 V, 50 Hz, TPN, 50 kA for 1 sec.
3.1	MATERIAL	Aluminum / ~~Copper~~
3.2	PVC SLEEVING.	Required / ~~Not Required~~
3.3	BUS BAR SUPPORT	SMC / DMC
4.0	**MASTER TERMINAL BOX FOR EACH SHIPPING SECTION FOR INTERCONNECTION TO DCS**	Required / ~~Not Required~~
5.0	**LOCATION OF MAIN BUS BARS**	Top / ~~Bottom~~
6.0	**TYPE OF MOTOR STARTER**	
	a) DOL STARTER	All motor feeders
	b) STAR / DELTA STARTER	Not applicable
	c) ANY OTHER TYPE	VFD controlled as per process requirement.
7.0	**MAXIMUM NO. OF FEEDERS PER VERTICAL SECTION**	6 nos.
8.0	**TYPE OF ASSISTED STARTERS FOR MOTORS**	To be specified on case to case basis.
9.0	**INCOMING FEEDERS.**	
9.1	CIRCUIT BREAKER / SWITCH / SWITCH DISCONNECTOR FUSE	Load Break Switch without fuse for MCCs located near PCC feeding to the same MCC. ACB for MCCs located away (in different SS) from PCC feeding to the same MCC. (Max. rating of MCC to be limited to 1250 A).
9.2	METERS (AMMETER, VOLTMETER, KWH, PF).	A, V, kW, kWH (Part of multifunction meter)
9.3	AMMETERS, SIZE	Minimum 96 X 96 Sq. mm for I/C (Applicable for Analogue Instruments only)
9.4	PROTECTION	Not required for MCCs located nearer to PCC.

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	MOTOR CONTROL CENTRE	
10.0	**OUTGOING FEEDERS**	
10.1	MOTOR FEEDERS	
10.1.1	CONTROL DEVICES ON COMPARTMENT DOOR	Stop Push Button, BMR RESET PB, (Local / remote & auto/manual switches if required, to be provided in LCS)
10.1.2	INDICATION ON COMPARTMENT DOOR	ON / OFF / TRIP
10.1.3	AMMETER ON MOTOR FEEDERS	Not required. Where ever current feedback (4-20mA) is required for DCS, transducer to be mounted in switchgear F
10.1.4	NO. & AMMETER SIZE ON MOTOR FEEDERS	NA
10.1.5	CURRENT TRANSFORMER SECONDARY FOR METER & RELAYS	1 A
10.1.6	CONTROL SUPPLY	240 V A.C SPN to be derived from Control Transformer
10.1.7	SPARE FEEDERS	20% spare feeders of each module size (minimum one number for each module size) in each bus section of switchboard
10.1.8	PAD LOCKING FOR ISOLATOR IN OFF POSITION.	Required
10.2	CONTROL TRANSFORMER FEEDER	Required
10.2.1	a) COMMON CONTROL TRANSFORMER FOR ENTIRE MCC	No
	b) STAND BY CONTROL TRANSFORMER WITH CHANGE OVER SWITCH	No
	c) CONTROL TRANSFORMER FOR EACH MOTOR FEEDER	No
	d) SEPARATE CONTROL TRANSFORMER FOR EACH BUS SECTION WITH CHANGE OVER SWITCH	Yes
10.2.2	FOUR POLE SWITCH / AUX. SWITCH IN ALL MOTOR FEEDERS FOR ISOLATING CONTROL SUPPLY	Auxiliary switch with control fuses required.
11.0	**ELCB / (CBCT with ELR) FOR EACH FEEDER (*)**	For all loads rated 5kW and above shall be provided with CBCT with ELR. F

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	MOTOR CONTROL CENTRE	
12.0	**OTHER ACCESSORIES**	
12.1	CONTROL SUPPLY BUS BARS	~~Wire Bus~~ / Solid Bus
12.2	SPACE HEATER SUPPLY BUS BARS.	~~Wire Bus~~ / Solid Bus
12.3	SPACE HEATER FOR MCC	Required / N~~ot Required~~
13.0	**ENCLOSURE**	
	a) MATERIAL	CRCA Sheet Steel / C~~ast Iron~~
	b) PROTECTION CLASS	Minimum IP 5X.
14.0	**CABLE ENTRY**	Bottom

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	VARIABLE FREQUENCY DRIVE	
1.0	**VOLTAGE RATING OF VFD**	415V
2.0	**RECTIFIER CONFIGURATION**	MINIMUM 12 PULSE
3.0	**LOCATION OF VFD**	SEPARATE PANEL / WITHIN MCC ENCLOSURE
4.0	**INPUT ISOLATION TRANSFORMER**	REQUIRED
5.0	**OUTPUT CHOKE**	REQUIRED / ~~NOT REQUIRED~~
6.0	**PROTOCOL COMMNUNICATION**	REQUIRED – MODBUS
7.0	**VFD BYPASS**	REQUIRED
8.0	**REQUIREMENTS FOR CONTROL & MONITORING ON**	
8.1	VFD	IN VFDs VFD/DOL SELECTOR SWITCH SHALL BE PROVIDED ON THE VFD PANEL ITSELF.
8.2	LOP	LOP SHALL INCLUDE START AND STOP PB, LOCAL / REMOTE SELECTOR SWITCH, READY TO START INDICATION, SPEED RAISE / LOWER PB, DIGITAL AMMETER AND DIGITAL SPEED INDICATOR.
8.3	DCS / SCADA	• ON / OFF CONTROL FROM DCS AND RUNNING INDICATION TO DCS. • LOCAL/REMOTE SELECTOR SWITCH SHALL BE PROVIDED IN LOP.
9.0	PROVISION OF SEPARATE THERMISTOR RELAY	REQUIRED
10.0	**CLIENT SPECIFIC REQUIREMENTS**	• VFDs shall be considered only if recommended by Process Licensers and if process requirement demands VFD. • 110 V AC UPS Supply shall be considered for VFD Control supply.

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	H. V. MOTORS			
1.0	**RATED VOLTAGE**	6.6. KV		
2.0	**VOLTAGE AND FREQUENCY VARIATION**	± 10 %V, ± 5 %Hz		
3.0	**COMBINED VOLTAGE AND FREQUENCY VARIATION**	± 10 %		
4.0	**CLASS OF INSULATION & TEMP. RISE**	Class '**F**' with temp. rise limited to Class '**B**'.		
5.0	**ENCLOSURE PROTECTION CLASS**	IPW 55 (with canopy for outdoor application)		
6.0	**TYPE OF ENCLOSURE**	Ex'd' / Ex'p'/ Ex'n'		
7.0	**TYPE OF COOLING (TEFC / CACA / CACW / TETV)**	TEFC / CACA Note : - TETV (For HT motors where TEFC / CACA type cooling is not available)		
8.0	**TEMPERATURE DETECTORS FOR WINDING (RTD)**	Simplex / Duplex – 4 Nos. for simplex / 2 Nos. for Duplex / winding. RTDs shall be provided for motors rated above 750 kW. Refer Instrumentation specification for further details.		
9.0	**a) TEMPERATURE DETECTORS FOR BEARING**	~~Simplex~~ / Duplex – One each for DE and NDE bearing. BTDs shall be provided for motors rated above 750 kW. Refer Instrumentation specification for further details.		
	b) DIAL TYPE LOCAL TEMP. INDICATOR FOR BEARINGS.	Required.		
10.0	**FAULT WITHSTAND CAPACITY FOR MAIN TERMINAL BOX**	40kA for 0.2 Sec.		
11.0	**NEUTRAL TERMINAL BOX**	Required / ~~Not Required~~ (PSTB)		
12.0	**TYPE OF CABLE TERMINATION AT MOTOR END**	Heat Shrinkable.		
13.0	**NO. OF COLD /HOT STARTS**	< 500 kW	500 kW – 1000 kW	>1000kW
	Cold Start	3	3	2
	Hot Start	2	2	1

F

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	H. V. MOTORS	
14.0	**NO. OF COLD STARTS PER HOUR**	2 Nos. (min) / hour, equally spaced
15.0	**NO. OF HOT STARTS PER HOUR**	1 Nos. (min) / hour, equally spaced
16.0	**SPECIAL WINDING TREATMENT**	Suitable for corrosive atmosphere with Epoxy Gel treatment on winding overhang.
17.0	**SEPARATE TERMINAL BOX FOR**	
	a) SPACE HEATER	Required / ~~Not Required~~
	b) RTDs	Required for motors above 750 kW / ~~Not Required~~
18.0	**AUXILIARY NAME PLATE**	Required (SS)
19.0	**ADDITIONAL CANOPY**	Required ~~/ Not Required~~
20.0	**STARTING CURRENT LIMIT**	Refer Cl.6.5.9 & 6.5.10 from Doc. 44NC-4600-0000/E.02/0002/A4.
21.0	**COLOUR SHADE**	632 as per IS 5
	(***) – To be decided during detail engineering based on voltage profile.	

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	L. V. MOTORS	
1.0	**RATED VOLTAGE**	415 V
2.0	**VOLTAGE AND FREQUENCY VARIATION**	± 10 % V, ± 5 % Hz
3.0	**COMBINED VOLTAGE AND FREQUENCY VARIATION**	± 10 %
4.0	**CLASS OF INSULATION & TEMP. RISE**	Class **'F'** with temperature rise limited to Class **'B'**.
5.0	**ENCLOSURE PROTECTION CLASS**	IPW 55 (Minimum) (with canopy for outdoor application)
6.0	**TYPE OF ENCLOSURE**	
	- ZONE 0	No Electrical Equipment
	- ZONE 1	Ex'd' ,
	- ZONE 2	Ex'n'
	- AGITATORS, MIXERS, LPG PUMPS & METERING PUMPS HANDLING FLAMMABLE MATERIAL, VERTICAL OIL SUMP PUMPS	Ex'd'
	- MOTORS IN ANALYZER STORAGE AREAS, PUMP HOUSE ASSOCIATED WITH STORAGE AREAS & WITHIN LOADING / UNLOADING GANTRY	Ex'd'
	- MOTORS ASSOCIATED WITH FIRED HEATERS IN PROCESS AREA	Ex'n'
	- MOTORS FED THROUGH VSD PANELS	Ex'd'
	- MOTORS IN PROCESS AREA APART FROM AS SPECIFIED ABOVE	Ex'n'
7.0	**TYPE OF COOLING (TEFC / SPDP)**	TEFC.
8.0	**TEMPERATURE DETECTORS FOR WINDING**	Not Applicable ~~For motors controlled by VSDs~~
9.0	**TEMPERATURE DETECTORS FOR BEARING**	Not Required.
10.0	**THERMISTORS WITH THERMISTOR RELAY**	For VFD controlled motors.
11.0	**NO. OF COLD / HOT STARTS**	3 / 2

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	L. V. MOTORS	
12.0	NO. OF COLD STARTS PER HOUR	3 (Minimum).
13.0	NO. OF HOT STARTS PER HOUR	2 (Minimum).
14.0	SPECIAL WINDING TREATMENT	Suitable for corrosive atmosphere with Epoxy Gel treatment on winding overhang.
15.0	ADDITIONAL CANOPY	Required ~~/ Not required.~~
16.0	SPACE HEATER	Required for above 22 kW rated motors
17.0	COLOUR SHADE	632 as per IS 5

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	CABLES & ACCESSORIES	
1.0	**HIGH VOLTAGE**	
1.1	VOLTAGE GRADE	6.6 kV UE.
1.2	EARTHED / UNEARTHED SYSTEM	6.6KV Low Resistance Earthed.
1.3	ARMOURED / UNARMOURED	Armoured (with armour designed based on short circuit withstand capacity)
1.4	CONDUCTOR MATERIAL	Aluminum / Copper
1.5	CONDUCTOR SCREENING	Semi conducting compound.
1.6	TYPE OF OUTER SHEATHING	Flame Retardant Low Smoke (FRLS) PVC
1.7	FAULT LEVEL WITHSTAND TIME	
	a) PLANT FEEDER	1 / 0.6 sec. (As Applicable)
	b) INCOMER FEEDER	0.6 / 1 sec. (As Applicable)
	c) FEEDER WITH INST. TRIPPING DEVICE.	0.25 sec. 0.19 sec. for motors
1.8	INSULATING MATERIAL	XLPE
1.9	INSULATION SCREENING	With semi conducting compound and with non-magnetic material (Cu. tape) for multi core cables.
1.10	TYPE OF CABLE TERMINATION (HEAT SHRINKING / PUSH ON / BITUMEN COMPOUND)	Heat shrinkable.
1.11	ANY SPECIAL REQUIREMENT	-
1.12	TYPE & MATERIAL OF CABLE LUGS	Heavy duty Crimping Type, Tinned Copper.
1.13	MAXIMUM / MINIMUM SIZE TO BE USED	300 mm^2 for Multicore cable.
2.0	**LOW VOLTAGE**	
2.1	VOLTAGE GRADE.	1100 V
2.2	CONDUCTOR MATERIAL	Stranded Al/ Cu conductor. Copper up to 16 sq.mm. Aluminium / Copper for above 16 sq.mm. Copper conductor for UPS ACDB Outgoing feeders.
2.3	NO. OF CORES	3/3.5 / 4 Cores for power cables
2.4	ARMOURED / UNARMOURED	Armoured
2.5	INSULATING MATERIAL	PVC.
2.6	TYPE OF INNER SHEATH	Extruded, Flame Retardant Low Smoke (FRLS) PVC

F

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	CABLES & ACCESSORIES	
2.7	TYPE OF OUTER SHEATH	Extruded, Flame Retardant Low Smoke (FRLS) PVC
2.8	TYPE AND MATERIAL OF CABLE LUGS	Heavy duty Crimping Type, Tinned Copper.
2.9	TYPE OF CABLE GLANDS	
	a) MATERIAL	Nickel Plated Brass / SS
	b) INDOOR PANEL	Double compression type
	c) MOTORS IN FIELD	Double compression type
	d) PUSH BUTTON AND CONTROL PANELS IN FIELD	Double compression type
	e) EQUIPMENT IN ZONE - 2 AREAS	Ex (d)-Double compression type
	f) EQUIPMENT IN ZONE - 1 AREAS	Ex (d)-Double compression type
2.10	MAXIMUM/MINIMUM SIZE TO BE USED	Max. size of 300 mm^2 cable.
2.11	CONTROL CABLES	2.5 mm^2 stranded copper conductor, PVC insulated, FRLS cables. Twisted pair or shielded wherever electromagnetic / electrostatic interference is anticipated. Shielded cables for DCS interface.
2.11.1	SPARE CORES	20 %
2.12	TELEPHONE CABLES	Single/multi pair, PVC insulated, screened, Petroleum jelly filled, armoured, overall PVC sheathed, FRLS type.
	CONDUCTOR	0.9 mm dia. Copper conductor
	SPARE CORES	20 %
2.13	PLANT COMMUNICATION & FIRE ALARM CABLES	PVC insulated (Petroleum jelly filled for Plant Communication System), armoured, overall PVC sheathed, FRLS type.
	CONDUCTOR	1.5 mm^2 Copper conductor
	SPARE CORES	20 %

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	DISTRIBUTION BOARDS (LDB,ASB,LP,PP)	
A)	**DISTRIBUTION BOARD (LDB/ASB)**	
1.0	**DESIGN**	Compartmentalized / Floor mounting / ~~Wall mounting~~ / Fixed type.
2.0	**BUSBAR**	415 V, 50 Hz, TPN, 25 kA for 1 second for LDB & 50 kA for 1 second for ASB
2.1	MATERIAL	Aluminum
2.2	INSULATING SLEEVING (HEAT SHRINKABLE PVC SLEEVING)	Required
2.3	LOCATION	Top
3.0	**INCOMING FEEDERS**	
3.1	TYPE OF COMPONENT (SWITCH DISCONNECTOR FUSE /MCCB)	ACB for I/C rated above 630 A. Switch Fuse Unit for ≤ 630 A. LDB max. Rating – 630 A (Timer, A/M SS shall be provided in LDB I/C feeder for outdoor lighting control).
3.2	METERING	Ammeter, Voltmeter, kWH (multifunction digital meter)
4.0	**OUTGOING FEEDERS**	
4.1	TYPE OF COMPONENT	Switch Fuse Unit/ Switch Fuse Unit with contactor/ ~~MCB with ELCB.~~
4.2	ENCLOSURE	
	a) MATERIAL	CRCA sheet steel
	b) TYPE & PROTECTION CLASS	
	FOR INDOOR INSTALLATION	IP 5X Minimum
	FOR OUTDOOR INSTALLATION	IP 5X Minimum
B)	**SUB- DISTRIBUTION BOARD (LP&PP)**	
1.0	**BUSBAR**	415 V, 50 Hz, TPN, 10 kA for 1 sec.
1.1	MATERIAL	Aluminium
2.0	**INCOMING FEEDER**	
	TYPE OF COMPONENT	MCB.

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	DISTRIBUTION BOARDS (LDB,ASB,LP,PP)	
3.0	**OUTGOING FEEDER**	
	COMPONENT	Switch Fuse unit / SPN / DP MCB.
4.0	**ELCB REQUIREMENT**	Required - to be provided at outgoing feeder (common for each phase) of LP.

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	LOCAL CONTROL STATIONS	
1.0	**MATERIAL OF ENCLOSURE**	~~Sheet steel~~ / ~~Cast iron~~ / Cast Al. / ~~FRP~~
2.0	**PROTECTION CLASS OF ENCLOSURE**	IPW 55
3.0	**PROVISION OF AMMETERS FOR DRIVES**	Required for all motors rated above 5.5 kW.
4.0	**REQUIREMENT OF SEPARATE / INTEGRAL CANOPY**	~~Integral~~ / Non integral (FRP)
5.0	**STOP PUSH BUTTON TYPE**	Red, Mushroom Head, Stay-Put type, press to lock & turn to unlock
6.0	**START PUSH BUTTON TYPE**	Shrouded type (Green Colour)
7.0	**PAD LOCKING REQUIREMENT**	Required
8.0	**A/M SELECTOR SWITCH**	As per process requirement. Emergency push button for feed pump, MOVs, Fin Fan Coolers and any other drives as per Hazop and safety requirements.

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	LIGHT FITTINGS	
1.0	**TYPES OF LAMP (GLS / FLUORESCENT / HPMV / SODIUM VAPOUR)**	Energy Efficient
	a) FOR PROCESS AREAS	HPMV (80 W, 125W well glass. 250 W, 400 W Flood Light fittings)
	b) FOR OUTDOOR AREAS	HPMV (For Hazardous Area) / HPSV for Safe area
	c) FOR ROAD & SECURITY.	1 x 125 W HPMV well glass for Area lighting and Street lighting.
	d) FOR GODOWN / WAREHOUSE/ DG ROOM/ COMPRESSOR ROOM, ETC.	1 x 250 W HPMV Medium bay /High bay/ Flood Light.
	e) SUBSTATION / CONTROL ROOM.	2 x 36 W Fluorescent Industrial Type for S/S 2 x 28 W T5 Fluorescent / CFL Mirror Optic decorative type for Control Room . Optionally LED Type fittings equivalent to above fittings in SS & CR – to be decided during detail engineering.
	f) ADMINISTRATION & OTHER NON PLANT BUILDINGS.	2 x 28 W T5 Fluorescent / CFL Mirror Optic decorative type
	g) OUTDOOR PROCESS AREA / TANKFARM / OTHER STRATEGIC LOCATIONS FOR GENERAL ILLUMINATION	Telescopic, Tubular Motorised Highmast fitting
2.0	**PERCENTAGE OF LIGHT FITTINGS ON EMERGENCY SUPPLY.**	20 - 25 %
3.0	**LIGHT FITTINGS ON DC / UPS SUPPLY FOR CRITICAL AREAS**	Entry points, Escape routes etc.
4.0	**TYPE OF AUTOMATIC CONTROL OF OUTDOOR LIGHTING**	Timer Control, Auto/ manual control .
5.0	**TYPE OF FITTINGS IN HAZARDOUS AREA**	
	ZONE 1	Ex'd'
	ZONE 2	Ex'd'
6.0	**PROVISION FOR LOOPING**	Junction box / in Light fitting / Separate Control Gear Box for process units/ Platforms / Process Building above 4 m. height as applicable.

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	LIGHT FITTINGS	
7.0	**WIRING OF LIGHT FITTING, CONDUIT / CABLE (SPECIFY AREA WISE)**	Outdoor Areas – with Armoured Copper cable Buildings with false ceiling: - Concealed conduit wiring below false ceiling - Surface conduit wiring above false ceiling.
8.0	**ILLUMINATION LEVEL (MINIMUM)**	F
	ROADS & TANK FARM	30
	PUMP OPERATING AREA	100
	MAIN OPERATION PLATFORMS & ACCESS STAIRS	60
	ORDINARY PLATFORMS	30
	PROCESS AREAS HEATERS, PIPE RACKS, HEAT EXCHANGERS, SEPARATORS	60
	SWITCHGEAR ROOM	200
	BATTERY ROOM	150
	CONTROL ROOM / LAB	500
	TOILETS & STAIRS	100
	TRANSFORMER BAY/ ROOM	100
	PRESSURIZATION / AIR CONDITIONING ROOM	150
	CABLE CELLAR	70
	OFFICE	300
	DG HOUSE	150
	COMPRESSOR HOUSE	150
	UPS / OPERATOR ROOM	300
	SWITCHYARD	30
	WARE HOUSE	100
9.0	**SPECIAL REQUIREMENTS**	**Energy Saving Lighting fittings for Substation / Control Room for implementing Green Building concept.**

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	UPS	
1.0	**TYPE**	IGBT
2.0	**REDUNDANCY / TYPE OF REDUNDANCY**	100 % / Parallel Redundant / ~~Hot Standby~~
3.0	**INPUT SUPPLY VOLTAGE**	415 V, TPN, 50Hz
4.0	**OUTPUT SUPPLY VOLTAGE**	110 V SPN for Instrumentation loads, VFDs
	O/G FEEDERS	SFU with semiconductor type fuse
5.0	**TYPE OF BATTERIES**	Ni-Cd ~~/ Lead acid~~
6.0	**BATTERY BACKUP TIME**	For UPS battery back-up requirement of F&G system refer instrument tender document / Corrigendum. This clause shall be read for UPS battery back-up of F&G system in all relevant tender document of electrical F
7.0	**BATTERY EXECUTION**	Common
8.0	**STABILISER IN BYPASS LINE**	~~Servo Controlled /~~ Static
9.0	**BYPASS TRANSFER CONTROL**	~~Auto~~ / Manual through Static Switch (Manual for maintenance Bypass). Auto transfer in case of DC & AC U/V or failure of both UPS modules.
10.0	**VDU WITH PC/PRINTER ETC.**	~~Required~~ / Not Required
11.0	**COMMUNICATION PORT**	Required
12.0	**SPARE CAPACITY**	20 %

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	UPS	
13.0	**SPECIAL REQUIREMENT**	I/P isolation transformer required. Rating of largest branch circuit shall not exceed 25 % of the system rating. O/G cables to ACDB shall be copper cables Fault Diagnostic feature Current, Voltage signal, fault summary contact and ON-OFF status for HMI through serial link on Modbus Provision for online discharge of battery bank on load 20 % spare feeders to be provided in ACDB.

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1.0	**BATTERY**	
1.1	TYPE	Ni-Cd . VRLA for GT-V & DG Sets
1.2	VOLTAGE	110 V DC / 125 V DC for GT-V Critical Drives
1.3	BACK UP TIME OF BATTERY	60 Minutes.
2.0	**BATTERY CHARGER**	
2.1	TYPE (DIODE WITH AUTO TRANSFORMER / THYRISTOR)	**Thyristorised**
2.2	FLOAT CHARGING CUM BOOST CHARGER / FLOAT & BOOST CHARGER SEPARATELY	Dual parallel redundant Float cum Boost Charger (FCBC-1 & FCBC-2)
2.3	REDUNDANCY OF BATTERY & CHARGER	Charger: 100% redundant Battery: Common
2.4	SPARE CAPACITY	25 % for Battery, charger and DCDB with 20 % spare feeders in DCDB
2.5	SPACIAL REQUIREMENT	Auto start facility for chargers Battery charger with Ripple overshoot annunciation Filter capacitor fuse failure annunciation and indication. Battery isolator near Battery Bank DCDB with 1 I/C DCDB with semiconductor fuses O/G cables to DCDB shall be copper cables Fault Diagnostic feature Current, Voltage signal, fault summary contact and ON-OFF status for HMI through serial link on Modbus. Provision for online discharge of battery bank on load

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	EARTHING	
1.0	**EARTH PIT TYPE**	Pipe / Plate Electrode
2.0	**EARTHING MATERIAL**	G.I (100 mm dia. minimum for Pipe Electrode/ 1200 x 1200 x 6.3 mm plate Electrode)
3.0	**TYPE OF EARTHING CONDUCTOR FOR EQUIPMENT**	
3.1	EARTHING MAIN GRID	G.I Strip
3.2	SWITCH YARD EQUIPMENT	
	a) TRANSFORMER NEUTRAL	G.I Strip
	b) EQUIPMENT	G.I Strip
	c) LIGHTNING ARRESTOR	G.I Strip
	d) STRUCTURE	G.I Strip
3.3	SUBSTATION EQUIPMENT	
	a) EQUIPMENT (PCC / MCC / HT SWGR. ETC.)	G.I Strip
	b) TRANSFORMER NEUTRAL	G.I Strip
3.4	PLANT EQUIPMENT	
	a) MOTORS & LCS	G.I. strip, Flexible G.I. wire rope or G.I. wires of appropriate sizes (double earthing for motors and LCS)
	MOTORS UPTO 3.7 KW	8 SWG solid wire
	MOTORS 5.5 KW TO 30 KW & WELDING RECEPTACLES	10 mm (3/8") wire rope
	MOTORS ABOVE 37 KW INCLUDING 37 KW INCLUDING HT MOTORS	16 mm (5/8") wire rope
	BUILDING COLUMNS	40 x 5 strip
	STORAGE TANKS (VERTICAL & HORIZONTAL)	40 x 5 strip
	LOADING RACKS	40 x 5 strip
	PIPE RACKS, VESSELS & HEAT EXCHANGERS	10 mm (3/8") wire rope
	SMALL EQUIPMENTS & INSTRUMENTS	8 SWG solid wire
	LIGHTING, POWER & INSTRUMENTATION PANELS	10 mm (3/8") wire rope

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	EARTHING	
	MAIN EARTH BUS/ LT & HT SWITCH GEAR INTERCONNECTIONS / POWER TRANSFORMER	As per calculation
	EHV & HV SUBSTATIONS	As per calculation
	PUSH BUTTON STATION	8 SWG solid wire
	STREET LIGHT POLES	10 mm (3/8") wire rope
	LIGHTING TRANSFORMERS	16 mm (5/8") wire rope
	b) STATIC EARTHING	G.I Strip
	c) LIGHTING FITTINGS	By 3rd core of 3C x 2.5 YWY Lighting Cable.
4.0	**LIGHTNING PROTECTION**	
4.1	AIR TERMINAL MATERIAL	Copper
4.2	DOWN CONDUCTOR	G.I Strip
4.3	EARTH PIT	1 No. per down conductor

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	ELECTRICAL INSTALLATION	
1.0	**MODE OF CABLE LAYING (TRENCH / BURIED / OVER HEAD TRAYS)**	Cable Trays on Overhead Cable / Pipe Rack in ISBL. Cable Trench / Overhead tray on piperack / cable rack as applicable in OSBL area (SS to ISBL Area).
2.0	**TYPE OF CABLE TRAY (PRE-FABRICATED / FABRICATED AT SITE WITH STRUCTURAL STEEL)**	Pre -fabricated, Ladder type / Perforated
3.0	**MATERIAL OF PRE-FABRICATED TRAYS**	~~M.S, Epoxy painted~~/ G.I.
4.0	**CABLE CLAMPING ARRANGEMENT (CLAMPS MADE OF STEEL / AL / NYLON ROPES)**	Clamps made of Aluminum / Non Magnetic material
5.0	**CABLE TAG (ALUMINIUM / S.S)**	SS
6.0	**CABLE MARKER FOR UNDERGROUND CABLE** **MATERIAL**	Required Cast Iron at 30 m interval and at turnings.
7.0	**SECURITY LIGHTING WITH STRUCTURAL TOWERS**	Not Required
8.0	**TYPE OF STREET LIGHT POLE REQUIRED**	12 / 10 meters high swaged tubular as per IS 2713
9.0	**SOCKET OUTLETS - INDUSTRIAL / FLP TYPE**	Industrial / Flameproof (for classified areas)
	a) FOR WELDING (RATINGS & AREAS TO BE COVERED)	63 A, 415 V TPN + E
	b) FOR PORTABLE ELECTRICAL EQUIPMENT'S	20 A, 240 V, SPN + E
	c) FOR FANS & OTHER EQUIPMENT'S IN NON-PLANT AREAS	6 + 16 A, 240 V, SPN + E
	d) FOR HAZARDOUS AREAS	20 A, 240 V, DP + E, Ex (d) type 20 A, 240 V, DP + E, Ex (e) type 6+16 A, 24 V DP + E, Ex (d) type for manholes (As Applicable)

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	TELEPHONE SYSTEM	
1.0	FUNCTIONAL REQUIREMENTS (BRIEF DESCRIPTION OF PLANT REQUIRED)	Push button type with redialing facility
2.0	NO. OF HAND SETS	Later
3.0	FURTHER EXPANSION TO BE CONSIDERED	20%
4.0	NO. OF P& T LINES TO BE INTERCONNECTED	Not Applicable
5.0	SPECIAL REQUIREMENT	Supply of TTB, Telephone Instruments etc. in ISBL Area by LSTK Contractor. Supply of MDF including supply of cable (MDF – TTB in ISBL Area) by OSBL Contractor. Hook up with existing EPABX including supply of cable (EPABX to MDF) shall be by CPCL.

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	PLANT COMMUNICATION SYSTEM	
1.0	**REQUIREMENTS (GENERAL PAGING / CONFERENCE BETWEEN VARIOUS STATIONS / POINT TO POINT COMMUNICATION)**	Standalone system per process area. Plant communication system shall be of Digital type Redundant CPU Direct communication between two FCS without interface of MCS / operator Paging speaker to produce sound level min. 6 db more than the ambient noise level.
2.0	**NO. OF STATIONS REQUIRED FOR**	
	FOR OPERATION OF THE PLANT SECURITY	Required as per the details specified in Job Specification.
3.0	**INTERFACE REQUIREMENTS**	
3.1	INTERFACE WITH TELEPHONE SYSTEM	Not Required.
3.2	INTERFACE WITH FIRE ALARM SYSTEM	Not Required
4.0	**SPARE CAPACITY**	20 %
5.0	**BATTERY BACK UP**	240 V AC Power Supply shall be provided to PCS with 2 hours battery back-up.
6.0	**ADDITIONAL REQUIREMENTS**	Status monitoring, fault diagnostics and report generation features Manual / Auto recording of conversation Ability to broadcast prerecorded messages

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	HMI SYSTEM	
1.0	**TYPE OF SYSTEM**	**Latest, proven, HMI System with communication protocol 61850. Windows based operating system.**
2.0	**COMMUNICATION REQUIREMENTS**	- Microprocessor based comprehensive relays in respective switchboards shall directly communicate on 61850 to RTU - Communication with Third party elements like VFD, UPS, Battery Charger, DCS, Meters etc. on Modbus.
3.0	**SYSTEM COMPONENTS**	**Minimum required hardware not necessarily be limited to,** - Engineering Work Station, - Operator Station, Server, - RTU, - I/O Racks, - Dummy Panels, - Ethernet switches for FO Connectivity, - Gateways, - Communication cables (FO cables).
4.0	**FEATURES**	- Sequence of Event Recording: 1 msec resolution - Time stamping & Time synchronization: - Data Logging - Feeder status monitoring - Relay Parameterization - Disturbance recording
5.0	**REDUNDANCY**	- RTU with redundant processor and redundant power supply with non-redundant I/O modules. - Redundant communication between RTU and IEDS and local HMI.
6.0	**INTERFACE WITH OTHER SYSTEMS**	Required with existing ABB Make SCADA System / Existing L&T make load shedding scheme. F
7.0	**SPARE CAPACITY**	20 % at all levels

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SPECIFICATION NO: 44NC-4600-0000/E.02/0001/A4

TITLE: ANNEXURE -1 TO
ENGINEERING DESIGN BASIS - ELECTRICAL
HMI I/O LIST

PROJECT REFERENCE:

- **Project No:** 44NC- 4600
- **Project Location:** Manali, Chennai
- **Project Title:** RESID UPGRADATION PROJECT
- **Client:** Chennai Petroleum Corporation Limited
- **Project Manager Authorization:** R.P.GAIKWAD **Date:** 12.07.2010
- **Client Authorization:** **Date:**

				APPROVALS		
Rev. No.	Issue Date	Pages	Revision Description	By	Check	Approve
E	12.07.2010	6	Issued for Engineering	ASR	PPP	RBD
D	04.06.2010	7	Issued for Engineering	ASR	PPP	RBD
C	01.05.2010	7	Client's comments incorporated & Issued for comments	ASR	PPP	RBD
B	27.04.2010	7	Client's comments incorporated & Issued for comments	PPP	VDV	RBD
A	04.03.2010	7	Issued for comments	PPP	VDV	RBD

☑	Entire Specification Issued this Revision	SPECIFICATION ISSUED FOR:			
		☐	In-house Review	☐	Purchase
☐	Revised Pages Only Issued this Revision	☐	Client Approval	☐	Construction
		☐	Enquiry	☑	Engineering

ANNEXURE I to DESIGN BASIS - ELECTRICAL
HMI I/O LIST

FEEDERWISE I/O LIST

Sr. No.	Input Description	Input Type	Input Type	
			Hard	Soft
	6.6 kV Incomer Feeder			
1	CB in Service & Closed	DI		✓
2	CB in Service & Open	DI		✓
3	Relay 86 operated & Reset	DI		✓
4	Relay 95 Operated & Reset	DI		✓
5	Relay 51Operated & Reset	DI		✓
6	Relay 51N Operated & Reset	DI		✓
7	Numerical Relay (51,51 N) Unhealthy	DI		✓
8	Relay 85 Operated & Reset	DI		✓
9	Numerical Relay (85) Unhealthy	DI		✓
10	Trip on under voltage activated	DI		✓
11	R Phase Current	AI		✓
12	Y Phase Current	AI		✓
13	B Phase Current	AI		✓
14	3-Phase Real Power	AI		✓
15	3-Phase Reactive Power	AI		✓
16	Frequency (Hz)	AI		✓
	6.6 kV Bus Coupler Feeder			
1	CB in Service & Closed	DI		✓
2	CB in Service & Open	DI		✓
3	Relay 86 Operated	DI		✓
4	Relay 95 Operated	DI		✓
5	Relay 95A Operated	DI		✓
6	Relay 95B Operated	DI		✓
7	Relay 86A Operated	DI		✓
8	Relay 86B Operated	DI		✓
9	Relay 87A Operated	DI		✓
10	Relay 87B Operated	DI		✓
11	Numerical relay 51 operated	DI		✓
12	Numerical relay 51N operated	DI		✓
13	Numerical relay 87A operated	DI		✓
14	Numerical relay 87B operated	DI		✓
15	Numerical relay (51,51 N) Unhealthy	DI		✓
16	Numerical relay (87A) Unhealthy	DI		✓
17	Numerical relay (87B) Unhealthy	DI		✓
18	Trip on under voltage activated	DI		✓
	6.6 KV 240V AC Supply Control			
1	AC Supply Incomer failed	DI		✓
	6.6 KV 110V DC Supply Control			
1	DC Supply 1 failed	DI		✓
2	DC Supply 2 failed	DI		✓
	6.6 KV Auto Transfer Scheme			
1	ATS selector switch in manual mode	DI		✓
2	ATS selector switch in independent mode	DI		✓
3	Auto Change over blocked	DI		✓
4	Synchro check relay healthy	DI		✓
5	Bus Coupler closed in manual mode	DI		✓
6	Momentary paralleling is in process and in manual mode	DI		✓

ANNEXURE I to DESIGN BASIS - ELECTRICAL
HMI I/O LIST

FEEDERWISE I/O LIST

Sr. No.	Input Description	Input Type	Input Type	
			Hard	Soft
	6.6 kV Bus PT			
1	Under Voltage operated	DI		✓
2	Load shedding scheme Stage-1 Operated	DI		✓
3	Load shedding scheme Stage-2 Operated	DI		✓
4	Load shedding scheme Stage-3 Operated	DI		✓
5	Load shedding scheme Stage-4 Operated	DI		✓
6	PT MCB Open	DI		✓
7	PT MCB Close	DI		✓
8	R-Y Bus Voltage	AI		✓
9	Y-B Bus Voltage	AI		✓
10	R-B Bus Voltage	AI		✓
	6.6 kV Line PT			
1	Under Voltage operated	DI		✓
2	PT MCB Open	DI		✓
3	PT MCB Close	DI		✓
4	R-Y Bus Voltage	AI		✓
5	Y-B Bus Voltage	AI		✓
6	R-B Bus Voltage	AI		✓
	6.6 kV X'mer Fdrs			
1	CB in service & Closed	DI		✓
2	CB in service & Open	DI		✓
3	Relay 86 Operated	DI		✓
4	Relay 95 Operated	DI		✓
5	Numerical Relay (50, 51) Unhealthy	DI		✓
6	Bucchloz Relay Alarm	DI		✓
7	Bucchloz Relay Trip	DI		✓
8	Winding Temperature Alarm	DI		✓
9	Winding Temperature Trip	DI		✓
10	Oil Temperature Alarm	DI		✓
11	Oil Temperature Trip	DI		✓
12	PRV Trip	DI		✓
13	MOG Alarm	DI		✓
14	Transformer emergency Trip operated & reset	DI		✓
15	Numerical Relay 50 Operated	DI		✓
16	Numerical Relay 51 Operated	DI		✓
17	R Phase Current	AI		✓
18	Y Phase Current	AI		✓
19	B Phase Current	AI		✓
20	3-Phase Real Power	AI		✓
21	3-Phase Reactive Power	AI		✓
22	Oil Temprature	AI		✓
23	Winding Temprature	AI		✓

ANNEXURE I to DESIGN BASIS - ELECTRICAL
HMI I/O LIST

FEEDERWISE I/O LIST

Sr. No.	Input Description	Input Type	Input Type	
			Hard	Soft
	6.6 kV Motor Fdrs			
1	CB in service & Closed	DI		✓
2	CB in service & Open	DI		✓
3	Relay 86 Operated	DI		✓
4	Relay 95 Operated	DI		✓
5	Numerical MPR Relay Unhealthy	DI		✓
6	Numerical MPR Relay Operated	DI		✓
7	Motor Trip from process	DI		✓
8	Trip on load shedding activated	DI		✓
9	Trip on under voltage activated	DI		✓
10	R Phase Current	AI		✓
11	Y Phase Current	AI		✓
12	B Phase Current	AI		✓
13	3-Phase Real Power	AI		✓
14	3-Phase Reactive Power	AI		✓
15	Hour Run meter	AI		✓
	6.6 kV Power Fdrs			
1	CB in service & Closed	DI		✓
2	CB in service & Open	DI		✓
3	Relay 86 Operated	DI		✓
4	Relay 95 Operated	DI		✓
5	Numerical Relay Unhealthy	DI		✓
6	Numerical Relay Operated	DI		✓
7	R Phase Current	AI		✓
8	Y Phase Current	AI		✓
9	B Phase Current	AI		✓
10	3-Phase Real Power	AI		✓
11	3-Phase Reactive Power	AI		✓
	0.415 kV Incomer Feeder			
1	CB in Service & Closed	DI		✓
2	CB in Service & Open	DI		✓
3	Relay 86 operated & Reset	DI		✓
4	Relay 95 Operated & Reset	DI		✓
5	Relay 51 Operated & Reset	DI		✓
6	Relay 51N Operated & Reset	DI		✓
7	Numerical Relay (51,51 N) Unhealthy	DI		✓
8	Relay 51G Operated & Reset	DI		✓
9	Numerical Relay (51G) Unhealthy	DI		✓
10	Relay 64R Operated & Reset	DI		✓
11	Numerical Relay (64R) Unhealthy	DI		✓
12	Trip on under voltage activated	DI		✓
13	R Phase Current	AI		✓
14	Y Phase Current	AI		✓
15	B Phase Current	AI		✓
16	3-Phase Real Power	AI		✓
17	3-Phase Reactive Power	AI		✓
18	Frequency (Hz)	AI		✓

ANNEXURE I to DESIGN BASIS - ELECTRICAL
HMI I/O LIST

FEEDERWISE I/O LIST

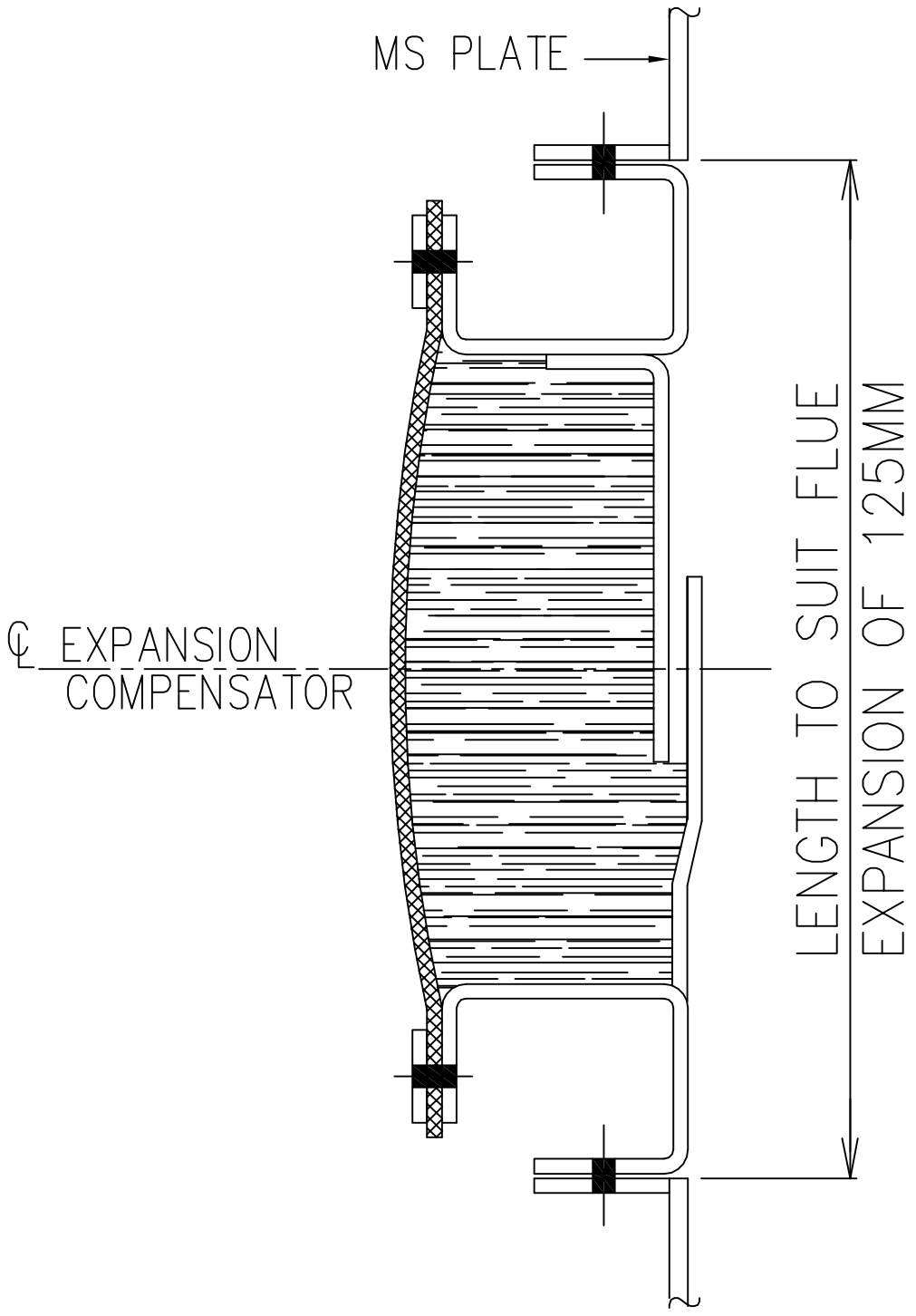
Sr. No.	Input Description	Input Type	Input Type	
			Hard	Soft
	0.415 kV Bus Coupler Feeder			
1	CB in Service & Closed	DI		✓
2	CB in Service & Open	DI		✓
3	Relay 86 Operated	DI		✓
4	Relay 95 Operated	DI		✓
5	Numerical relay (51,51 N) Unhealthy	DI		✓
6	Numerical relay 51 Operated	DI		✓
7	Numerical relay 51 N Operated	DI		✓
8	Trip on under voltage activated	DI		✓
9	R Phase Current	AI		✓
10	Y Phase Current	AI		✓
11	B Phase Current	AI		✓
12	3-Phase Real Power	AI		✓
13	3-Phase Reactive Power	AI		✓
	0.415 KV 240 V AC Supply Control			
1	AC Supply Incomer failed	DI		✓
	0.415 KV 110V DC Supply Control			
1	DC Supply 1 failed	DI		✓
2	DC Supply 2 failed	DI		✓
	0.415 KV Auto Transfer Scheme			
1	ATS selector switch in auto mode	DI		✓
2	ATS selector switch in manual mode	DI		✓
3	ATS selector switch in independent mode	DI		✓
4	Auto Change over blocked	DI		✓
5	Synchro check relay healthy	DI		✓
6	Auto Change over scheme operated	DI		✓
7	Bus Coupler closed under ATS Scheme	DI		✓
8	Momentary paralleling is in process and in manual mode	DI		✓
	0.415 kV Bus PT			
1	Under Voltage operated	DI		✓
2	Load shedding scheme Stage-1 Operated	DI		✓
3	Load shedding scheme Stage-2 Operated	DI		✓
4	Load shedding scheme Stage-3 Operated	DI		✓
5	Load shedding scheme Stage-4 Operated	DI		✓
6	PT MCB Open	DI		✓
7	PT MCB Close	DI		✓
8	R-Y Bus Voltage	AI		✓
9	Y-B Bus Voltage	AI		✓
10	R-B Bus Voltage	AI		✓
	0.415 kV Line PT			
1	Under Voltage operated	DI		✓
2	Frequency Relay Operated	DI		✓
3	PT MCB Open	DI		✓
4	PT MCB Close	DI		✓
5	R-Y Bus Voltage	AI		✓
6	Y-B Bus Voltage	AI		✓
7	R-B Bus Voltage	AI		✓

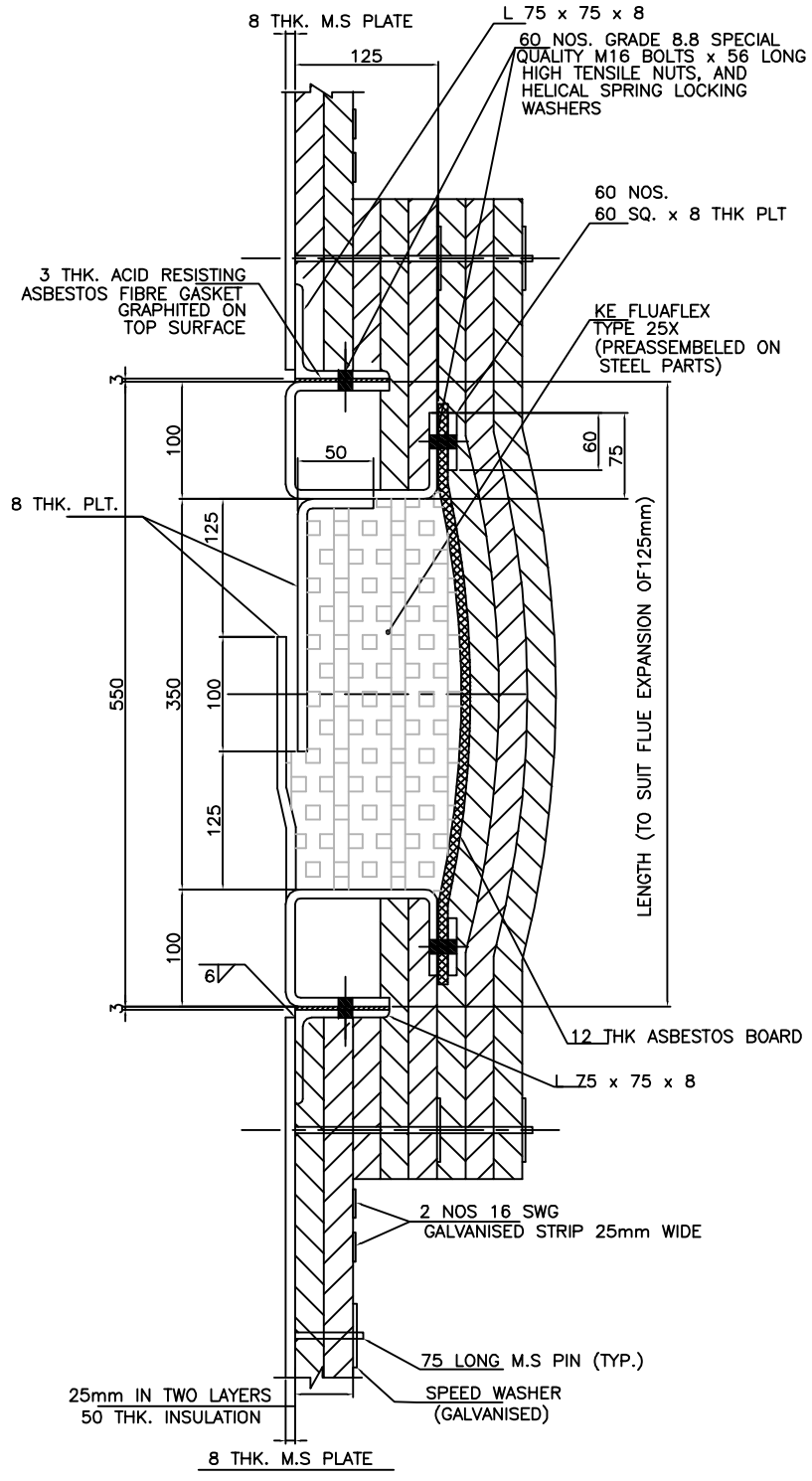
ANNEXURE I to DESIGN BASIS - ELECTRICAL
HMI I/O LIST

FEEDERWISE I/O LIST

Sr. No.	Input Description	Input Type	Input Type	
			Hard	Soft
	0.415 kV Motor Fdrs			
1	CB in service & Closed	DI		✓
2	CB in service & Open	DI		✓
3	Relay 86 Operated	DI		✓
4	Relay 95 Operated	DI		✓
5	Numerical MPR Relay Unhealthy	DI		✓
6	Numerical MPR Relay Operated	DI		✓
7	Motor Trip from process	DI		✓
8	Trip on load shedding activated	DI		✓
9	Trip on under voltage activated	DI		✓
10	R Phase Current	AI		✓
11	Y Phase Current	AI		✓
12	B Phase Current	AI		✓
13	3-Phase Real Power	AI		✓
14	3-Phase Reactive Power	AI		✓
15	Hour Run meter	AI		✓
	0.415 kV Power Fdrs			
1	CB in service & Closed	DI		✓
2	CB in service & Open	DI		✓
3	Relay 86 Operated	DI		✓
4	Relay 95 Operated	DI		✓
5	Numerical Relay Unhealthy	DI		✓
6	Numerical Relay Operated	DI		✓
7	Trip on under voltage activated	DI		✓
8	R Phase Current	AI		✓
9	Y Phase Current	AI		✓
10	B Phase Current	AI		✓
11	3-Phase Real Power	AI		✓
	Miscellaneous Signals			
1	Critical DC Lighting "ON"	DI	✓	
2	UPS Charger Failure	DI	✓	
3	UPS Inverter Failure	DI	✓	
4	UPS Battery Discharged	DI	✓	
5	UPS Battery isolated	DI	✓	
6	Common fault UPS System	DI	✓	
7	110 V DC Supply Charger-1 Failure	DI	✓	
8	110 V DC Supply Charger-2 Failure	DI	✓	
9	110 V DC System on Battery	DI	✓	
10	Common Fault 110 V DC System	DI	✓	
11	UPS voltage	AI	✓	
12	UPS Current	AI	✓	
13	110 V DC System voltage	AI	✓	
14	110 V DC System Current	AI	✓	
15	Common Fault VFD	AI	✓	
16	VFD Bypassed.	AI	✓	

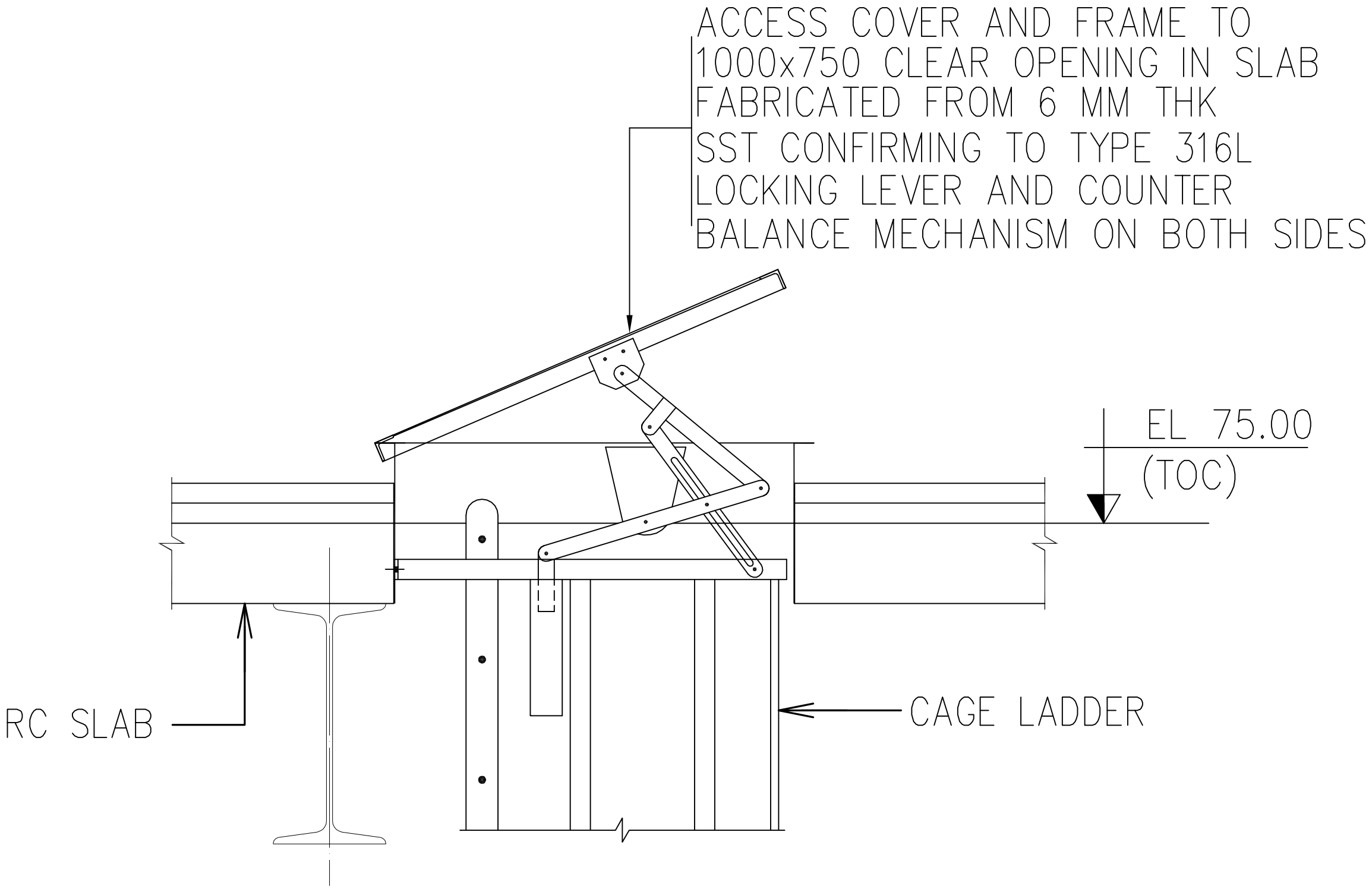
4. Non metallic expansion compensator for flues – 01 Pages





TENTATIVE DETAIL OF NON METALLIC EXPANSION COMPENSATOR FOR FLUE (TENDER PURPOSE ONLY)

5. Roof access cover – 01 Pages



TENTATIVE DETAIL OF ROOF ACCESS COVER

(FOR TENDER PURPOSE ONLY)

6. CPCL Safety Clauses – 49 Pages

APPENDIX – 6 TO SCC
SAFETY REGULATION

Chennai Petroleum Corporation Limited

(A group company of Indian Oil)

Manali, Chennai – 600 068

Contractors Safety Guidelines

INDEX

1. INTRODUCTION:

1.1 The guidelines listed herein comprise contractor's obligations towards safety and its compliance to work. Contractor working within the refinery premises shall adhere to these guidelines and shall also follow any additional precautions that may be prescribed from time to time by CPCL to prevent any injury to contract workmen and any loss or damage to the property. CPCL reserves its right to modify or replace the contents of this manual, orally or in writing, without prior notice. Contractor shall keep their personnel and subcontractors informed about the potential health and safety hazards to which they are exposed to and shall ensure that their personnel and their subcontractors are supplied with all necessary personal protective equipment and aware of the applicable emergency response and mitigation plans.

2. GENERAL:

2.1 Security Awareness

Contract personnel shall be alert to any suspicious situations or persons and report them to their supervisor or CISF personnel available nearby. The contractor shall keep their tools, equipment, or materials securely with lock for all toolboxes, buildings, and compounds. All such preservations shall bear the signage of the respective contractor for easy identification. Briefcases, purses, wallets, keys, or other valuables should not be left unattended or unsecured.

2.2 Loss of Property

Thefts or suspected thefts of CPCL or contractor's material should be reported to the CISF. Any loss of property of the contractor from the parking lots outside CPCL Gate should be reported to the local Police.

2.3 Traffic Accidents in the Plants

All traffic accidents shall be immediately reported to CISF and to the Engineer-in-Charge with details of driving license, vehicle registration, insurance, etc. Driver of the vehicle involved in an accident shall stop the vehicle at the scene of the accident, for further action by the concerned authorities.

2.4 Traffic Rules

Fire fighting is important activity in a refinery. Hence, road users should give Right of Way to the fire trucks, ambulances and rescue vehicles at all times. Contractors are advised not to proceed beyond any red flashing warning light that indicates an emergency in an area unless the contractor has the specific duties or responsibilities related to the emergency. Contractors shall not park the vehicles near Fire hydrants, manifolds, MCPs, etc. blocking them. All drivers should possess and practice exemplary driving courtesy and defensive driving techniques. The speed limit for all vehicles should not exceed beyond

25 KMPH. Persons operating motor vehicles within CPCL premises shall possess relevant valid Driving License and Registration and Insurance for the vehicles. They shall comply with traffic signs, parking rules and other regulations listed from time to time. Vehicles movement into refinery processing areas and tank farms shall be permitted only with a valid permit/clearance.

2.5 Prohibited Items / Acts

Items such as cellular phones, Radio, Transistor, Tape recorder, SLR / Video Camera, cigarettes, Match box, Crackers, alcohol, Arms & Ammunition, Flammable materials are prohibited inside the CPCL.

a) Cameras: Contractor while seeking entry into CPCL should declare the camera in their possession to CISF, who in turn shall keep the camera under safe custody and return the same on exit. Contractors who need to take photographs within CPCL must obtain prior approval from Functional Director of CPCL through their respective Engineer-in-Charge.

b) Cell Phones: Contractor shall deposit their cellular phones at the plant main Gate to CISF and the cell phone could be collected on exiting the refinery.

c) Movement: Loitering within CPCL and near the gates of CPCL by Contractor personnel without any specific business and with out their photo passes is prohibited.

d) Smoking: Smoking is strictly prohibited within the premises of CPCL.

e) Gambling: Gambling in all forms is prohibited within the premises of CPCL.

3. GATE ENTRY / EXIT PROCEDURE

Entry of personnel and materials into the Refinery is restricted on account of the safety and security of the installation. Contractor shall comply with the prevailing guidelines and regulations for entry of their men and material to the refinery. All the contract workmen and their supervisory staff shall obtain passes for themselves duly authorized by the appropriate authorities of CPCL and must display their passes at the gates and at the sites whenever demanded by CPCL officials or CISF. CISF will collect details of Contractor's officials / men who enter the Refinery and forward to CLM Cell for records purposes. Gate pass systems in CPCL are as follows:

3.1 Permanent Photo Gate Pass

Permanent Photo Gate Passes will be issued to contractor's workmen for a period not less than one month, which can be extended further on

recommendation of the Engineer-in-charge. The pass shall be duly certified & issued by CISF. Application format for permanent photo gate pass is available with CPCL-CLM Cell.

3.2 Temporary Gate Pass

Temporary Gate passes will be issued to contractor's workmen to be deployed for less than one month. The validity of the temporary gate pass is for a maximum period of 15 days, which may then be extended further for period of 15 days on recommendation of Engineer-in-Charge. Application format for temporary gate pass is available with CPCL-CLM Cell.

3.3 Documentation required for Permanent & Temporary Gate Passes:

- ✓ Filled in Format along with signature and seal of all signatories of the officials/competent authorities
- ✓ Two copies of recent passport size photographs.
- ✓ Proof of Residence namely copy of the Permanent Residence certificate issued by District / Sub Division Authority OR copy of the certificate issued by Village Head / Municipality Board Head duly verified by the State Police Authorities OR Copy of the Passport or PAN Card or Driving License or Voter Identity Card
- ✓ Safety Pass.

3.4 Special Temporary Pass

Special Temporary Pass is issued to Executives of contractors visiting CPCL on a temporary assignment. The said pass is valid initially for a maximum period of 15 days and can be extended further for maximum 15 days on recommendation from Engineer-in-Charge. Copy of format is available with CPCL-CLM Cell. The documentation required for issuance include Filled up format along with sign and seal of all signatories and Photocopy of Identity Card from concerned organization attested by Engineer-in-Charge with recent Passport size Photograph.

3.5 Vehicle Pass for Contractors

Entry of contractor's vehicles in to CPCL is restricted. For execution of work, contractor shall apply for Vehicle Pass through respective Engineer in charge and the same will be approved by the competent authority of CPCL and the Pass will be issued by CPCL CISF.

3.6 Special permission for working on holidays/Sundays/Nights.

Special permission is required for working on holidays/Sunday/nights. The contractor shall submit a request letter to CISF through the EIC and CPCL CLM Cell.

3.7 **Entry and Exit of Contractor's Material**

Entry / Exit of contractor's materials will be allowed through CPCL Gate as per CPCL procedures. All entries of contractor's materials into CPCL shall be endorsed on the delivery challan or authorized document by CISF. The endorsed challan shall be preserved for reconciliation. The material shall be subjected to CPCL inspection / checking before it is taken to site or put to beneficial use. Contractor while taking the materials out of CPCL shall ensure possession of CPCL Gate Pass indicating the materials to be taken out with respective inward challans endorsed by CISF.

4. PERSONAL PROTECTIVE EQUIPMENT

All Contractor's officials and workmen entering CPCL must wear BIS certified steel - toed safety shoes and helmets complying with the relevant BIS standard. Other personnel protective Equipment such as Chemical Splash & Impact Resistant Face shields and Goggles, Safety Glasses with Molded Side Shields, Eye and Face Protectors, Appropriate Gloves and Hearing Protection shall be used by the contractor's workmen while carrying out specialized work.

5. SAFETY TRAINING

5.1 Contractor's supervisory staff and workmen shall undergo Induction safety briefing given by CPCL Fire & Safety department, before issue of Safety pass. They shall be required to undergo safety training / demonstrations periodically through CPCL Fire & Safety department. Further, Contractor shall release their staff and workmen for training and specific subjects given by CPCL from time to time.

5.2 Contractor's supervisory staff and workmen shall be in possession of valid safety training badge while working in CPCL premises.

5.3 It shall be the responsibility of the contractor to provide detailed Induction training to new staff and workmen and provide periodic training to them.

5.4 The contractor' **JOB SUPERVISORS** shall deliver safety talks/tool box talk (2-minute) to their workmen on a daily basis prior to commencement of the day's work covering the jobs planned during the day and with specific reference to the Job Safety Analysis document for the jobs. The Owner will monitor the same and any violation in this regard will be viewed seriously.

5.5 Sub-contracting of work shall be dealt as per the relevant clause of the tender document. However, for all purposes contractor's employed workmen and the sub-contractor's employed workmen at site will be considered as "Contractor's Workmen" on whom the contract is awarded by CPCL and any shirking of liability by the contractor citing the reason as sub-contractor will not be acceptable. The contractor shall take all practical efforts to ensure safety of their own workmen and their sub-contractor's workmen at site at any point of time.

6. JOB SAFETY ANALYSIS (JSA):

Before starting of the work, contractor has to prepare "Job Safety Analysis" for all the activities involved in the contract and submit the same to the Engineer in charge for their review and acceptance. The preventive measures stipulated in the JSA have to be strictly complied by the contractor to ensure safety at work site. A sample JSA format is enclosed as **Annexure - 1.**

7. CONTRACTOR'S SAFETY OFFICERS

7.1 Deployment

7.1.1 Contractor shall deploy the following minimum safety personnel at site:

Labour Strength	Minimum No. of Safety Staff
Less than 30	One Engr./Supvr. with safety experience on Part Time basis
30 – 100	One safety supervisor on Full time basis
101 – 250	(a) For 'manpower supply oriented contract – One safety Supervisor on full time basis- Full time (b) For 'works contract" - One safety Engineer on full time basis + One safety supervisor full time basis
251 – 500	One safety Engineer full time basis + One safety supervisor on full time basis for every 250 employees deployed at site
More than 500	One safety Engineer on full time basis + One Environment Engineer on full time basis + One safety Supervisor on full time basis for every 250 employees deployed at site

7.1.2 The number of safety personnel has to be augmented by the Contractor, considering the hazardous nature of work, as per the instructions of the Engineer in charge, without claiming any compensation from CPCL.

7.1.3 Safety personnel deployed at site should possess certificate from a recognized institute. However, exclusive supervisors with other qualifications viz. Diploma, Graduate, etc. can also be deployed, with the permission of the engineer in charge, if they possess sufficient knowledge on safety or if they have previous experience as Safety personnel at work site.

7.1.4 In case of non deployment of safety personnel as above, penalty shall be imposed as mentioned in the Penalty clause of these guidelines.

7.2 Responsibilities

7.2.1 To assess the hazards associated with jobs in consultation with all concerned and establish safe working procedure including identification of the escape routes.

7.2.2 To establish a written record of factors this can cause injuries & illnesses.

7.2.3 To undertake routine/ surprise inspections of all work sites and identify unsafe conditions & practices, if any. Check for compliance of the safety practices being followed with approved HSE Plan.

7.2.4 To investigate promptly the incidents (including near-miss) in order to advise corrective and/or preventive action.

7.2.5 To maintain statistical information for use in analyzing all phases of incidents and events involving contract personnel.

7.2.6 To provide the means for complying with the reporting requirements for occupational injuries and illnesses.

7.2.7 To check whether the proposed working arrangements are safe and satisfactory, particularly at the interface between the contractors' planned work and CPCL's existing facilities.

7.2.8 To communicate to the Contractor the imposed restrictions which may affect the work/ personnel such as the temporary closure of a corridor or electrical isolation of equipment?

7.2.9 To review and monitor the contractor's adherence to approved HSE plan and all applicable environmental, health, and safety requirements.

7.2.10 To ensure that Consultant, Contractor's Managers, Supervisors and workmen at all levels (who will plan, monitor, oversee and carry out the work) undergo Health, Safety and Environmental training in their respective responsibilities with respect to conducting work safely and with due regard for the protection of the environment.

7.2.11 To identify areas of operations where specialized training is required to deal with potential dangers.

7.2.12 To document and to bring to the attention of plant Supervisor and Contractor any non-compliance/violation of the safety norms against approved safety and health planner safety and health requirements and also raises these issues in the Safety Committee Meetings.

7.2.13 To take part in Tool Box Meetings at random and to ensure maintenance of records.

7.2.14 To attend weekly meeting with Refinery Safety Officer with their weekly safety performance and submit action plan / status of recorded points of last meeting and discuss the safety, health and environment issues at work site of contractor.

7.2.15 To get assessed the health of equipment /appliances of contractor before they begin the job. The thorough assessment shall be done for all such equipment appliances before first use and at regular interval to ensure that their health is okay and statutory requirements are complied. The example is as below:-

- Healthiness of all lifting machine (cranes, derrick, forklifts, etc.), tools and tackles and their test certificate.

- Healthiness of gas cylinders and their test certificate. No cylinder shall be allowed to enter without a test certificate.

- Adequacy and healthiness of Scaffolding materials.

- Health of portable machines/ tools such as grinding machine and hand tools

- Health of welding machine, other machines and IC engine
  Standard and health of Electric equipments, cables, protective devices

- Standard and health of battery operated equipment with their certificate

- Health assessment checks certificate of all contractor vehicles and fitness certificate of RTO for vehicles, if entry allowed.

- Safety items such as materials for barricading & shoring, gas testing equipment, instruction boards, flash back arrester, fire proof cloth, including PPE (Adequacy, quality and certification)

7.2.16 Contractor's job supervisor shall deliver toolbox talks daily and safety talks on a weekly basis respectively to the workmen to familiarize the work site hazards, hazardous materials being used at site, safe work procedures to be followed at site, etc.

7.2.17 Investigate thoroughly, document and submit reports in case of injury, accident or near misses involving any of the workmen in the work site. Necessary follow up actions to be taken with the workmen to avoid recurrence of such acts in future.

7.2.18 Adequate job specific safety procedures have to be developed to suit the site condition and the same should be followed meticulously, wherever potential safety risks are identified.

7.2.19 Safety meetings have to be conducted to create commitment amongst all the stakeholders of the site work.

7.2.20 Increase safety awareness by providing signboards, posters, etc.

7.2.21 Perform at least one safety audit per month and submit the audit report to CPCL for review. Carry out Continuous motivation to the workmen for safe working practices, attitudes, etc.

7.2.22 Device methods, viz., incentive for longer safety man-hours for a team among workmen for improving the motivation among the workers.

7.2.23 The following precautions shall be taken during execution of welding & cutting works at site:

- Certified welder alone should carryout the welding work.
- Welding machine with proper routing with ELCB and body earthing should be ensured.
- Proper lugs and return lead with crocodile lamp.
- Both end flashback arrester (Cylinder & Torch) should be made available before the start of welding work.
- Cylinder trolley for gas cutting sets
- Fire blanket, Fire hose and Fire extinguishers
- Proper house keeping

8. WORK PERMIT & CLEARANCE SYSTEM

8.1 General

8.1.1 Contractor shall obtain the necessary entry permits for all his labour before commencing the job and abide by the instructions in this regard. Presently, CPCL has the following Permit System:

a) Hot Work Permit
b) Cold work Permit
c) Height work & Scaffolding Permit
d) Electrical Isolation / Energisation Permit
e) Excavation Clearance
g) Road Block Clearance

8.1.2 CPCL may introduce new permit system, which shall be followed by the contractor as and when introduced.

8.1.3 Before commencement of any work, contractor shall intimate at least a day in advance to Engineer-in-Charge, who in turn will arrange for work permits. The contractor shall take all the precautions given in the permit before starting of the work to the satisfaction of the Engineer-in-Charge. On account of operational problem it is possible that the clearance and permit may get

delayed for which the contractor shall not be paid any compensation whatsoever. Fire equipment such as fire extinguishers, fire hoses, control type nozzles, personal protective equipment, Blow man air apparatus, etc. required for safety precautions are to be arranged by contractor himself. However, in case of emergency upon authorization from Engineer-in-Charge such of those items cited above, can be issued to the contractor from the Refinery's Fire Station on chargeable basis and shall be returned after completion of the work/works in working condition, to the satisfaction of the Fire & Safety Officer. In case of any damage to the fire & safety equipments issued or used by the contractor, the contractor shall bear the cost of such damage in full as decided by the Engineer-in-charge and the same must be recovered from the contractor's bills.

8.1.4 All safety measures stipulated in the respective Work Permits shall be strictly complied at all times while carrying out the work within the premises of the Owner.

8.1.5 Owner reserves the right to cancel a work permit without assigning reasons. When called upon to stop the work by the Engineer-in-Charge, the Contractor shall immediately cease to continue the work. Before re-commencement, work permit must be obtained afresh.

8.1.6 The Engineer-in-Charge reserves the right to terminate the contract or forfeit amounts due to the contractor in case the contractor does not strictly adhere to the precautions written on the permit.

8.2 **Hot Work Permit (For Hot works, Radiography & Vessel Entry)**

8.2.1 Hot work permit issued by the concerned department or area-in-charge covers for the work to be carried out in that specific area within the refinery premises only. In addition, clearance must be obtained from the concerned officer or supervisor prior to commencement of any job. A hot permit is required for:

a) Any work involving open flames, spark such as welding, gas cutting, soldering, grinding, concrete breaking, use of hurricane lamps and internal combustion driving vehicles / Radiography / Crane lifting / Vessel entry.

b) Sand blasting, Trucks, Jeeps, Cranes, Lifts, Cars or any kind of vehicle driven by an internal combustion engine or by batteries. Use of gasoline, diesel or electrical power engines or tools.

c) Entry of vehicles inside battery limits of process area within tank dykes and adjacent to pump houses and loading gantries, etc.

8.2.2 Open fire such as burning of wood, coal, etc. is strictly prohibited inside the battery area. Flammable / combustible materials should either be removed from the work place or should be properly protected.

8.2.3 Hot work permit must be obtained on every shift basis in a day, for works inside columns, Vessels, tanks or any enclosed area where chemicals, hydrocarbons or hazardous materials is either used or stored. Contractor shall ensure stand by persons, provision of exhaust fan and use of breathing apparatus, etc. for vessel entry.

8.2.4 While carrying out the hot job, the contractor and his workmen must ensure the following minimum safety measures without which, the work shall not be executed:

- Valid hot Work permit,
- Availability of tested and proper fire extinguisher at the work places
- Provision of running firewater hose at work place.

8.3 Cold Work Permit

Any work with in CPCL premises which are not covered under Hot work Permit are classified as Cold works and Cold work permit on daily basis shall be obtained from the issuing authority which can be extended further for the next consecutive days.

8.4 Height Work & Scaffolding Permit

8.4.1 The contractor's workmen have to take adequate protection while working at height.

8.4.2 Contractor's workmen desirous to work at a height more than 2 meters shall get them examined and certified at CPCL OHS Center for their Medical Fitness. In case, if it is not possible for medical examination at CPCL OHS Center, Medical officers in CPCL OHS Center may prescribe the medicals tests to be done by the workmen by a Registered Medical practitioner who is possessing allopathic qualification recognized by the Indian Medical Council. Contractor shall produce the test report and the certificate issued by the registered medical practitioner to CPCL OHS for verification. After verification, CPCL OHS will retain the test report and issue Medical Fitness certificate for the workmen, which will be valid for One year period from the date of issue. Format for Medical Fitness Certificate is enclosed as **Annexure - 2**. Every contract workmen shall keep this certificate with them during work at site.

8.4.3 Safety devices used by the workmen while working at height are called as Fall Protection device. Wherever fall protection devices are used, 'TIE-OFF' must be used. Fall protection devices shall comply with relevant BIS standards and shall be used in the following situations:

- When working at **unprotected** elevations (including ladders) 6' (ft) or more above grade level.
- When working from elevated personnel platforms, such as a man lift, man basket, aerial lift, etc.

- When erecting or dismantling scaffolding as directed by the Scaffolding Supervisor.

8.4.4 Snap-hooks used in fall protection devices should not be hooked to another (or hooked together). More than one snap hook should not be attached to D or O-ring. Locking type of snap hooks should be used.

8.4.5 Tying point or anchoring point of the fall protection device should be located above the wearer's attachment. Minimum slack shall be maintained in between the wearer of the device and the anchoring point, so that even during a fall, the wearer is not hit by any obstruction in the lower level. The structure to which the fall protective device is anchored shall be strong enough to sustain the load of the wearer, in case of a fall. Weak structures should be avoided for tying or anchoring. Structures preferred for anchoring are Structural beams / angles, 4" dia. Pipes for one person and more than 6" dia. for more than one person, Fixed ladder rails and clips, etc. Structures should not be used for anchoring are Temporary platform or scaffold handrails, Ladders made out of scaffolding, Conduit pipes / electrical cable tray, Parts of valve / equipments / instruments, Cages / rungs of ladders, etc.

8.4.6 In case of use of lifelines, 2 or more persons shall not be permitted at a time. Such lifeline should possess sufficient tensile strength and shall be properly secured at the anchorage points with proper connecting & locking devices.

8.4.7 While working at height, at more than 2 Meter from floor level, following safety precautions has to be followed:

i) Contractor has to obtain Height work permit issued by competent authority

ii) Proper type of scaffolding/platform/ladder should be made to facilitate the job at height. Minimum 2 nos. of ladders should be provided at opposite sides.

iii) Use of bamboo scaffolding is strictly prohibited inside CPCL. Only steel scaffolding shall be used for work inside the Refinery. The steel scaffolding material and its erection shall be done as per relevant IS specification.

iv) Contractor shall ensure the use of safety belts by the person who is working at heights. Safety belt to be used should be of good quality (IS marked) and shall be hooked up with firm support.

v) Full body safety belt, horizontal & vertical fall arrestors are to be used. Safety nets also to be used as per site conditions

vii) Before starting the job, scaffolding shall be inspected by competent person and a record of the same shall be kept at site.

8.4.8 Suitable scaffolding should be provided for workmen for all works that cannot safely be done from the ground or from solid construction except such short period work as can be done safely from ladders. When a ladder is used, an extra mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying materials as well, suitable footholds and handholds shall be given in inclination not steeper than 1 in 4 (1 horizontal and 4 vertical).

8.4.9 Scaffolding or staging more than 12 meters above the ground or floor, swing or suspended from an overhead support or erected with stationery support shall have a guard rail properly attached, bolted, braced and otherwise guarded at least 1 meter above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent from swaying from the building or structure.

8.4.10 Working platform, gangways and stairways should be so constructed that they should not sag unduly or unequally and if the height of the platform or the gangway or the stairway is more than 12 meters above ground level or floor level, they should be closely guarded, should have adequate width and should be suitably fastened.

8.4.11 Any opening in the floor of a building or in working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable grills, fencing or railing having a minimum height of 1 meter.

8.4.12 Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 900 cm in length, while the width between the side rails in rung ladder shall in no case be less than 30 cms for ladder up to and including 300 cm in length. For longer ladders, this width should be increas ed by at least 6 mm for each additional foot of length. Uniform step spacing shall not exceed 30 cm. Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or public. Contractor shall also provide all necessary fencing and lights to protect the workers and staff from accidents.

8.4.13 Scaffolding wherever erected inside CPCL, shall be done after obtaining approval in the prescribed format enclosed in **Annexure - 3**. The tags to be used for scaffolding certification shall be as given in **Annexure - 4**. A register shall be maintained for the scaffolding erected by the contractor. Format for the register shall be as detailed in **Annexure - 5**.

8.4.14 General Guidelines for erection and use of scaffolding:

i) Wooden Planks bent / damaged scaffold tubes and repaired / defective aluminum ladders shall not be used.
ii) During erection of scaffoldings, full body harness with double hook lanyard shall be used.

iii) Erection of scaffoldings should be avoided during heavy raining & high wind.
iv) General requirements to be verified during inspection of scaffold before clearing for use / periodical inspection after erection is given in the Checklist below.
v) Scaffoldings shall be inspected & certified at frequency not exceeding 7 days or whenever some modification / alteration carried out or whenever scaffold is exposed to adverse weather condition.
vi) Scaffoldings under modification/alteration shall be provided with RED tag.
vii) Contract workmen certified fit under the supervision of competent supervisor of the contractor shall dismantle the scaffolding after job completion.
viii) The following Checklist shall be considered for scaffolding inspection:
ix) Has the surrounding area near the scaffold been cordoned off?
x) Are base plates provided to scaffold?
xi) Is longitudinal / transverse (cross) bracing provided to ensure the stability?
xii) Is base lift provided not more than 6 inch height?
xiii) Guard railing should be in between 95 cm & 120 cm but space between toe board & guard shall not exceed 2'-6'' (76 cm)
xiv) Are toe boards with minimum 4 inches height provided?
xv) Is working platform covered by planks with no gap & free of cracks or damage?
xvi) Are all braces, bearer, and clamps well secured?
xvii) Is ladder is well secured & provided at a safe place to get up and down the scaffold?
xviii) Is ladder provided above the landing platform?
xix) Is the front of the scaffold within 14 inches of the work place?
xx) Is there any projection of Scaffold pipes, which obstructs pathway?
xxi) Ladder shall rise to a height of at least 3'–6'' above the landing place.
xxii) Overlapping of planks at working platform should be avoided.
xxiii) Upper lift should not more than 2 meter (6'-6'') height.

8.5 Electrical Isolation / Energisation Permit

8.5.1 The Contractor shall deploy a competent Engineer / Electrician to attend to electrical matters. All temporary power supply boards shall conform to IE Regulations.

8.5.2 Contractor or his nominated subcontractor should have valid electrical contractor's license for working in State. Contractor shall furnish a copy of the same to Engineer-in-Charge before commencement of any work pertaining to Electrical System. In any case, no work shall be permitted to be executed at site without a valid Electrical Contractors License, and the decision of the Engineer-in-charge in this regard shall be final and binding. Any claim / or compensation towards the same will not be made on this account.

8.5.3 Motors, Gearing, Transmission, Electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safeguards.

8.5.4 The contractor should ensure that the portable electrical equipment like grinding machine, drilling machine etc. is in healthy condition. The contractor should take all precautionary safety action, as providing of earth leakage circuit breakers for their portable electric machines, also double insulated portable equipment may be used.

8.5.5 All portable electrical apparatus shall be regularly examined, tested and maintained to ensure the apparatus and leads are in good order. Temporary jointing of extension wire, power cables etc. is not allowed.

8.5.6 Ensure that all portable appliances are provided with 3 pin plug and socket connections and that the metal body of the apparatus is effectively earthed. All loose wiring such as flexible cables for portable lamps, tools & trailing cables and other portable and transportable apparatus shall be tested regularly at frequent intervals to ensure safety. All temporary board shall have ELCB of 30 ma sensitivity for personnel safety and double earthed / double insulated hand tools.

8.5.7 When workers are employed on electrical installations, which are already energized, insulating mats, wearing apparel, such as tested rubber gloves, sleeves and boots as may be necessary, shall be provided. The workers should not wear any metallic rings, watches, keys or other materials, which are conductors of electricity.

8.5.8 While working on electrical system, the contractor and his workmen shall ensure that the following safety measures are in place:-

- Proper & valid Electrical line clearance is obtained for the equipment;
- The cables are properly insulated and are without any temporary joint;
- All Flammable / combustible materials should either be removed from the work place or should be properly protected;

- Suitable Earth leakage Circuit Breaker (ELCB) is provided for incoming and all outgoing feeders;

- Proper earthing is provided to distribution board and other electrical equipments like welding machines & grinding machines etc.

- Pipe sleeves are provided for road crossings of temporary cables laid by the contractor for his work;

- The power connection should not be overloaded and suitable overload protection should be provided;

- The tools used by the contractor personnel should be properly insulated and in good condition;

- The grinding machine & other power tools should have proper guard.

8.5.9 Do not attempt to work on electrical apparatus unless authorized by an electrical department, and without obtaining clearance or permit from the area-in-charge. Use only approved electrical fitting gadgets or equipment. Obtain clearance from electrical personnel and produce the clearance to area-in-charge prior to obtaining permit to start the work. Electrical personnel will check the norms and should sign the register/permit. Keep the register/permit at the site. Time to time the equipment is to be checked by contractor's authorized electrical supervision and necessary entry shall be made in the register. If any norms are found violated, the work of those equipment to be stopped till the equipment is either rectified or replaced, the norms are as below:

i) Contractor should use approved quality earth leakage circuit breakers (ELCB) on their portable distribution board for all type of electrical equipment used including welding sets etc. Checking with the polarity meter by contractor.

ii) Also use ELCB on their main distribution board for each feeder. Contractor should ensure the healthiness of their Electrical Portable Apparatus by competent electrical supervisors. Contractor shall provide proper earthing for their distribution board.

iii) Contractor should engage licensed electrical supervisors for certifying their equipment and ensuring safety of their connection.

8.5.10 The work area shall always be kept accessible for switching off power supply in case of emergency. Before leaving the work place, the Contractor shall ensure power supply is switched off properly. For this purpose a record shall be maintained of the last person leaving the concerned work site on all days of activity.

8.5.11 No dry battery or accumulator type of electric hand lamp or torch, which is not of the flameproof safety type, shall be taken inside the Refinery.

8.6 **Excavation Clearance**

8.6.1 All trenches 1.2 meters or more in depth shall at all times be supplied with at least one ladder for each span of 30 meters length.

8.6.2 Ladder shall be extended from bottom of the trench to at least 100 cm. above the surface of the ground. The site of the trenches which are 152 cm. or more in depth shall be stepped back to give suitable slope or securely held by timber bracing, so as to avoid the danger of sides to collapse. The excavated material shall not be placed within 152 cm. of the edge of the trench or half of the trench depth whichever is more. Cutting shall be done from top to bottom. Under no circumstances undermining or under cutting be done.

8.6.3 All the areas where the existing grading is disturbed in the course of work by the contractor shall be made good by him to the full satisfaction of the Engineer-in-Charge.

8.6.4 Excavation is executed only after obtaining a valid Excavation Clearance and Hot Work permit. For deeper excavation, precautions viz. barricading, sloping trenches instead of vertical cutting, adequate shoring / strutting, etc. shall be ensured. Wherever required sufficient illumination, escape ladders, etc. should be provided. Minimum number of workmen should be permitted to work inside the excavated trenches. Heavy machineries viz. Crane, etc. should not be permitted near the excavated trenches.

8.7 **Road Block Clearance**

Wherever required, Road Block Clearance has to be obtained as detailed in **Annexure – 6.**

9. SAFETY OF LIFTING EQUIPMENTS

9.1 All lifting machines (cranes, forklifts, elevators, hydra cranes, etc.), lifting tools and tackles (includes slings, chain pulley blocks, wire rope, chains, shackles hooks, etc.) brought inside refinery by contractor shall have identification marks, Safe Working Load (SWL) displayed on equipment and certified by the competent authority as per Tamilnadu Factories Rules. All lifting equipment shall be exposed to “Pre-use check” before use every time. Pre-use check must include checking of all critical controls such as brake, limit switches, interlock, warning devices, etc. Contractor shall maintain record of pre-use check conducted at site.

9.2 All lifting machines, lifting tools and tackles shall be removed from service before expiry of testing date. Visual inspection of such equipment shall also be carried out regularly to look for deformation/physical damage and the

defective equipment shall be removed after such observations.

9.3 The methodology of erection shall be got approved by the Owner prior to carrying out equipment erection/lift by lifting machines. Contractor shall provide all required data of the lifting machines for this purpose. All crane operators and riggers deployed for the purpose of erection shall be well trained and certified for the specific purpose. The area below crane boom shall be barricaded when the equipment lift is being made and it shall be ensured that no person shall come under suspended load at any given time. When cranes are used in night, there shall be adequate illumination and the crane operator and rigger shall wear fluorescent and light reflective jackets.

9.4 The following should be ensured for material handling equipments:

- Third party approved certificate for Sling, Chain sling, Shackles & webbing slings
- Insurance
- Third Party License
- Reverse light, front light & warning light during night & reverser horn.
- Driving License for heavy vehicle driving for the driver.
- Limit switches
- Angle Indicator
- Safe work load marking
- Safety Hook Latch
- Load Chart
- Signal man

9.5 No cranes shall be left unattended with hanging load. On completion of work, the boom/ jib of the crane may be brought down and kept in horizontal condition. No crane including hydra crane shall be allowed to move on road with suspended load.

10. HOUSEKEEPING

10.1 Housekeeping is a very important aspect towards maintaining a healthy & safe work environment inside any Industry. Most of the safety related issued can be addressed if proper housekeeping is done and maintained. . The Contractor therefore must ensure for removal of scrap, inflammable material, waste and debris at appropriate interval including proper storage of materials and equipment. The debris, scrap and other unwanted materials generated out of the activities carried out by the Contractors must be removed from site and shifted to the designated location or as instructed by Engineer-in-Charge. The Contractor may ensure the following.

10.2 Ensure proper storage of both Owners' / Contractor's materials & equipment at site used for carrying out the maintenance or construction job.

10.3 Remove the loose materials, which are not required for use. Accumulation of these at the site can obstruct means of access to workplaces and passageways. Scrap generated out of the maintenance job should also be removed.

10.4 Workplaces and passageways, that are slippery due to spillage of oil, grease or other causes, should be cleaned up or strewn with sand, sawdust, ash, chalk powder etc.

10.5 The workplace should be kept clean on continuous basis. Even for continuous nature of work, the work place must be cleaned, non-compliance of which shall be treated as violation of safety norms.

10.6 Before offering a completed job for final inspection/acceptance Contractor must ensure that all maintenance waste, scrap and other disposable items are removed from the workplace. Failing the same will call for rejection of inspection call and the contractor shall be penalized for the wastage of inspection time through necessary recovery from their bill.

10.7 All disposable material and scrap shall be dumped in the specified location only and penal recovery shall be made if found dumped in other than designated locations. It may be noted that in all contracts engaged by the Owner, housekeeping is a part of the scope of work and as such deduction made in case of non-compliance is deemed to be accepted by the Contractor.

10.8 The following procedures shall be complied while stacking materials at the worksite:

- Barricading of materials arriving at site
- Proper access for materials stacked
- Proper identification of materials stacked
- Precautions to be visibly displayed for chemical materials viz. Paint, thinner, solvents, etc.
- Proper storage of cylinders with bifurcation for empty and filled cylinders.

11. EMERGENCY PROCEDURES

11.1 In case of Emergencies such as fires, explosion, leakages or accidents noted by contractors' personnel, such events should be immediately informed to the nearby CPCL employees and Fire Station. They may use any of the modes of communication available nearby viz. Intercom telephone to Fire Control room - 3630 / 3663 or Breaking MCP (Manual call point) or PA system or nearby control room to intimate Fire Station about the incident / accident.

11.2 In case of fire, until assistance arrives at the scene of fire, contractor's workmen should use Fire water or portable Fire Fighting media available nearby. The following Siren Code is practiced in CPCL to communicate in emergency:

- ✓ Minor fire : No siren
- ✓ Major Fire: Waling sound for 2 minutes. Sirens will be sounded three times for thirty seconds with an interval of fifteen seconds in between.
- ✓ Disaster : Same type of siren as in case of Major Fire but the siren will be sounded three times at the interval of two minutes.
- ✓ All clear: Sounding of Fire sirens continuously for two minutes.

11.3 If the Contractors' employees notice any oil leak or fire, they should immediately report such matters to the Owner's representatives and the Fire Station by using any one of the communication mode mentioned above and stop all the jobs.

11.4 On hearing the alarm/ siren the work in progress should be stopped immediately, shut -off the machinery, such as welding machines and take advice from owner's representatives.

11.5 Those using firewater for any purpose must immediately stop using the same and must shut off the hydrant valve from which water being drawn

11.6 Only when the all-clear siren is blown, work should be resumed. Fresh permits should be taken before commencing work in such cases.

11.7 Assist owner personnel in mitigating emergency situation as per advice.

11.8 Any contractor driving vehicle at the site of fire should park his vehicle at a suitable location away from the site of fire and fire fighting equipment deployed by the Owner.

12. EMERGENCY RESPONSE PLAN

12.1 Contractors' working within the refinery premises is deemed to have studied the emergency response plan of the Owner. An emergency response plan can be seen at the Owner's Fire & Safety Department. Contractor has to adhere and respond to the on-site emergency plan and coordinate with the site main controller of Refinery in such a circumstance.

12.2 Contractor personnel shall stop their work and proceed to a safe area in the event an emergency arises in the area where they are working such as fire, oil spillage, power failure, etc. Before re-commencement of the job they should obtain clearance of Owner's supervisor of area involved.

12.3 In view of the hazards associated with Hydrocarbon processing; on site emergency plan has been prepared in the event of major accident occurring on

site. The plan envisages handling emergency situation, which shall be communicated through siren, based on nature of emergency as mentioned below.

12.4 In case of major emergency, it is the responsibility of the contractor to head count his personnel and takes them out with the help of concerned Refinery Co-ordinator to safer location. Contractor must confirm the safe evacuation of his personnel to Refinery Co-ordinator. In case of missing personnel, it must be brought into the notice of Refinery authorities immediately in writing.

12.5 In case of emergency/major accident or disaster, site-in-charge shall coordinate with Site Main Controller for sheltering & evacuation and advise his workmen to rush to one of the following Assembly points:

1. Refinery-I Control Room
2. Refinery-II Control Room
3. Lube Expansion Block/ DHDS Control Room
4. Power & Utilities – I Control Room
5. Workshop / Garage
6. Main Fire Station
7. LPG/Asphalt Office
8. Indcoserve Office
9. Southgate
10. Power & Utilities-II Control Room
11. Power & Utilities -III Control Room
12. Refinery-III Control Room
13. Refinery-III Fire Station
14. Mandatory Tank Farm Main gate
15. Mandatory tank Farm South gate
16. Mandatory Tank Farm Fire station
17. Tertiary Treatment Plant Main Gate

13. ACCIDENT / NEAR MISS INCIDENTS REPORTING

13.1 Accidents happen within the CPCL premises or in other work sites of CPCL, should be reported to the Engineer in Charge in the format available with the Engineer in charge / Fire & Safety department.

13.2 Contractor's safety supervisors and workmen shall report the Near Miss Incidents to the Engineer in charge, who in turn will forward it to Fire & Safety department. At least one Near Miss incident should be reported in each working day during the contract period.

13.3 CPCL may constitute a "Contractor's Safety Steering Committee" who will interact with CPCL Fire & safety regularly, share best practices amongst themselves, carryout cross audit of work spots and report areas of improvement.

14. SAFETY REPORT

Contractor shall submit a monthly safety report as per the format enclosed marked as **Annexure - 7.**

15. PENALTIES FOR NON-COMPLIANCE OF SAFETY

15.1 The contractor has to take full precautions to implement all provisions of Safety requirements of CPCL. In case of non-compliance of procedure, the owner shall impose the following penalties on the contractor and such penalties imposed will be deducted from their running/final bill. EIC or any other authorized personnel of CPCL are authorized for imposition of penalties.

15.2 Above violations resulting in any reportable physical injury as per Factories Act, a penalty of 0.50% of contract value (Maximum of Rs. 2,00,000/- (Rs. Two lakh only) per injury shall be levied. In addition to the above, penalty for safety violation as given below shall be levied by CPCL.

15.3 Above violations resulting in a Fatal Accident, a penalty of 1.0% of contract value (Maximum of Rs. 10,00,000/- (Rs. Ten lakh only)) per fatality shall be levied. In addition to the above major and minor non-compliances, the following penalties shall be levied for the events listed:

Sl. No.	Event	Penalty
1	Absence of Resident Engineer of Contractor in CPCL's safety meeting	Rs.5000 per Meeting
2	Non deployment of Safety Engineer / Supervisor	Rs.1000/- per Person per day
3	Failure to submit monthly safety reports	Rs.1000/- month
4	Failure to have regular site safety Inspection (by contractors themselves) every week	Rs. 1000/- Week
5	Failure to conduct Health / Safety / Environment (HSE) meetings and HSE Audit by Contractor at site (in-house) and maintain records	Rs. 1000/- Month
6	Failure to report & follow up of accident, fire, explosion and property damage incident (including Near Miss Incidents)	Rs.1000/- per occasion

Sl. No.	Event	Penalty
7	Poor House Keeping	Rs.1000/- per occasion
8	For non use of Personal Protective Equipment (Helmet, goggles, gloves, Safety belts, Safety shoes, Full body harness, face shield, etc.,)	Rs. 250/- per day / item / person
9	Working without Work Permits / Clearance	Rs.5000/- per occasion
10	Non-use of safe electricity at work sites (Not installing / bypassing ELCB, poor jointing of cables, non-use of plug-tops/insertion of naked wire ends into socket holes, laying cables/wires across roads/drains, etc., absence of competent electrician)	Rs.1000/- per item per day
11	Working at height / depth without permit and/or failure to arrange fall-protection arrangement such as scaffolding/barricading, Safety Nets, etc. Working at height without full body harness Working at height using non-standard / rejected scaffolding and not arranging fall protection arrangement as required like	Rs.1000/-case/day
12	Unsafe handling of compressed gas cylinders (No trolley, jubilee clips double gauge regulator, improper storage / handling)	Rs.100/- per item per day
13	Use of domestic LPG for cutting purpose	Rs.1000/- per occasion
14	No fencing/barricading of excavated areas	Rs.1000/- per occasion
15	Non providing shoring / strutting / proper slope and not keeping the excavated earth at least 1.5M away from excavated area	Rs.1000/- per occasion
16	Inadequate First Aid Box	Rs.500/- per occasion

Sl. No.	Event	Penalty
17	Traffic rules violations like over speeding of vehicles, rash driving, wrong parking, not using seat belts, vehicles not fitted with reverse warning alarms	Rs.1000/- per occasion
18	Degradation of environment (not confining toxic spills, spilling oil / lubricants onto ground)	Rs.1000/- per occasion
19	Not medically examining the workers before allowing them to work at height, not providing ear muffs while allowing them to work in noise polluted areas, made them to work in air polluted areas without respiratory protective devices, etc.	Rs.1000/- per occasion
20	Use of Grinder without wheel guard	Rs.500 per occasion
21	Non-use of CCOE approved spark arrestors; Fire extinguishers in vehicles	Rs.1000/- per item per occasion. On third repeated occurrence, contractor shall be prohibited from taking vehicles into the Refinery beyond the Main Gate
22	Non-use of flash back arrestors in oxy-acetylene cylinders	Rs.1000/- per occasion
23	Blocking of roads without permission (OR) Not providing barricade & caution boards	Rs.5000/-per occasion
24	Movement of crane with suspended loads; people travelling in cranes & forklifts.	Rs.5000/- per occasion
25	Any violation not covered above	To be decided by Engineer-in-charge

15.4 The rate of above penalty shall be double in case of violation of aforesaid acts more than three times during the pendency of the contract. In addition, CPCL reserves the right to cancel the pass of contractor supervisors / workmen in case of violations and ban them from entering the refinery.

16. RADIOGRAPHY

16.1 Radiography is a potential hazard to all concerned. Hazardous conditions for both users of radioisotopes and the general public have to be prevented. Procedure no. CPCL-INSP-RAD-01, titled “Procedure for the safe use of

Industrial Radiography sources during field Radiography" (all sheets), issued by CPCL has to be followed, to prevent a hazardous condition during radiography.

16.2 Hot work Permit should be obtained for any Radiography works with CPCL premises. The Engineer-in-charge shall inform F&S Department about the radiography works in progress.

16.3 Details such as the type and strength of the source, the model and the serial number of the Radiography camera proposed to be used at the site, the names of the Radiographers and the name of the site-in-charge should be communicated to the Engineer-in-charge along with the request for approval of the proposed site. A sketch of the site (to scale) indicating the location of the Radiography operators should also be sent.

16.4 Each Radiography site should possess the specified and calibrated survey meters. At least one radiation survey meter with calibration certificate shall be made available in good working condition at all times.

16.5 Enough care should be taken before dispatch of the Radiography camera to site. As far as possible the package containing radiography camera and source should be duly escorted to the site by an authorized person along with all documents pertaining to the camera including a certificate stating that the camera is safely packed for transport.

16.6 All accessories required for the safe use of the Radiography source such as the manipulator rod should also be necessarily transported to the Radiography site along with the Radiography Camera.

16.7 Upon arrival at site, the Radiography Camera should be inspected by the Site-in-Charge and Owner's nominated Engineer-in-charge and an appropriate entry made in the relevant logbook.

16.8 The Radiography Camera and source when not in use, should always be stored in a separate storage room / pit under lock and key. It should never be left at the work site unattended. If a number of Cameras and source are to be stored, individual compartments may be provided in the same storage room or alternatively individual underground pits with lids bearing appropriate identification markings / tags may be provided. Care should be taken to avoid water seepage into the pits, which should be duly protected. Prior approval for the proposed design of the site storage facility should be obtained from the Owner.

16.9 Radiation warning signs should be conspicuously posted on the entrance door of the storage room. The storage room should be provided with adequate illumination and ventilation. Site-in-Charge shall be the custodian of the Radiography Cameras and sources at the site and shall maintain a logbook / issue register regarding the sources or cameras.

16.10 As far as possible, field radiography should be done only during night when there is little or no movement of personnel around the site of radiography.

16.11 Field Radiography during daytime may be permitted on a restricted scale when the occupancy is minimum e.g. during lunch interval or on holidays. If field radiography is done at the same location repeatedly, it is advisable to provide either a wire fencing around or a temporary brick enclosure.

16.12 A suitable area around the radiation source should necessarily be cordoned off during field radiography so that the radiation levels outside the area do not exceed the maximum permissible radiation levels.

16.13 The distance to be cordoned off around the source is decided by the nature and strength of the radiation source used, the type of exposure given, the nature of occupancy around and the total exposure time per week.

16.14 Radiation warning symbols should be conspicuously posted all along the cordon. Red warning lights should be conspicuously displayed during night all along the cordon and especially at the point of entry.

16.15 The concerned radiographer shall be physically present outside the cordoned area during exposures.

16.16 All personnel working with the radiography sources should wear appropriate personnel monitoring badges during radiography. The film badge should be work on the chest. In addition, the worker may also wear a wrist badge depending upon the type of operations to be conducted.

16.17 As soon as the radiation work is over, the film badges should always be stored in a radiation free area along with the control film. It should never be carried home or left at a place where radiation sources are stored.

16.18 The Site-in-Charge should arrange to collect and return all used films to his Head Office or direct to the Owner, as appropriate, at the end of every radiographic examination without fail.

16.19 Any accidental exposure to the film badge or damage to the film due to mishandling should be immediately reported to the Owner and the film sent to Owner for urgent processing. The person affected should be provided with a new film.

16.20 To facilitate proper evaluation of radiation exposure the film badge should be protected from excessive heat, moisture and pressure.

16.21 In addition to the film badge, each radiation worker may be provided with a pocket dosimeter, which has a range of 200 mR full scale. These dosimeters should be charged each day prior to use. The pocket dosimeter reading

should be noted in a register against the name of each radiation worker at end of the day's work. The pocket dosimeter should be handled carefully so as to avoid self-discharge due to excessive humidity conditions, accidental fall, etc.

16.22 Radiation emergencies may be caused due to loss of sources or damages to the camera or source pencil or due to improper functioning of the equipment.

16.23 Contractor with the assistance of contractor's Safety Officer and Owner should institute strict internal management procedure to ensure that accidents are avoided.

17. STATUTORY / OISD / BIS GUIDELINES:

Contractors and their supervisors must acquaint themselves with all the relevant statutory guidelines like Factories Act, Tamilnadu factories rules, Indian Explosives Act and Rules, Petroleum Act and Rule, Indian Electricity Act and rules, relevant IS codes, OISD standards / guidelines, etc. relating to safety equipment and safe working practices. The list of such standards, guidelines and codes are given in **Annexure-8.**

ANNEXURE – 1

FORMAT OF JOB SAFETY ANALYSIS

CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
(A) EXCAVATION • Pit Excavation upto 3.0m	➢ Falling into pit	➢ Personal injury	➢ Provide guard rails/ barricade with warning signal ➢ Provide atleast two entries/ exits. ➢ Provide escape ladders.
	➢ Earth Collapse	➢ Suffocation/ Breathlessness ➢ Buried	➢ Provide suitable size of shoring and strutting, if required. ➢ Keep soil heaps away from the edge equivalent to 1.5m or depth of pit whichever is more. ➢ Don't allow vehicles to operate too close to excavated areas. Maintain atleast 2m distance from edge of cut. ➢ Maintain sufficient angle of repose. Provide slope not less than 1:1 and suitable bench of 0.5m width at every 1.5m depth of excavation in all soils except hard rock. ➢ Battering/benching the sides.
	➢ Contact with buried electric cables ➢ Gas/ Oil Pipelines	➢ Electrocution ➢ Explosion	➢ Obtain permission from competent authorities, prior to excavation, if required. ➢ Locate the position of buried utilities by referring to plant drawings. ➢ Start digging manually to locate the exact position of buried utilities and thereafter use mechanical means.
• Pit Excavation beyond 3.0m	➢ Same as above plus ➢ Flooding due to excessive rain/ underground water	➢ Can cause drowning situation	➢ Prevent ingress of water ➢ Provide ring buoys ➢ Identify and provide suitable size dewatering pump or well point system
	➢ Digging in the vicinity of existing Building/ Structure	➢ Building/Structure may collapse ➢ Loss of health & wealth	➢ Obtain prior approval of excavation method from local authorities. ➢ Use under-pining method ➢ Construct retaining wall side by side.
	➢ Movement of vehicles/ equipments close to the edge of cut.	➢ May cause cave-in or slides. ➢ Persons may get buried.	➢ Barricade the excavated area with proper lighting arrangements ➢ Maintain at least 2m distance from edge of cut and use stop blocks to prevent over-run ➢ Strengthen shoring and strutting

ANNEXURE – 2

SAMPLE MEDICAL CERTIFICATE FORMAT

Certified that I _____ have examined Shri_____, Age _____ , ESI Number _____ on _____ and I find him medically fit to work at height more than 2 meters / work in confined space.

Signature and Rubber stamp Date of Medical Practitioner

(Name, Qualification and Registration Number)

Signature / Thumb Impression of the workman ID Card No.

_____

Note:

1. This certificate is to be given on the letter head of the registered medical practitioner who is possessing allopathic qualification as recognized by the Indian medical council.

2. The detailed medical examination report shall be given to the workman for handing over to CPCL-OHS Centre.

ANNEXURE – 3

Scaffold Pre-erection cum Periodical Inspection Clearance Form

Location of work (Unit /Area/ Equipment no.)

Name of Contractor: SAP Work order No.:

Scaffold Pre-erection Clearance:

Sl. No.	Requirements	Yes	No	Remarks (if any)
1	Scaffold site erection site inspected and surface is firm / hard			
2	Scaffold erectors have medical certificate			
3	Following materials in good quality & sufficient quantity available at site (please tick)			
	Scaffold pipes- □, Scaffold couplers - □, Base plates - □, Toe boards- □, Tags (Red & Green) - □, Metal Scaffold planks - □, Metal wire - □, Aluminum ladder- □, Barricading tape - □, Full body harness with double lanyard - □, Warning signs - □.			

	Performing authority	Authorized Engineer
Date of Request & Clearance for erection		
Signature		
Name		
Designation & PR .No		

After pre-erection clearance, RED tag shall be handed over to Performing Authority for providing in the scaffold till the erected scaffold is offered for inspection & cleared for use.

Scaffold Cleared for use:

	Performing authority	Authorized Engineer
Date of Request & Clearance for use		
Signature		
Name		
Designation & PR .No		

After clearing for use, GREEN tag shall be provided in the scaffold.

Scaffold Clearance Renewal:

Sl. No.	Date		Authorized Engineer			Remarks
	From	To	PR. No.	Name	Signature	

ANNEXURE – 4

TAGS TO CERTIFY SCAFFOLDING

SCAFFOLD INSPECTION TAG
(Red Color)
Location:
Erected by:

DO NOT USE

Name of the authorized engineer:

Signature:

Date of inspection:

SCAFFOLD INSPECTION TAG
(Green Color)
Location:
Erected by:

FIT FOR USE

Date of Inspection	Name of Authorized Engineer	Signature

ANNEXURE – 5

FORMAT OF SCAFFOLDING REGISTER

1.	Description of the Work:			
2.	Location:			
3.	Name of the Agency:			
4.	Work Order No. & Date:			
5.	Remarks:			
INSPECTION RECORD				
Date	Name of Contractor's Safety supervisor	Signature	Name of CPCL's Engineer-in-Charge	Signature

ANNEXURE – 6

ROAD BLOCK CLEARANCE

	CHENNAI PETROLEUM CORPORATION LIMITED (A group company of IndianOil) **ROAD BLOCK CLEARANCE** (This is not an Excavation Clearance)	F&S Regn.No.

Exact Location of road block (Attach marked up drawings /Plan)	

Purpose: Crane movement ☐ Culvert opening ☐ Road cutting ☐
Erection ☐ Others ☐ (Put X for not applicable)

Commencing Date &Time:		Schedule date of completion	

Name of the Contractor Ph.No.

Performing Department

Permitted with the following:
Excavation Clearence obtained ☐ Work Permit obtained ☐
Marked alternate route ☐ Any other requirement (specify) ☐
(Put X for not applicable)

Performing Engineer Name: Signature: Contact No.	Approved by Performing authority: Name: Signature: Contact No.

F&S checked the following:
Caution boards provided ☐ Traffic cone & barricading tape provided ☐
Red light during night (FLP type in hazardous area) provided ☐

Checked by Shift-in-charge (F&S) Name: Signature: Ph.No.	Clearance by Mgr / SM (F&S) Name: Signature: Ph.No.

Remarks:

Extension	Date	Performing Engineer	Performing Authority	Mgr / Shift-in-charge (F&S)	Remarks
1st renewal					
2nd renewal					
3rd renewal					

Important Notes:
1) In case of road cutting & road block, regular excavation clearance and work permit shall be obtained prior to road block clearance and attached to this application.
2) Permission for roadblock should be obtained in duplicate.
3) Road block, diversion, safety signs, etc. shall be arranged by performer.
4) On completion of the job, the performing authority shall inform F&S Shift-in-charge.
5) In case of road cutting, on completion of job, the road shall be backfilled, compacted and made good for vehicular movement.
6) F&S Dept shall keep SMSO, Head of the Section / Dept. in charge of the area and GMs on road blocks on a daily basis in Intranet or thru e-mail.

ANNEXURE – 7

MONTHLY SAFETY REPORT

(To be submitted by each Contractor)

Actual Work start Date: _____ for the Month of:

Project: _____ Report No.: _____

Name of the Contractor: _____ Status as on: _____

Name of work: _____ Name of Designated Safety Officer:_____

Item	This Month	Cumulative
Total Strength (Staff + Workmen)(Ave/day)		
No. of Safety Officer		
No. of Tool box Safety Meetings organized at site		
No. of persons attended tool box meeting		
No. of persons attended class room training		
No. of persons attended other safety training		
First Aid classes conducted		
Number of near misses		
Number of Fatal accidents		
Number of Reportable Accidents (Non Fatal)		
Other accidents (Non Reportable)		
Total no. of Accidents		
Total Man Hrs. worked		
Total Safe Man hours Worked		
Cumulative man hours worked		
Total Man Hrs. Lost due to accident		
No. of Fire Incidents		
No. of First Aid Cases at site		
No. of First Aid cases reported at CPCL First Aid center		
No. of Near Miss Incidents		
No. of Violations of Health and Safety provisions		
Amount of penalties levied		
Remarks, if any		

Date: _____

Safety Officer / Resident Engineer
(Signature and Name)

To_____

ANNEXURE - 8

APPLICABLE CODES / STANDARDS / GUIDELINES

BIS CODES

SP: 53	Safety code for the use, care and protection of hand operated tools.
IS: 818	Code of practice for safety & health requirements in electric and gas welding and cutting operations
IS: 1179	Eye & Face precautions during welding, equipment, etc.
IS: 1860	Safety requirements for use, care and protection of abrasive grinding wheels
IS: 1989	Leather safety bolts and shoes (Part-II)
IS: 2925	Industrial Safety Helmets
IS: 3016	Code of practice for fire safety precautions in welding & cutting operation
IS: 3043	Code of practice for earthing
IS: 3764	Code of safety for excavation work
IS: 3786	Methods for computation of frequency and severity rates for Industrial injuries and classification of industrial accidents
IS: 3996	Safety Code of scaffolds and ladders
IS: 4082	Recommendations on stacking and storage of construction materials and components at site
IS: 4770	Rubber gloves for electrical purposes
IS: 5121	Safety code for piling and other deep foundations
IS: 5216	Recommendations on Safety procedures and practices in (Part-I) electrical works
IS: 5557	Industrial and Safety rubber lined boots
IS: 5983	Eye protectors
IS: 6519	Selection, care and repair of Safety footwear
IS: 6994	Industrial Safety Gloves (Leather & Cotton Gloves) (Part-I)
IS: 7293	Safety Code for working with construction Machinery
IS: 8519	Guide for selection of industrial safety equipment for body Protection

IS: 9167	Ear protectors
IS: 11006	Flash back arrestor (Flame arrestor)
IS: 11016	General and safety requirements for machine tools and their operation
IS: 11057	Specification for Industrial safety nets
IS: 11226	Leather safety footwear having direct moulded rubber sole
IS: 11972	Code of practice for safety precaution to be taken when entering a sewerage system
IS: 13367	Code of practice-safe use of cranes
IS: 13416	Recommendations for preventive measures against hazards at working place

INTERNATIONAL STANDARDS

Safety Glasses	ANSI Z 87.1, ANZI ZZ 87.1, AS 1337, BS 2092, BS 1542, BS 679, DIN 4646 / 58211
Safety Shoes	ANSI Z 41.1, AS 2210, EN 345
Hand Gloves	BS 1651
Ear Muffs	BS 6344, ANSI S 31.9
Hard Hat	ANSI Z 89.1 / 89.2, AS 1808, BS 5240, DIN 4840
Goggles	ANSI Z 87.1
Face Shield	ANSI Z 89.1
Breathing Apparatus	BS 4667, NIOSH
Welding & Cutting	ANSI Z 49.1

OISD GUIDELINES

OISD-GDN-207	Contractor Safety
OISD-STD-105	Work Permit System
OISD-GDN-192	Safe practices during Contract

ANNEXURE – 9

FORMAT FOR ELECTRICAL ISOLATION / ENERGISATION

Chennai Petroleum Corporation Limited DUPLICATE

(A group company of IndianOil)

Manali, Chennai - 600 068.

Electrical Isolation / Energisation Permit **Nº 007761**

Section-A : Isolation Permit.

Request for Isolation : Date : _____ Time : _____

Department / Section / Area issuing the permit _____

Equipment number to be isolated : _____

Name of the equipment / circuit to be isolated : _____

FORMAT

The above-mentioned equipment / circuit shall be de-energized and isolated from all live conductors to carry out the maintenance work by _____ section / for operational requirement.

Issuer Name	Designation	Signature
_____	_____	_____

Certificate of Isolation : Date : _____ Time : _____

Certified that Equipment / Circuit no. _____ of _____ plant has been electrically isolated and the danger tag is put on the supply panel. Actions in respect of electrical isolation have been recorded in the electrical shift logbook.

Name of Authorized Person	Designation	Signature
_____	_____	_____

COPY

Section-B : Energisation Permit. **Nº 007761**

Request for Energisation : Date : _____ Time : _____

Department / Section / Area issuing the permit _____

Equipment number to be energied : _____

Name of the equipment / circuit to be energized : _____

FORMAT

Work on the above mention equipment / circuit has been completed and all the applicable permits closed. This equipment / circuit may be energized.

Issuer Name	Designation	Signature
_____	_____	_____

Certificate of Energisation : Date : _____ Time : _____

Certified that Equipment / circuit no. _____ of _____ plant has been electricity energized and the danger tag removed from the supply panel. This is also recorded in the electrical shift logbook.

Name of Authorized Person	Designation	Signature
_____	_____	_____

SECTION – 13

SAFETY REGULATIONS

13.1 General :

13.1.1 The Contractor's employees and labour, engaged in the performance of the Work , shall adhere to safe construction practice and guard against hazardous or unsafe working conditions and shall comply with the Owner's Safety Rules as set forth herein. The safety rules specified herein are in addition to and not in substitution of the applicable provisions of the Factories Act, 1948, The Contract Labour Act 1970, and other statutory provisions, which in all cases shall apply.

13.1.2 The Contractor shall not be entitled to any extra or additional payment or other compensation for the compliance with all applicable safety rules.

13.1.3 The requirement to comply with all applicable safety rules shall not entitle or justify the Contractor to demand or claim any time or cost overrun.

13.1.4 Contractor shall post a qualified and experienced 'Safety Manager' and provide Safety Engineers / Officers / Supervisors in every shift, to exclusively oversee and ensure compliance with all applicable safety rules.

13.1.5 It shall be the responsibility of the Contractor to keep those engaged in the Work duly and promptly informed of any patent and latent dangers at the work sites. The Contractor shall undertake safety talks with his staff and labourers each day before the commencement of the work and outline dangers on site.

13.1.6 The Contractors shall not employ minors (persons below the age of 18 years). Also, the women workers shall not be engaged in hazardous areas. Notwithstanding the requirement under any applicable law, the Owner or the Engineer-in-charge, may at any time require the Contractor to subject any contract workman, to a medical examination, generally or in relation to specific jobs such as in canteen, tank cleaning, etc.

13.1.7 Contractors are prohibited from using Cellular phones within the Refinery premises, except to the extent permitted by the Owner by special or general order / instruction.

13.2 First Aid and Industrial Injuries :

13.2.1 Contractor shall ensure maintainance of first aid facilities for his employees and those of his sub-contractors. However, if practicable and available, emergency first-aid treatment may be obtained from Owner's First Aid Center / Emergency Care Center.

13.2.2 Contractor shall make his own arrangements for the transportation and treatment of his employees and those of his sub-contractors suffering injuries. Name and telephone numbers of those providing such services shall be prominently displayed in Contractor's Site Office.

13.2.3 All cases of personal injury sustained by the Contractor's personnel within the premises of the Owner shall be promptly reported in writing to the Engineer-in-charge / Emergency Care Center / Owner's Safety Department, if occurring during normal working hours and to the Shift Manager or Emergency Care Center of the Owner if occurring at other times.

13.2.4 The Contractor shall be solely responsible for any and all liability under the Workmen's Compensation Act, and other applicable laws with respect to all those engaged by the Contractor or any sub-contractor.

13.2.5 All and every accident or incident involving the personnel, vehicles or machinery of the Contractor or any sub-contractor, shall be duly reported to the Owner promptly.

13.3 Carrying Match Boxes / Lighters and Smoking :

Carrying / Striking of matches, lighters inside the Owner's premises or smoking within the refinery, tank farm or dyke limits are strictly prohibited. Owner's regulatory officials shall be entitled to forthwith remove, using force if necessary, anyone violating the 'No Smoking' and other fire safety rules.

13.4 Work Permits :

13.4.1 Contractor shall obtain the necessary entry permits for all his labour before commencing the job and abide by the instructions in this regard.

13.4.2 Contractor shall obtain necessary permits for hot work, cold work and excavation jobs as may be directed by the Engineer-in-charge from time to time.

13.4.3 Safety measures stipulated in the respective Work Permits shall be strictly complied at all times when within the premises of the Owner.

13.4.4 Owner reserves the right to cancel a work permit without assigning reasons. When called upon to stop the work by the Engineer-in-charge, the Contractor shall immediately cease to continue the work. Before re-commencement, fresh work permit must be obtained.

13.4.5 Contractor's personnel shall abide by the applicable instructions as may be issued from time to time to handle any emergent situations, such as explosion, fire, terrorist attacks, major accident, etc. In the event of such emergencies, the Contractor's personnel shall stop their work and proceed to a safe designated place assembly point in the area of their work and inform the Engineer-in-Charge immediately. If needed, they shall be safely evacuated.

13.5 Entry Pass for Men and Machinery :

13.5.1 Contractor shall arrange to apply for and secure valid gate passes for the entry and exit of his men, materials and equipment, including those of the sub-contractors, from the concerned authorities of the Owner.

13.6 Owner's Fire Fighting Facilities :

13.6.1 Fire hydrant water shall never be used by the Contractor, directly or indirectly, for any purpose other than putting out any fire, unless otherwise permitted by the Engineer-in-charge.

13.6.2 Contractor or their workmen shall not remove the fire hose / extinguishers from their locations under any circumstances.

13.7 Operation of Vehicles :

13.7.1 The Contractor shall ensure that all State traffic rules and regulations are complied with when Motor Vehicles are driven inside the Refinery / Project premises. In addition, the following shall also be complied with by the Contractor's personnel ;

13.7.2 Speed Limit within the Refinery / Project premises, as stipulated by the Owner shall be strictly adhered to. Unless otherwise specified the speed limit shall be 25 K.M. per hour.

13.7.3 Vehicles driven inside the Owner's premises shall be serviceable and roadworthy and shall have CCE approved spark arrestors.

13.7.4 Vehicle drivers shall always check over-head and side clearance while driving vehicles. Hanging of loads on the sides or at the rear is prohibited.

13.7.5 Vehicles shall be parked only in designated areas. No vehicle shall be parked opposite fire hydrants or at the intersection of roads or within 10 meters of any road corner or in front of the Fire Station.

13.7.6 No Contractor's material should be spread or stacked on any of the roads, unless it is in the performance of the Work.

13.7.7 The Work shall, as far as is practicable, be carried out by the Contractor so as not to interfere with the normal activities of the Owner and the normal use of all facilities in the Owner's premises.

13.7.8 Vehicles such as tractors, cranes or forklifts shall not be used to transport people.

13.8 Contractors Barricades :

13.8.1 Contractor shall erect and maintain suitable barricades to guard or protect :

a) Excavations, demolitions
b) Hoisting areas
c) Areas adjudged hazardous by Contractor's or Owner's inspectors
d) Owner's existing property liable to damage by Contractor's operations, in the opinion of the Engineer-in-charge
e) Railroad unloading spots.

13.8.2 Contractor's employees and those of its Sub-contractors shall become acquainted with Owner's barricading practice and shall respect the provisions thereof.

13.8.3 Barricades and hazardous areas situated in passages, pathways, or roads and in areas adjacent thereto shall be conspicuously indicated including by red flasher lanterns at night.

13.9 Scaffolding :

13.9.1 Suitable scaffolding should be provided for workmen for all works that cannot safely be done from the ground or from solid construction except such short period work as can be done safely from ladders. When a ladder is used, an extra mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying materials as well, suitable footholds and handholds shall be given in inclination not steeper than 1 in 4 (1 horizontal and 4 vertical).

13.9.2 All scaffolding material used shall be as per relevant IS specifications and tested periodically as per statutory requirements.

13.9.3 Scaffolding or staging more than 12 meters above the ground or floor, swing or suspended from an overhead support or erected with stationery support shall have a guard rail properly attached, bolted, braced and otherwise guarded at least 1 meter above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent from swaying from the building or structure.

13.9.4 Working platform, gangways and stairways should be so constructed that they should not sag unduly or unequally and if the height of the platform or the gangway or the stairway is more than 12 meters above ground level or floor level, they should be closely guarded, should have adequate width and should be suitably fastened as described in clause 13.9.3 above.

13.9.5 Any opening in the floor of a building or in working platform be provided with suitable means to prevent the fall of persons or materials by providing suitable grills, fencing or railing having a minimum height of 1 meter.

13.9.6 Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 900 cms. in length, while the width between the side rails in rung ladder shall in no case be less than 30 cms. for ladder upto and including 300 cms. in length. For longer ladders, this width should be increased at least 6 mm for each additional foot of length. Uniform step spacing shall not exceed 30 cms. Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or public. Contractor shall also provide all necessary fencing and lights to protect the workers and staff from accidents, and shall be bound to bear the expenses of defence of every suit, action or other proceedings, as law that may be brought by any

person for injury sustained owing to the neglect of the above precautions and to pay any damages and costs which may be awarded in any such suit or action or proceedings to any such persons or which may be with the consent of the Contractor be paid to compromise any claim by any such person.

13.9.7 Scaffolding must be inspected and certified fit by the Contractor's Safety Manager weekly or more frequently in the event of adverse weather. Such inspections shall be recorded.

13.10 Excavation and Trenching :

13.10.1 All trenches 1.2 meters or more in depth, shall at all times be supplied with at least one ladder for each span of 30 meters length.

13.10.2 Ladder shall be extended from bottom of the trench to at least 100 cms. above the surface of the ground. The site of the trenches which are 152 cms. or more in depth shall be stepped back to give suitable slope or securely held by timber bracing, so as to avoid the danger of sides to collapse. The excavated material shall not be placed within 152 cms. of the edge of the trench or half of the trench depth whichever is more. Cutting shall be done from top to bottom. Under no circumstances undermining or under cutting be done.

13.11 Demolition :

Immediately prior to the commencement of any demolition work and also during the process of demolition the following additional precautionary steps shall be observed.

13.11.1 All roads and open areas adjacent to the particular site shall either be closed or suitably controlled.

13.11.2 All underground / overground power / telephone cables or water / sewerage lines in the vicinity of the particular site shall be either suitably diverted or made non-functional for the duration of the demolition activity.

13.11.3 All practical steps shall be taken to prevent danger to persons employed from risk of fire or explosion or flooding. No floor, roof or other part of the building shall be overloaded with debris or materials as to render it unsafe.

13.12 Safety Equipment :

13.12.1 The Contractor shall ensure ready availability at the respective work site of necessary personal protective equipment for use by persons employed at the site and such equipment shall be maintained in a condition suitable for immediate use. The Contractor shall ensure proper use of such equipment by those concerned. Contractor shall use material handling equipment and tools such as chain pulley blocks, wire ropes, lifting machines etc. and scaffolding materials only if they are duly certified as per statutory requirements.

13.12.2 Workers engaged in mixing asphaltic materials, cement and lime mortar shall wear protective footware and protective gloves.

13.12.3 Workers engaged in white washing and mixing or stacking of cement bags or any materials which are injurious to eyes shall be provided with protective goggles / dust masks.

13.12.4 Those engaged in welding and cutting works, shall be provided with protective face and eye-shields, hand gloves, apron etc.

13.12.5 Stone breakers shall be provided with protective goggles and protective clothing and located at safe intervals.

13.12.6 When workers are required to work in sewers and manholes, which are in use, the Contractor shall ensure that the manhole covers are opened and ventilated at least for an hour before the workers are allowed to get into manholes and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent accidents.

13.13 Risky Places :

13.13.1 If there is risk of drowning or such like danger at or near the work site, adequate safety equipment shall be positioned at such site(s) in ready-to-use condition. Steps necessary for prompt rescue of any person in danger shall be taken.

13.13.2 When work is required to be performed in areas where H_2S / CO gas is likely to be present, the Contractor should ensure with the Permit Issuing Authority on the total gas free atmosphere. Care should be exercised when work in a contaminated area upto the Threshold Limit Value (TLV) is undertaken, by wearing a Self Contained Breathing Apparatus (SCBA) or using a Blow Man Apparatus. Such work should not be performed by a single worker and should always be done under close supervision.

13.14 Hoisting Equipment :

13.14.1 All hoisting machines and tackles including their attachments, anchorage and supports shall be as per relevant IS specifications, standards and tested / inspected periodically by the concerned competent authorities. Necessary records / certificates etc., in this regard shall be maintained as per statutory requirements.

13.14.2 These shall be of good mechanical construction, sound materials, and adequate strength and free from patent defect and shall be kept in good repair and in good working order.

13.14.3 Ropes used in hoisting or lowering materials or as a means of suspension shall be of durable quality, of adequate strength and free from defects.

13.14.4 Every crane driver or hoisting appliance operator shall be properly qualified. No person under the age of 21 years shall be in charge of any hoisting machine including any scaffolding winch or for giving signals to the operator.

13.14.5 In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or lowering or as means of suspension, the safe working load shall be ascertained by appropriate means. Every hoisting machine and all gear referred to above shall be prominently marked to show the safe working load. In case of a hoisting machine having a variable safe working load, each safe working load and the respective conditions under which it is applicable shall be clearly indicated. No part of any machine or any gear shall be loaded beyond the safe working load except for the purpose of testing.

13.14.6 In respect of machines made available by the Owner, the safe working load shall be notified by the Engineer-in-charge. As regards Contractor's machines, the contractor shall notify the safe working load of the machine to the Engineer-in-charge, whenever he brings any machinery to site of work and cause it to be verified by the Engineer-in-charge.

13.14.7 Hoisting appliances should be provided with such means as will reduce to the minimum, any risk of accidental descent of the load.

13.14.8 Adequate precautions should be taken to avoid the risk of any part of a suspended load becoming accidentally displaced.

13.15 Electrical Equipment :

13.15.1 The Contractor shall deploy a competent Engineer / Electrician to attend to electrical matters. All temporary power supply boards shall conform to IE Regulations.

13.15.2 Motors, Gearing, Transmission, Electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safeguards.

13.15.3 When workers are employed on electrical installations which are already energised, insulating mats, wearing apparel, such as gloves, sleeves and boots as may be necessary, shall be provided. The workers should not wear any metallic rings, watches, keys or other materials which are conductors of electricity.

13.15.4 The work area shall always be kept accessible for switching off power supply in case of emergency. Before leaving the work place, the Contractor shall ensure power supply is switched off properly. For this purpose a record shall be maintained of the last person leaving the concerned work site on all days of activity.

13.16 Maintenance of Safety Devices :

All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in safe conditions and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities should be provided at or near places of work.

13.17 Display of Safety Instructions :

13.17.1 The Contractor shall display a 'Safety Policy' at a prominent place at his site office and each work spot.

13.17.2 The safety provisions covered herein should be brought to the notice of all concerned by display on a notice board at a prominent place at the work spot(s).

13.18 Personal Conduct :

13.18.1 Gambling, fooling on the work, horseplay, mock fighting or fighting is strictly forbidden in the Refinery premises / Project area.

13.18.2 Entering the Refinery premises / Project area under the influence of alcohol / narcotics or its possession is strictly forbidden.

13.18.3 Entering the Refinery premises / Project area with weapons such as knives, gun etc. is prohibited.

13.19 Housekeeping :

13.19.1 Good housekeeping must be practised by the Contractor's personnel at all times while within the Owner's premises. During and after completion of work, they are to ensure that their work area is kept clean and tidy.

13.19.2 Records of routine housekeeping inspection shall be maintained.

13.19.3 Materials and equipment should be stored in a safe and orderly manner so that they will not block exits to roads, buildings, aisles, passages and approach to fire fighting equipment such as fire hydrants, fire hoses, fire extinguishers or areas where emergency safety showers, electrical switch panels and switch rooms are located.

13.20 Enforcement of Safety Regulations :

13.20.1 To ensure effective enforcement of the rules and regulations relating to safety precautions, the arrangements made by the Contractor shall be open to inspection by the Engineer-in-Charge or Safety Engineer of the Owner or their representatives.

13.20.2 Contractors and their supervisory staff shall undergo a one-day training programme annually by CPCL on Safe Working Practices in the Refinery Premises so as to familiarize themselves with the safety rules, regulations and practices. Contractor shall be in possession of valid safety training badge while working in the Refinery premises.