

2 X 660 MW THDC KHURJA-TG

**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS AND MISCELLANEOUS ITEMS
SPECIFICATION NO: PE-TS-475-558-E006, REV-0**



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, UTTAR PRADESH, INDIA – 201301**



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS AND
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SPECIFICATION NO. PE-TS-475-558-E001

VOLUME II

CONTENTS SHEET

2 X 660 MW THDC KHURJA - TG PROJECT

REV. 0

DATE: 27.08.2021

SHEET 1 OF 1

CONTENTS

<u>S NO.</u>	<u>DESCRIPTION</u>	<u>NO. OF SHEETS</u>
	COVER SHEET	01
01	SECTION - I	
	CONTENTS	01
	COMPLIANCE CERTIFICATE	01
	SPECIFIC TECHNICAL REQUIREMENT	19
	DATA SHEET-A	05
	LIST OF APPLICABLE STANDARDS	03
	DATA SHEET-B	01
	ANNEXURE A (SUB-VENDOR LIST)	05
	ANNEXURE B (DOCUMENTS REQUIRED AFTER AWARD OF LOI)	05
	ANNEXURE C (SCOPE MATRIX FOR BROAD ACTIVITIES)	01
02	SECTION - II	
	STANDARD TECHNICAL REQUIRMENTS	39
	ANNEXURE-II (TYPICAL MOUNTING ARRANGEMENT DWGS/ DETAILS)	10
	QUALITY PLAN	06
03	ANNEXURE-2	
	CRITERIA UNDER GRIHA REQUIREMENT FOR ILLUMINATION	10

TOTAL NUMBER OF SHEETS (INCLUDING COVER & SEPARATOR SHEETS: 107



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS AND
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-TS-475-558-E006

VOLUME II

SECTION - I

2X660 MW THDC KHURJA- TG

REV. 0

DATE:

SHEET 1 OF 1

COMPLIANCE CERTIFICATE

The bidder shall confirm compliance to the following by signing/ stamping this compliance certificate and furnishing same with the offer.

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.
2. There are no deviation with respect to specification other than those furnished in the 'schedule of deviations'.
3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.
4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.
5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in BOQ-Cum-Price schedule of the specification shall not be considered (i.e. technical description & quantities as per specification shall prevail).



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS AND
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-TS-475-558-E006

VOLUME II

SECTION - I

2X660 MW THDC KHURJA-TG

REV. 0

DATE:

SHEET OF

SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS AND
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-TS-475-558-E006

VOLUME II

SECTION - I

2X660 MW THDC KHURJA-TG

REV. 0

DATE:

1.0 SCOPE OF SUPPLY AND SERVICES

1.1 SUPPLY:

Design, manufacture, assembly, inspection & testing at vendor's/ sub-vendor's works, proper packing and delivery to site of **LIGHTING FIXTURES, LAMPS & MISCELLANEOUS ITEMS** as mentioned in different sections of this specification, complete with all accessories for efficient and trouble-free operation.

1.2 SYSTEM DESIGN ENGINEERING:

System Design Engineering is included in vendor's scope, which includes design of complete lighting system for indoor and outdoor areas of the power plant. Please refer the list of LLO/LDC/CLO/PDS drawings (mentioned in NIT) for the tentative areas to be covered by the lighting system. The aspect of engineering covers preparation of electrical distribution and control schemes, quantity estimation, luminaire layout drawings, conduit layout drawings, wiring schemes upto luminaires, cable schedules and all associated design work not specifically mentioned in the specification. The quantity estimation to include all items required for the complete lighting system viz. lighting fixtures, Lighting DBs, Welding DBs, lighting panels, conduits, PVC wires etc.

1.3 Supervision of Erection & Commissioning (as required by site) of lighting system is included in vendor's scope.

1.4 Although Erection and Commissioning is not included in vendor's scope, the vendor shall still not be absolved of his responsibility of establishing the correctness of engineering and equipment at site.

1.5 Standard technical requirements of the lighting fixtures, lamps & miscellaneous items and lighting system design requirements are indicated in Section-II. Project specific requirements/changes are listed in Section-I.

1.6 The stipulations of Section-I, followed by those of Data Sheet-A shall prevail and govern in case of conflict between the corresponding requirements of Section-I and Section-II.

1.7 Review of sub-vendor's documents by the purchaser shall not relieve the vendor from the responsibility of design & supply.

1.8 The documents shall be in English language and MKS system of units.

1.9 Make of all equipment and components shall be as per attached Sub-Vendor List enclosed as per Annexure-A to section- I.

2.0 BILL OF QUANTITIES:

2.1 Quantity requirements shall be as per BOQ-cum-price schedule as part of NIT.

2.2 After placement of PO, Supplier to give the following undertaking w.r.t. the BOM:

"The BoM provided herewith completes the scope (in content and intent) of material supply under PO No. -----, dated ----- . Any additional material which may become necessary for the intended application of the supplied item(s)/package will be supplied free of cost in most reasonable time."

3.0 STATUTORY AND REGULATORY REGULATION



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS AND
MISCELLANEOUS ITEMS**

2X660 MW THDC KHURJA-TG

SPECIFICATION NO. PE-TS-475-558-E006

VOLUME II

SECTION - I

REV. 0

DATE:

3.1 Statutory and regulatory regulation shall be applicable as per Indian Electricity Rule, 1956 with amendment-3 Rule no. 35, 48, 49, 50, 61 & 64 for illumination & low voltage power services.

4.0 DOCUMENTATION

4.1 Documents required along with the technical offer: -

- a) Signed & Stamped copy of Compliance certificate
- b) Duly filled in signed & stamped copy of scope matrix for broad activities
- c) Signed & stamped copy of unpriced price schedule with "quoted" word indicated against all items.
- d) Duly filled in signed & stamped copy of Datasheet-B.

4.2 Documents required after award of LOI/PO shall be as per NIT (to be submitted by successful bidder).

5.0 SPECIFIC TECHNICAL REQUIREMENTS

5.1

S.No.	Reference clause No. of Section-II	Specific requirement/Change
1	5.2.1(n), Page-17	"The LED chip efficacy shall be min 120 Lm/W. The luminaire efficacy shall be not less than 80Lm/W" shall be read as "The LED chip efficacy shall be min 120 Lm/W"
2	-	Please note that following items are excluded from the supply of this package: Poles, Mast, LDB, WDB, LP, Rigid conduit, wire & earthing wires.
3	-	For recessed type fixtures provided in Aluminium Frame type false ceiling, suitable provision for removing the fixture and accessing the driver for maintenance from bottom shall be provided by bidder.
4	12.4 AS BUILT DRAWINGS	Preparation of as-built drawings shall be in BHEL Scope. However, vendor shall be furnishing the final autocad drawings to BHEL.
5	Clause 9.1- Bidder shall confirm compliance to BHEL Standard Quality Plan (PE-QP-999-558-E006) without any deviation. Equipment which are not covered in the Quality Plan shall be tested as per QP to be submitted by bidder	Bidder shall confirm compliance to NTPC Standard Quality Plan (0000-999-QOE-S-062) without any deviation.
6	7.2 1	Materials like concrete blocks of paved surface required for installation of container shall be made available by BHEL. Other supporting material like Rails etc. shall be part of Container only.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS AND
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-TS-475-558-E006

VOLUME II

SECTION - I

2X660 MW THDC KHURJA-TG

REV. 0

DATE:

7	5.2.1(n)	In addition to clause 5.2.1(n), bidder to consider parameters mentioned against Clause 2.2 of "Additional Technical Requirements".
8	Additional Clause no.6 to be added under annexure-I of section-II as below:-	

6.0

SL. No.	Type of Luminaire	Description	Total Luminous flux (Lumen) of luminaire- Minimum value	Measured Electrical Input Power(Watt)- Maximum value
1	FC02(LED)	Industrial type LED fixture suitable for conduit /surface/ suspended mounting, with integral driver aesthetically designed for Switchgear / Equipment room/stair case/ corridors	3780	42
2	FC06(LED)	Industrial type LED fixture suitable for conduit /surface/ suspended mounting, with integral driver aesthetically designed for Switchgear / Equipment room	3780	42
3	FC07(LED)	Industrial type LED fixture suitable for conduit/ surface/ suspended/ column mounting, having integral driver. Fixture shall operate on 220V DC input supply. Necessary accessories like DC to AC convertor etc to be included accordingly, if required.	1260	14
4	FC26(LED)	Panel (approx. 1200 mm X 300 mm) LED luminaire suitable for recess mounting in false ceiling with integral driver aesthetically designed for Control Room/ Office	3780	42
5	FC30 (LED)	Panel 600 mm X 600 mm LED luminaire suitable for recess mounting in false ceiling with integral driver aesthetically designed for Control Room/ Office	3780	42
6	FC32 (LED)	Decorative, surface mounted LED fixture having integral driver	3780	42



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS AND
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-TS-475-558-E006

VOLUME II

SECTION - I

2X660 MW THDC KHURJA-TG

REV. 0

DATE:

7	FC33 (LED)	Decorative, recessed type LED fixture having integral driver. Fixture shall operate on 220V DC input supply. Necessary accessories like DC to AC convertor etc. to be included accordingly, if required	1260	14
8	FC34 (LED)	Well glass, dust proof type LED fixture having integral driver. Fixture shall operate on 220V DC input supply. Necessary accessories like DC to AC convertor etc. to be included accordingly, if required	1260	14
9	FC81(LED)	Corrosion proof, totally enclosed type LED fixture having integral driver.	3780	42
10	SB11 (LED)	Medium bay, Industrial type LED fixture	10080	112
11	SB02 (LED)	High Bay Industrial type LED fixture	16920	188
12	SB03 (LED)	High Bay Industrial type LED fixture suitable for turbine hall operating floor (mounting height >10 m)	24750	275
13	SF63 (LED)	Flood light, heavy duty type LED fixture	16920	188
14	SF64 (LED)	Flood light, heavy duty type LED fixture	27000	300
15	SF66 (LED)	Flood light, heavy duty type LED fixture	45000	500



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS AND
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-TS-475-558-E006

VOLUME II

SECTION - I

2X660 MW THDC KHURJA-TG

REV. 0

DATE:

16	SS61 (LED)	Street light LED fixture	6500	73
17	SS62 (LED)	Street light LED fixture	10080	112
18	SS63(LED)	Street light LED fixture	16920	188
19	SW41(LED)	Well glass type, vapour proof LED fixture suitable for Boiler / ESP platforms	4680	52
20	SW42(LED)	Well glass type, vapour proof LED fixture suitable for Boiler / ESP platforms	7380	82
21	MW96(LED)	Well glass, flame proof increased safety luminaire LED fixture having an integral driver suitable for division-2, Group IIA/IIB of hazardous areas.	8460	94
22	FC30 (LED) DIMMABLE	Panel 600 mm X 600 mm LED luminaire suitable for recess mounting in false ceiling dimmable type with driver aesthetically designed for Control Room/ Office	8460	94
23	Downlighter(LED)	Recessed Mounted Downlighter with Integral driver aesthetically designed for Control Room/ Office	1500	18
24	Downlighter(LED) DIMMABLE	Recessed Mounted Downlighter Dimmable type with driver aesthetically designed for Control Room/ Office	1500	18



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS AND
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-TS-475-558-E006

VOLUME II

SECTION - I

2X660 MW THDC KHURJA-TG

REV. 0

DATE:

Notes:

- 1) LED must comply all the parameters of IS 16105 or IESNA LM-80-08.
- 2) The Luminaire must comply all the parameters of IS 16106 or IESNA LM-79-08.
- 3) The LED driver should comply to IEC 61347-2-13, IS 15885: Part 2: Sec 13, IEC 62384, IS 16104 and CISPR 15.
- 4) The luminaire complete with all accessories shall comply to relevant specified standards.
- 5) The values of minimum luminous flux & maximum measured electrical input power are specified above for the luminaire (including any accessories like driver module etc). These values shall be measured as per IS 16106 & shall not be subject to any further tolerance.
- 6) All parameters mentioned in Section-II, Clause 5.2.1 are to be complied in totality.

TESTS:-

[A] For LED Fixture

- a) All equipments to be supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.
- b) However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client /Employers representative and submit the reports for approval.
- c) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.
- d) The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change. Minor changes if any shall be highlighted on the endorsement sheet.

LED fixtures Type test reports to be submitted for one rating each of following type of LED fixtures.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS AND
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-TS-475-558-E006

VOLUME II

SECTION - I

2X660 MW THDC KHURJA-TG

REV. 0

DATE:

- a) High bay fixture.
- b) Well glass fixture.
- c) Street light fixture
- d) Surface mounted type fixture.
- e) Recessed mounted type fixture.

[B] For all other lighting equipment:

a) All equipment to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

b) However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval.

All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

Selection of samples for type test, acceptance test & routine test and acceptance criteria for all the items shall be as per relevant IS.

Type test reports of the following items as per technical specification requirements/ standards shall be submitted for approval.

- i. Lighting fixtures of each type
- ii. Lighting panel of each type (Degree of Protection)
- iii. Junction Box of each type.

Type test reports for LED as per standards for following shall be submitted for approval.

1. Visual and Dimension check
2. Proof of procurement of LEOs
3. Safety tests
 - a. Marking
 - b. Construction
 - c. Provision for Earthing
 - d. External and Internal wiring
 - e. Protection against electrical shock
 - f. Endurance and Thermal
 - g. Insulation resistance & electrical strength.
 - h. Resistance to heat fire & tracking
 - i. Resistance to Humidity
4. Fire Retardant test
5. Performance tests (electrical, Photometric color and Life
6. Burn-in Test
7. Power Cycling
8. Temperature rise test
9. Emission Tests



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS AND
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-TS-475-558-E006

VOLUME II

SECTION - I

2X660 MW THDC KHURJA-TG

REV. 0

DATE:

- a) Radiated & conducted emission
- b) Harmonics & flickers
- 10. Immunity tests

In addition, following test reports to be submitted for LED chip/LED luminaire:

- a) LED parameters like Lumen per watt, CRI, Beam angle from manufacturer.
- b) LM 80/IS: 16105 report.
- e) LM 79/IS: 16106 report.

Acceptance Test and Routine Test:

All lighting fixtures, lamps and other items shall be subjected to acceptance and routine test, as per relevant specified standards.

Junction boxes, switch boxes, receptacle enclosure etc. shall be subjected to physical and dimensional checks also. Switch boxes shall be made of 1.6 mm thick MS sheet with 3.0 mm thick decorative, Perspex cover. Switch box shall be hot dip galvanized.

Switch boxes shall be of following types:

Type	No. of Switch	Fan regulator	Socket
SWB1	5 A- 2nos		
SWB2	5 A- 3nos		5 A- 1nos
SWB3*	5 A- 5nos	1	5 A- 1nos
SWB4*	5 A- 7nos	3	5 A- 1nos
SWB5**	5 A- 5nos		5 A- 1nos

* Space provision shall be kept for fan regulator in switch boxes.

** Shall have the provision for mounting the 16 A contactor.

ADDITIONAL TECHNICAL DETAILS

1.0 SCOPE:

The purpose of this design document is to cover basic approach for designing lighting system for power plant. The document covers various types of lighting system, lighting system design, and illumination levels for various areas, luminaries type and low voltage power services for various areas of the power plant. The lighting system of switchyard, AHP, CHP, SG areas and chimney shall be under the scope of switchyard, AHP, CHP, SG pkg areas and Chimney package agencies respectively. **Only those areas that are under turbine generator & associated auxiliaries package as per contract shall be in the scope of main lighting package (i.e under the scope of this document).**

2.0 LIGHTING SYSTEM DESIGN:

- 2.1 Lighting system will be designed to ensure adequate uniform visual performance, safety & reliability and will be free from excessive glare and flicker from discharge lamp. In main control room, particular attention will be given to ensure that illumination is proper and aesthetic. Control room lighting will be such as to prevent any glare/ luminous patch on control board /panel/ VDUs when viewed from an angle.
- 2.2 All fixtures shall be of a proven design for applications in power plant environment. All outdoor fixtures shall be weatherproof type.

Type of fixtures/ lux level shall be as per Annexure-I

- 2.3 LED medium bay fixtures will be installed in areas with sufficient minimum headroom of 5 meter.
- 2.4 Flame proof LED lighting fixtures will be installed in hazardous area as per area classifications. All highbay fixtures will have vibration damper.
- 2.5 In general, the type of fixtures, type of luminaries and illumination levels to be achieved will be as per enclosed Annexure-I.
- 2.6 The lighting fixtures in the plant area will be group controlled from lighting panel. The lighting fixtures in office areas, control rooms, AC areas/Service building etc. will be controlled by switches.
- 2.7 Lighting panel (LP) for controlling lights with additional provision for manual control shall be provided:
- | | |
|-------------------------|------------|
| Indoor lighting panel: | With Timer |
| Outdoor lighting panel: | With Timer |
- 2.8 Outdoor areas like CPU re-generation area, open yard etc. shall have flood light fixtures mounted on flood light poles.
- 2.9 Hazardous areas shall have Flameproof Type Fixtures.

ADDITIONAL TECHNICAL DETAILS

3.0 ILLUMINATION DESIGN CALCULATION:

- 3.1 Lighting design for indoor areas will be done by LUMEN method only.
For a given indoor area, number of luminaires is calculated as follows:

$$\text{Number of luminaires} = \frac{L \times W \times \text{LUX LEVEL (Average)}}{\text{LUMEN} \times \text{COU} \times \text{MF}}$$

where,

L= Length of room

W= Width of room

LUMEN= Lumen output of each lamp

COU= Coefficient of Utilisation

MF= Maintenance Factor

Coefficient of Utilisation (COU) is determined from the COU chart for a particular luminaire of the manufacturer, corresponding to selected reflection factors and calculated Room Index.

The working plane from the floor level considered at : 0.85 meter

The Room Index is calculated by the following formula:

$$\text{Room Index} = \frac{L \times W}{(L + W) \times \text{MH}}$$

where, MH = Mounting height of luminaire.

The Reflection Factor (RF) will be considered as given below:

	Ceiling (rc)	Wall (rw)	Floor (rf)
Clear Areas like Swgr room/ control room	70	50	10
Dusrty areas like conveyor galleries/ tunnel, etc	50	30	10

Values of Maintenance Factor (MF), which includes the luminaire depreciation factor also as per IS-3646, will be considered as given below:

Area prone to chemical/dust pollution	0.6
Control room & air conditioned area with false ceiling	0.8
Switchgear/ MCC Rooms in TG Bldg/ Service Bldg	0.7
Other Indoor Areas	0.7

- 3.2 Lighting design for outdoor area, open area shall be done by computer programme as per standard norms for lighting design to meet the specified lux level.
Average maintenance factor for outdoor and road lighting : 0.55

4.0 LIGHTING SYSTEM DESCRIPTION

Lighting system will be provided with AC normal, AC emergency and DC emergency as listed against various areas as per Annexure-II enclosed.

The sources of power lighting are as below :

- (i) 415V AC Normal (ACN) Supply from different station PMCCs /MCCs
- (ii) 415V AC Emergency (ACE) Supply from Emergency Board
- (iii) 220V DC Emergency Supply from DC Distribution Board
- (iv) 24V AC Supply for maintenance

For main plant area normally all AC luminaries will be in service on normal AC supply.

Approximately distribution of AC Luminaries on AC normal and AC emergency shall as below:

ADDITIONAL TECHNICAL DETAILS

AC Normal (ACN) supply: 80 %

AC Emergency (ACE) supply: 20 %

Normally all DC luminaries shall be 'ON'. Upon failure of AC supply, DC luminaries will be 'ON' through DC supply. On restoration of AC Emergency supply through DG, ACE luminaries will be put-on.

For other auxiliary areas AC Normal lighting will provide 100% illumination level and normally all AC lighting fixture shall remain "ON" as long as normal AC supply is available. In DG room, in addition to DC emergency lighting, 100% AC emergency lighting will be provided.

Lighting level by DC emergency lighting will be provided to meet functional/ operational requirements. DC fixtures will be located at strategic locations such as near entrance, staircase, landings etc. for safe personnel movement during emergency.

In off-site areas/odd locations (BHEL scope), for safe movement of personal during emergency, self contained battery operated emergency lighting units (ELUs) is envisaged.

4.1 AC Normal Lighting Systems:

AC Normal lighting fixtures are fed through a number of conveniently located AC Lighting panel (ACLP) which are fed from Lighting Distribution Board (LDB).

LDBs consisting of dry type isolation transformer housed in LDB with proper separation from distribution panels as per details indicated below is envisaged:

Transformer rating:	50 / 100 kVA
Transformer voltage ratio:	415 / 415 Volt, taps of +5% to -5% in steps of 2.5%.
Transformer type:	Non-encapsulated
Distribution Panel type:	Single front fixed type
LDB Configuration:	One incomer
Incomer type:	TPN MCCB
Incomer rating:	As per lighting transformer rating
Outgoing feeder type:	TPN MCCB
Outgoing feeder rating:	63A

AC normal lighting panel as per details given below is envisaged:

Incomer type:	TPN MCCB
Incomer rating:	63A
Outgoing feeder type:	SPN MCB
Outgoing feeder rating:	20A
Short circuit rating:	9kA

Street lighting panel as per details given below is envisaged:

Incomer type:	TPN Switchfuse unit
Incomer rating:	100A
Outgoing feeder type:	TPN MCB
Outgoing feeder rating:	20A
Short circuit rating:	9kA
ON/ OFF control	With Timer

ADDITIONAL TECHNICAL DETAILS

4.2 AC Emergency Lighting Systems:

AC Emergency lighting fixtures are fed through a number of conveniently located AC Lighting panel (ACLP) which are fed from AC Emergency Lighting Distribution Board (ELDB).

ELDBs consisting of non-encapsulated, dry type isolation transformer housed in ELDB with proper separation from distribution panels as per details indicated below is envisaged:

Transformer rating:	50 / 100 kVA
Transformer voltage ratio:	415 / 415 Volt, taps of +5% to -5% in steps of 2.5%.
Transformer type:	Non-encapsulated
Distribution Panel type:	Single front fixed type
LDB Configuration:	One incomer
Incomer type:	TPN MCCB
Incomer rating:	As per lighting transformer rating
Outgoing feeder type:	TPN MCCB
Outgoing feeder rating:	63A

AC emergency lighting panel as per details given below is envisaged:

Incomer type:	TPN MCCB
Incomer rating:	63A
Outgoing feeder type:	SPN MCB
Outgoing feeder rating:	20A
Short circuit rating:	9kA

4.3 DC Emergency Lighting Systems:

DC Emergency lighting fixtures fed through suitable numbers of conveniently located DC Emergency Lighting panel (DCELP) which are fed through DC Lighting Distribution Board (DCLDB).

The DCLDB shall be fed from two sources i.e. AC Normal lighting distribution board (LDB) and DCDB. The emergency lighting fixtures connected to this system shall remain normally 'ON' all the time from AC supply & on failure of AC supply they will automatically switch over to DC supply system. DCLDB shall be equipped with AC under voltage relay and contactor for emergency auto changeover scheme.

DCLDBs as per details given below is envisaged:

Distribution Panel type:	Single front fixed type
DC Incomer type:	DP Switchfuse unit with contactor
DC Incomer rating:	125A
AC Incomer type:	TPN MCB with contactor
AC Incomer rating:	63A
Outgoing feeder type:	DP Switchfuse unit
Outgoing feeder rating:	32A

DCLPs as per details given below is envisaged:

Incomer type:	DP Switchfuse unit
Incomer rating:	32A
Outgoing feeder type:	DP MCB
Outgoing feeder rating:	16A

ADDITIONAL TECHNICAL DETAILS

4.4 The LDBs will be provided with voltmeter and ammeter along with selector switch, supply ON indicating lamps etc. All indicating lamps will be cluster LED type. The DOP for LDB will be IP-54 and for transformer cubicle IP-42. Where as the DOP for LP will be IP-55 for indoor and IP-55with canopy for outdoor.

4.5 24V AC Supply system:

Each 24V AC supply module will have one no. dry type two winding, 1 phase transformer and necessary terminals for incoming and outgoing connections. Details of 24V supply modules shall be as given below:

Module type:	Portable type / Fixed type
Transformer rating:	500 VA
Transformer voltage ratio:	240 / 26.5 Volt
Primary side isolation:	DP MCB with HRC fuse
Isolator rating:	16A
HRC fuse rating:	6A
Secondary side isolation:	SPN MCB with HRC fuse
Isolator rating:	6A
HRC fuse rating:	16A

Fixed type 24V supply modules shall be provided in following areas:

TG Building:	Near HP & LP heaters, turbine flash tank, blow down tank, near condenser water box and near bus duct termination of generator
other area:	Near Deaerator

Suitable numbers of 24V portable halogen lamp unit along with flexible copper cable shall also be supplied as per details below:

Cable size:	2.5 sq. mm
Cable length:	20 meter

ADDITIONAL TECHNICAL DETAILS

4.6 Emergency EXIT lamps:

Emergency exit lamps backed up by battery shall be provided at strategic locations of the building for safe exit of personnel. These exit lamps will remain ON all the time and normally received power supply from ACELP.

Exit lamp unit shall contain maintenance free Ni-Cd battery with 4 hours backup capacity.

4.7 ELUs shall contain maintenance free Ni-Cd battery with 4 hours backup capacity. Each ELU will have battery charger and lamps.

5.0 STREET LIGHTING / OUTDOOR LIGHTING

5.1 The roads within BHEL scope as per contract will be considered for lighting.

5.2 Street lights / outdoor lighting will be fed from separate panel located at suitable places. Automatic switching ON/OFF of these circuits shall be done from street light panel.

5.3 For street lighting, street light pole will be used. For outdoor area lighting, if required, flood light pole will be used. Pole type shall be as below:

Pole height: 8.0 meter (Min.)

Pole construction type: Fabricated, swaged, steel tubular poles with swan neck

Pole type: Hot-dip galvanized

The technical details of poles will be as per IS-2713. The poles shall be equipped with junction boxes and all other required accessories.

The poles will be located 1.5 M away from the road edge. The buried cable will run in hume pipe (100 mm dia) wherever it is crossing the roads.

Flood Light Poles shall be used for area Lighting wherever required.

Lighting High Mast in case required during detailed Engineering shall be provided.

6.0 LOW VOLTAGE POWER SERVICES

6.1 Different type of receptacles as per details below will be provided:

(i) Decorative receptacle:

At least 01 number **6/16A**, 5-Pin, 240V AC decorative socket will be provided in office, store, cabin etc.

(ii) Industrial receptacle:

At least 01 number **20A**, 3-Pin, 240V AC industrial type receptacles will be provided at suitable location in plant building like swgr room, MCC room (location will be decided during detailed engineering) . The receptacles shall be provided at interval of 20m or part thereof. All receptacles will be controlled with a switch. In hazardous area receptacles will be of flameproof type. Receptacles (20A) shall be provided min 01 for each transformer in trf. yard and min 02 in MCC room.

(iii) Welding receptacle:

63A, 3-phase, 415V AC welding receptacles with isolating switch will be provided at specific points (location will be decided during detailed engineering) . Maximum 03 nos. receptacles will be fed through one feeder. In hazardous areas these receptacle will be located in MCC room.

6.2 Transformer rating for welding distribution board shall be 50/100kVA. Other construction details shall be identical to AC LDB.

6.3 Based on room size, suitable nos. of ceiling fans (1200mm sweep) with Stepped electronic regulator shall be provided in office rooms, store rooms and social buildings which are not covered by air-conditioned and ventilation system. In the office premises, one fan per 10 sq. metres shall be provided.

ADDITIONAL TECHNICAL DETAILS

6.4 For the maintenance of lighting fixtures within the power house, 1 nos. free standing adjustable aluminium ladder, adjustable from 05M to 10M shall be provided. For the maintenance of street lights, 01 no. of wheel mounted adjustable aluminium ladder shall be provided.

6.5 Junction boxes for indoor lighting shall be FRP type. Junction boxes for street lighting poles shall be made of 1.6 mm thick CRCA Sheet. CRCA sheet steel hot-dip galvanized, dust and damp proof.

7.0 WIRING / CONDUITS

7.1 Wiring of lighting system will be done as follows:

(i) **Wiring in TG Hall MOT room and hazardous areas like transformer yard, outdoor area (like Tank area, GT area etc) will be done using Cu/Al, PVC insulated, FRLS PVC sheathed unarmoured cable which shall be laid in cable tray running in these areas.**

Wiring installation in other areas will be done by multi-stranded, PVC insulated, colour coded wires laid in GI conduits of 20 mm dia size (minimum) conforming to IS-9537 for areas like . The thickness of conduits upto & including 25 mm dia will be 1.6mm and conduits above 25 mm will be 2.0mm.

(ii) Conduits will be heavy-duty type hot dip galvanised steel conforming to IS-9537. Conduit accessories will be hot dip galvanised. In corrosive area, conduits will have suitable epoxy coating additionally.

(iii) Flexible conduit shall be water proof and rust proof made of heat resistant lead TERNE coated steel.

(iv) Conduits in control room and other air-conditioned areas will be surface mounted on the roof above false ceiling, however vertical drops of conduits will be concealed along walls and finally plastered for better aesthetics.

(v) Filling area of wires in conduit shall not exceed 40% of the conduit area.

(vi) Wiring for AC Normal, AC Emergency, and DC Emergency services will run in separate conduits.

(vii) Lighting and receptacles will be fed from separate circuits. No two different phase circuits will be run in the same conduit. However, different circuits of same phase may be laid in the same conduit.

(viii) Maximum 03 numbers of 1-phase receptacles will be loop in & loop out in a circuit.

7.2 **Following sizes of 1100 V grade, PVC insulated single core stranded copper conductor wires/ PVC insulated Standard 2 Core copper/aluminium conductor cable will be used:**

	Wire	Cable
Lighting Panel to Fixtures:	2.5 sq. mm (Cu)	2.5 sq. mm (Cu)
Lighting Panel to JB's/ Switches:	2.5 sq. mm (Cu)	2.5 sq. mm (Cu)
JB's/ switches to Fixtures:	2.5 sq. mm (Cu)	2.5 sq. mm (Cu)
Panel to First receptacles:	4.0 sq. mm (Cu)	10 sq.mm (Al)
First receptacles to looping other receptacles:	4.0 sq. mm (Cu)	10 sq.mm (Al)
In case of only one receptacles in ckt., Panel to receptacles:	4.0 sq. mm (Cu)	10 sq.mm (Al)
Panel/ JB's to flood light fixtures:	2 x 2.5 sq. mm (Cu)	2.5 sq. mm (Cu)

ADDITIONAL TECHNICAL DETAILS

8.0 EARTHING

Earthing of lighting system will be done by using of following sizes of wire / flat:

Lighting Distribution Board: GS Flat 50x6 mm

Lighting Panels: GS Flat 25x6 mm

Lighting fixtures, receptacles, conduits, junction boxes & switch boxes: 14 SWG GI wire

Welding receptacles: GS Flat 50x6 mm

Street light pole/ flood light pole and High mast: GS Flat 50x6 mm

Electrode for Pole/ High mast earthing: 2 nos, 40 mm dia MS rod, 3 mtr long

9.0 STATUTORY & REGULATORY REQUIREMENT

Statutory and regulatory regulation shall be applicable as per Indian Electricity Rule, 1956 with amendment-3 Rule no. 35, 48, 49, 50, 61 & 64 for illumination & low voltage power services.

ADDITIONAL TECHNICAL DETAILS

AVERAGE LUX LEVEL & TYPE OF FIXTURES

S. No.	LOCATION	AVERAGE LUX LEVEL	TYPE OF LIGHTING FIXTURES
01	TG Hall operating floors	200	High bay LED Luminaire
02	TG hall ground, mezzanine floor	200	LED High/ Medium bay, LED well glass fixture
03	Switchgear/ Charger rooms	200	Energy Efficient LED TL
04	Central control room	350	LED luminaire equivalent to Mirror optics with anti glare features type/ downlighter
05	Office areas, Conference rooms	300	Decorative mirror optics LED Luminaire/ LED Downlighter
06	Service Building	200	LED, Decorative recessed/surface mounted type LED.
7	UPS/Operator Room	200	Energy Efficient LED TL
8	Battery rooms	100	Industrial corrosion proof energy efficient LED.
9	Cable Vault	50	Energy efficient LED TL
10	Transformer yard	20 (General),50 (on equipment)	Flood light/dust proof integral well glass type LED.
11	DG room	150	LED medium bay/ industrial type LED luminaire.
12	AC plant/ Air washer room	200	LED luminaire, Totally enclosed vapour proof clear acrylic
13	Street lighting/ Perpherial Lighting	20(Primary), 10 (Secondary)	LED street lights
14	Corridors walk ways, staircase, toilets, wash rooms etc	50	LED Luminaire, industrial type
15	Toilet Wash room etc.	70	LED Luminaire, industrial type
16	CPU Regeneration Building	150	LED, high bay, industrial type.

- Note:**
- 1) The fixture will be suitable for Division-2, Group IIA/IIB of hazardous area as per IS-2148.
 - 2) Decorative type fixtures will be provided for false ceiling areas.
 - 3) For DC lighting & Hazardous areas LED type luminaries shall be used.
 - 4) Medium bay light shall be used if mounting height vary from 5Mtr to 8Mtr

ADDITIONAL TECHNICAL DETAILS

LIGHTING & LV POWER SERVICES IN DIFFERENT AREAS

S. No.	AREA	ACN	ACE	DCE	5/15A Socket	20A Socket	63/125A Socket	ELU \$
1	TG building	Y	Y	Y	Y*	Y	Y	-
2	Transformer Yard	Y	Y	-	-	Y	Y	-
3	DG room	Y	Y	-	-	Y	Y	Y
4	CPU regeneration area	Y	-	-	Y*	Y	Y	Y
5	Outdoor area	Y	-	-	-	Y	Y	-
6	Service Building	Y	-	-	Y*	Y	-	Y

LEGEND:

ACN:	AC Normal Lighting
ACE:	AC Emergency Lighting
DCE:	DC Emergency Lighting (CFL shall be used)
Y:	YES
Y*:	YES, Only in control room, offices & toilets
\$:	Emergency Lighting Unit (ELU) & 5/15A Switch socket for ELU



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

4X250 MW THDC KHURJA-TG

SPECIFICATION NO. PE-TS-475-558-E006

VOLUME II

SECTION - I

REVISION 0 | DATE:

SHEET 1 OF 8

DATA SHEET –A

S. No.	Description	Unit	Value
1.0	SYSTEM DESIGN DATA		
1.1	Design ambient	°C	50
1.2	AC Supply		
a)	Rated voltage	V	415
b)	Rated frequency	Hz	50
c)	Voltage variation (permissible)	%	+10% to -10%
d)	Frequency variation (permissible)	%	+3% to -5%
e)	Combined voltage & frequency variation (sum of absolutes permissible)	%	10%
f)	System fault level & duration	kA, sec.	50kA for 1 sec.
1.3	DC Supply		
a)	Rated voltage	V	220
b)	Voltage variation (permissible)	%	+10% to -15%
c)	System fault level & duration	kA, sec.	25kA for 1 sec.
2.0	SCOPE OF SYSTEM DESIGN ENGINEERING		Included in vendor's scope
3.0	Lighting Concept		
3.1	Types of supplies considered (other than AC Normal)		
a)	AC emergency		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
b)	DC emergency		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
c)	DC Normal		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
3.2	Diversity Factor for Sockets	%	25%
4.0	LUMINAIRES, LAMPS & ACCESSORIES		
4.1	Type of false ceiling for recessed fluorescent luminaire		Grid False ceiling (600mm X 600mm) / Aluminium false ceiling (for Control Room).
4.2	Degree of protection for drip proof luminaires		Outdoor : Min IP65 and weather proof



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

4X250 MW THDC KHURJA-TG

SPECIFICATION NO. PE-TS-475-558-E006

VOLUME II

SECTION - I

REVISION 0 | DATE:

SHEET 2 OF 8

			Indoor : Surface / pendant mounting : IP54 Recess mounting (false ceiling): IP20.
4.3	Flame proof luminaires		
a)	Hazardous area classification		NOT APPLICABLE
b)	Degree of protection		
c)	Mounting type for well glass		
4.4	Non-integral controlgear box for HPMV/HPSV lamps		
a)	Material		[] CRCA sheet steel [√] Cast Aluminium LM6
b)	Sheet thickness	mm	[] 2 for CRCA sheet [√] 3 for Cast Aluminium LM6
c)	Degree of protection		IP55
d)	Surface treatment		[√] Powder coated [] Galvanized
e)	If galvanized		NOT APPLICABLE
	Process		-
	Weight of zinc	g/m ^{2ma}	-
f)	If painted		
	Paint shade		RAL 9002
	Minimum paint thickness (DFT)	micron	50
4.5	Lamps		
a)	Type of Fluorescent Lamps (if applicable)		[√] Cool Daylight [√] White Light
4.6	Emergency Lighting Unit		
a)	Lamp type		[] FLT [] CFL [√] LED
b)	Nos. of Lamp		2
c)	Lamp wattage	W	6
d)	Lumen output of lamp at rated voltage	Lumen	To furnished by Vendor.
e)	Type of battery (Rechargeable type)		[√] Ni-Cd [] Lead-Acid [] Li-Ion
f)	AH capacity of battery	AH	To furnished by Vendor.
g)	Battery voltage	V	9



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

4X250 MW THDC KHURJA-TG

SPECIFICATION NO. PE-TS-475-558-E006

VOLUME II

SECTION - I

REVISION 0 | DATE:

SHEET 3 OF 8

h)	Battery backup time	Hr	4
i)	In built charger		Yes
4.7	Exit Sign		
a)	Lamp type		LED
b)	Nos. of Lamp		1
c)	Lamp wattage	W	20
d)	Lumen output of lamp at rated voltage	Lumen	To furnished by Vendor.
e)	Type of battery		<input checked="" type="checkbox"/> Ni-Cd <input type="checkbox"/> Lead-Acid <input type="checkbox"/> Li-Ion
f)	AH capacity of battery	AH	To furnished by Vendor.
g)	Battery voltage	V	To furnished by Vendor.
h)	Battery backup time	Hr	0.5
5.0	Junction Box		
a)	Enclosure material		Thermoplastic / thermosetting / FRP type.
b)	Enclosure thickness	mm	3.0 mm thickness minimum
c)	Galvanized (applicable for CRCA sheet)		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
d)	Degree of protection		IP-55 for indoor area & IPW-55 for outdoor area
6.0	Industrial/ Welding Receptacle		
a)	Enclosure material		<input checked="" type="checkbox"/> MS sheet & hot dip galvanised / Die cast aluminium alloy / CRCA sheet steel with electrostatic powder coating
b)	Enclosure thickness	mm	2 mm (min) for MS sheet & hot dip galvanised / 2.5 mm (min) for die cast aluminium alloy / 2 mm (min) for CRCA sheet steel with electrostatic power coating
c)	Surface treatment		As mentioned in 6.0 (a)
d)	If galvanized		
	Process		Hot dip
	Weight of zinc	g/m ²	460 gm / mm ² (65 microns)
e)	If painted		NOT APPLICABLE
	Paint shade		



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

4X250 MW THDC KHURJA-TG

SPECIFICATION NO. PE-TS-475-558-E006

VOLUME II

SECTION - I

REVISION 0 | DATE:

SHEET 4 OF 8

	Minimum paint thickness (DFT)	micron	
f)	Degree of protection		IP-55
7.0	Decorative Receptacle		
a)	Enclosure material		[] Cast aluminium alloy [√] MS Sheet
b)	Enclosure thickness	mm	[] 2 for cast aluminium alloy [√] 2 for MS sheet
c)	Surface treatment		[] Painted [√] Galvanized/ Electro-plated
d)	If galvanized		
	Process		Hot dip
	Weight of zinc	g/m ²	460 gm / mm ² (65 microns)
e)	If painted		NOT APPLICABLE
	Paint shade		
	Minimum paint thickness	micron	
f)	Degree of protection		IP-55
9.0	Switch Box		
a)	Enclosure material		[] FRP [√] MS Sheet.
b)	Enclosure thickness	mm	1.6mm MS sheet with 3mm thick decorative, Perspex cover.
c)	Galvanized		[√] Yes [] No
d)	Painted		[] Yes [√] No
d)	Degree of protection		IP-55
10.0	Conduit (Flexible)		
a)	Type		[√] TERNE coated conduit [] Lead coated
b)	Size	mm	20
c)	Standard length	m	25 to 50
d)	Thickness of Galvanization	microns	
5.13	Cable Glands		By vendor for all incoming and outgoing cables
a)	Type		[√] Double compression [] Single compression
b)	Material		Brass



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

4X250 MW THDC KHURJA-TG

SPECIFICATION NO. PE-TS-475-558-E006

VOLUME II

SECTION - I

REVISION 0 | DATE:

SHEET 5 OF 8

c)	Nickel Plating provided		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
d)	Flameproof glands with flameproof equipment		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5.14	Cable Lugs		By vendor for all incoming and outgoing cables
a)	Type		Crimping type/ ring type
b)	Material		Tinned copper
12.0	LADDERS		
a)	Type		<input type="checkbox"/> Free standing <input type="checkbox"/> wheel mounted <input checked="" type="checkbox"/> both
b)	Material		<input type="checkbox"/> Steel <input checked="" type="checkbox"/> Aluminium
c)	Duty		<input type="checkbox"/> Heavy <input checked="" type="checkbox"/> Medium
d)	Surface treatment		<input checked="" type="checkbox"/> Galvanised <input type="checkbox"/> Painted
e)	Reference Standard		IS: 4571, 3696

Note:

1. Detailed luminaire and lamp data shall be placed by vendor after award of contract.
2. Galvanization wherever applicable shall be hot dip galvanized with weight of Zinc as 460g/m² (65micron).



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

4X250 MW THDC KHURJA-TG

SPECIFICATION NO. PE-TS-475-558-E006

VOLUME II

SECTION - I

REVISION 0 | DATE:

SHEET 6 OF 8

LIST OF APPLICABLE STANDARDS

ILLUMINATION

Code of practice for interior illumination	IS 3646
Code of practice for industrial lighting	IS 6665
Code of practice for lighting of public thoroughfare	IS 1944

LUMINAIRES

Luminaires	IS 10322
Industrial luminaires with metal reflector	IS 1777
Industrial lighting fittings with plastic reflectors	IS 3287
Decorative lighting outfits	IS 5077
Waterproof electric lighting fittings	IS 3528
Watertight electric lighting fittings	IS 3553
Dust-proof electric lighting fittings	IS 4012
Dust-tight electric lighting fittings	IS 4013
Flameproof electric lighting fittings - well glass & bulk head types	IS 2206
Electric lighting fittings for division 2 areas	IS 8224
General & Safety requirement of Luminaire	IS 1913
General Lighting. LEDs and LED modules Terms and definitions	IS 16101
Self Ballasted LED Lamps for General Lighting Services.	IS 16102
LED modules for General lighting Safety Requirements.	IS 16103
Lamp control gear Part 2 particular	IS 15885(Part 2)
Requirements d.c. or a.c. Supplied Electronic control gear for LED modules	IS 16104

LAMPS

Tungsten filament lamps for domestic and similar general lighting purpose	IS 418
Tubular fluorescent lamps for general lighting service	IS 2418
High pressure mercury vapour lamps	IS 9900
High pressure sodium vapour lamps	IS 9974

LUMINAIRE COMPONENTS



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-TS-475-558-E006

VOLUME II

SECTION - I

4X250 MW THDC KHURJA-TG

REVISION 0 | DATE:

SHEET 7 OF 8

Ballast for fluorescent lamps for switch start circuits	IS 1534
Ballast for high pressure mercury vapour lamps	IS 15882
Capacitors for use in tubular fluorescent high pressure mercury and low pressure sodium vapour discharge lamp circuits	IS 1569
Bi-pin lamp holders for tubular fluorescent lamps	IS 3323
Methods of measurement of lamp cap temperature rise	IS 8913
Starters for fluorescent lamps	IS 2215
Holders for starters for tubular fluorescent lamps	IS 3324
Cast acrylic sheets for use in luminaires	IS 7569

ASSEMBLED EQUIPMENT AND COMPONENTS

Low voltage switchgear and controlgear.	IS 60947
Code of practice for selection, installation & maintenance of switchgear & control gear	IS 10118
Explosive atmospheres	IS 60079
Classification of hazardous areas for electrical installations	IS 5572
Dry type transformers	IS 11171
Electrical Accessories - circuit breakers for over protection for household and similar installations	IS 60898
Low voltage Fuses for voltages not exceeding 1000 V ac or 1500 V dc	IS 13703
Indicator lamps (visual)	IS 1901

POLES, SOCKETS AND OTHER MISCELLANEOUS

Plugs and socket outlets of rated voltage upto and including 250 volts and rated current upto and including 16 amperes	IS 1293
Interlocking switch socket outlet	IS 4160
Electric ceiling type fans and regulators	IS 374
Structural steel (Standard quality)	IS 2062
Danger notice plates	IS 2551
Enclosures for accessories for household and similar fixed electrical installations	IS 14772
General construction in steel - Code of practice	IS 800
Wrought aluminium and aluminium alloy bars, rods, tubes and sections for electrical purposes	IS 5082
Code of practice for phosphating of iron and steel	IS 6005



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

4X250 MW THDC KHURJA-TG

SPECIFICATION NO. PE-TS-475-558-E006

VOLUME II

SECTION - I

REVISION 0 | DATE:

SHEET 8 OF 8

Colour for ready mixed paints & enamels	IS 5
Recommended practice for hot dip galvanising of iron & steels 2629	
Method of testing uniformity of coating on zinc coated articles	IS 2603
Flexible steel conduits for electrical wiring	IS 3480
Conduits for electrical installations	IS: 9537
Scaffolds & ladders - Code of safety	IS: 3696
Aluminium extension ladders	IS: 4571
General Requirement for enclosures for accessories for household & similar fixed electrical installations	IS: 5133

2X660 MW THDC KHURJA- TG

DATA SHEET - B

SL. NO.	DESCRIPTION	MEASURED ELECTRICAL INPUT POWER (W) MAX. VALUE	TOTAL LUMINOUS FLUX (LUMEN) OF LUMINAIRE - MIN. VALUE	MAKE OF LUMINAIRE
	MAIN SUPPLY ITEMS			
1.0	Lighting Luminaires (complete with accessories)			REFER BELOW NOTE 2&3
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
1.10				
1.11				
1.12				
1.13				

NOTE :

- 1 Bidder to fill details of luminaires as per parameters mentioned above and furnish Data Sheet - B as per sl. no. 2 & 3 below.
- 2 Lighting designer shall furnish the make of above mentioned luminaires along with the MOU as per technical PQR prior to the placement of order.
- 3 Luminaire manufacturer shall furnish the make of above mentioned luminaires prior to the placement of order.

ANNEXURE A

STATION LIGHTING SYSTEM (Proposed List of Sub vendor)								
S.no.	ITEM CODE	ITEM/SERVICE DESCRIPTION	SL NO.	VENDOR CODE	VENDOR NAME	ADDRESS	PHONE	REMARKS
1	ES1	AC CONTACTORS	1	S01	SIEMENS	RC-IN I S NR DEL AREA, JIL BUILDING, TOWER-B, PLOT NO. 78, SECTOR 18, GURGAON-122015, INDIA	0124-2842000, 9873424331 amit.bhadauria@siemens.com	
		AC CONTACTORS	2	A35	GE-POWER	KAMAK TOWER, 3RD FLOOR, PLOT NO. 12-A, TVK INDUSTRIAL ESTATE, EKKADUTHANGAL, GUINDY, CHENNAI-600032	044-49681447	
		AC CONTACTORS	3	E1144	TELEMECHANIQUE/ SCHNEIDER ELECTRIC INDIA PVT. LTD.	9TH FLOOR, BLDG. NO. 10, TOWER-C, DLF CYBER CITY, PH-II, GURGAON-122002	0124-3940400	TAKEN OVER BY SCHNEIDER
		AC CONTACTORS	4	L01	L&T	32, SHIVAJI MARG, P.O. BOX- 6223, NEW DELHI-110015	011-41419554/59	
		AC CONTACTORS	5	B04	BCH	20/4, MATHURA ROAD, FARIDABAD, HARYANA-121006	0129-4293000	
2	ES3	AC MCCB	1	C01	C&S ELECTRIC LTD.	222, OKHLA IND. ESTATE, PH-III, NEW DELHI-110020	011-3088 7520-29	
		AC MCCB	2	S03	SCHNEIDER ELECTRIC INDIA PVT. LTD.	9TH FLOOR, BLDG. NO. 10, TOWER-C, DLF CYBER CITY, PH-II, GURGAON-122002	0124-3940400	
		AC MCCB	3	S01	SIEMENS	RC-IN I S NR DEL AREA, JIL BUILDING, TOWER-B, PLOT NO. 78, SECTOR 18, GURGAON-122015, INDIA	0124-2842000, 9873424331 amit.bhadauria@siemens.com	
		AC MCCB	4	A35	GE-POWER	KAMAK TOWER, 3RD FLOOR, PLOT NO. 12-A, TVK INDUSTRIAL ESTATE, EKKADUTHANGAL, GUINDY, CHENNAI-600032	044-49681447	
		AC MCCB	5	L01	L&T	32, SHIVAJI MARG, P.O. BOX- 6223, NEW DELHI-110015	011-41419554/59	
		AC MCCB	6	C02	CROMPTON GREAVES	RAIL TRANSPORTATION SYSTEMS,VANDANA BUILDING, 11, TOLSTOY MARG, TOLSTOY MARG, NEW DELHI, DL 110001	011 3041 6300	
3	ES11	CABLE GLANDS	1	E1201	ALLIED TRADERS & EXPORTERS	C-124 A, SECTOR-2, NOIDA -201 301, UTTAR PRADESH, INDIA	Mr. Vijay Mohan Sood +(91)-(120)-2525694 +(91)-(120)-3052594 +(91)-(11)-23287156 vijay_mohansood@yahoo.com	
		CABLE GLANDS	2	E1017	ARUP ENGG & FOUNDRY WORKS	391/119,PRINCE ANWAR SHAH ROAD, CALCUTTA-700068	033 2473 0850	
		CABLE GLANDS	3	E1206	BALIGA LIGHTING EQPT.PVT.LTD.	63A,CP RAMASWAMY ROAD, ALWARPET,P.B.No 6910, CHENNAI-600018	44-24995505,22680990-4	
		CABLE GLANDS	4	E1036	COMMET BRASS PRODUCTS	NUTAN CHEMICAL COMPOUND, WALBHAT ROAD, GOREGAON, MUMBAI-400063	91-022-26852961/62/63 comet@vsnl.net	
		CABLE GLANDS	5	DW08	DOWELLS	M/S. DOWELLS ELECTRICALS 47/47A, SATGURU INDUSTRIAL ESTATE. OFF AAREY ROAD, GOREGOAN (EAST). MUMBAI 400 063.	CEO : Mr. Jayantibhai S. Patel TEL: 022-32504770./022- 29270876/ 022-29270878.	
		CABLE GLANDS	6	E1044	ELECTROMAC INDUSTRIES	27/28AF NEW EMPIRE IND.ESTT., R.KRISHNA MANDIR RD.JB NGR ,ANDHERI(E),MUMBAI- 400059	91-22-28324829 / 66919034 devang@electromacglands.com	
		CABLE GLANDS	7	I01	INCAB	HARE STREET,KOLKATA, WEST BENGAL-700001	91-33-2480161/62/63/64 Fax : 91-33-2485766	
4	ES12	CABLE LUGS	1	E1040	DOWELLS	M/S. DOWELLS ELECTRICALS 47/47A, SATGURU INDUSTRIAL ESTATE. OFF AAREY ROAD, GOREGOAN (EAST).	CEO : Mr. Jayantibhai S. Patel TEL: 022-32504770./022- 29270876/	
		CABLE LUGS	2	E1149	UNIVERSAL MACHINES LTD.	4,B.B.D.BAG (EAST) 90,STEPHEN HOUSE,5TH FLR CALCUTTA-700001	033 2282 2540	
5	ES16	GI CONDUITS	BIS APPROVED MAKE					
6	ES17	GI CONDUIT (EPOXY PAINTED)	BIS APPROVED MAKE					
7	ES18	FLEXIBLE CONDUITS (LEAD COATED)	1	P03	PLICA INDIA PVT. LTD.	V.P.AGARWAL MANAGING DIRECTOR, PLICA INDIA PVT. LTD. 149, MODEL TOWN EAST GHAZIABAD - 201009	M - 9810052131 / 0120-4563979 / 9810557567 Mail: agr@plicaindia.com	
8	ES19	FLEXIBLE CONDUIT (PVC COATED)	REPUTED MAKE					
		CONTROL SWITCHES/ SELECTOR SWITCH	1	E1076	KAYCEE	KAYCEE INDUSTRIES LTD., C/O-CMS COMPUTERS LTD., 35A, REAR BLDG., KILOKARI, NEW DELHI-110014	Rajiv Sharma-9312004687	

S.no.	ITEM CODE	ITEM/SERVICE DESCRIPTION	SL NO.	VENDOR CODE	VENDOR NAME	ADDRESS	PHONE	REMARKS
9	ES21	CONTROL SWITCHES/ SELECTOR SWITCH	2	A35	GE-POWER	KAMAK TOWER, 3RD FLOOR, PLOT NO. 12-A, TVK INDUSTRIAL ESTATE, EKKADUTHANGAL, GUINDY, CHENNAI-600032	044-49681447	
		CONTROL SWITCHES/ SELECTOR SWITCH	3	G01	ALSTOM LTD	A-7, SEC-65, NOIDA	0120-479000	
		CONTROL SWITCHES/ SELECTOR SWITCH	4	S03	SCHNEIDER ELECTRIC INDIA PVT. LTD.	9TH FLOOR, BLDG. NO. 10, TOWER-C, DLF CYBER CITY, PH-II, GURGAON-122002	0124-3940400	
		CONTROL SWITCHES/ SELECTOR SWITCH	5	SRC01	M/s Shrenik & Co.	39A/3, PANCHRATNA INDUSTRIAL ESTATE, SARKHEJ-BAVLA ROAD, CHANGODAR,		
		CONTROL SWITCHES/ SELECTOR SWITCH	6	RE05	RECOM PVT. LTD.	M/S RECOM PVT. LTD., 16A , 2ND FLOOR A, WING RAJ INDUSTRIAL COMPLEX, MILITARY	Mr. Chandrashekar Kamath (MD) : 09820249503	
10	ES27	EMER. PORTABLE LTG. SET	1	B05	BAJAJ ELECTRICALS	BAJAJ ELECTRICALS LTD. ENGINEERING & PROJECTS BU (NORTH) 3rd FLOOR, GULMOHARHOUSE, COMMUNITY CENTRE 161/B-4, GAUTAM NAGAR, YUSUF SARAI NEW DELHI – 110049	CONTACT PERSON : Mr. S. SREEMANY. SR. MANAGER (PROJECTS) CONTACT DETAILS : (+91) 9871025705. MAIL ID : srabans@bajajelectricals.com;	
		EMER. PORTABLE LTG. SET	2	B05	BAJAJ ELECTRICALS	BAJAJ ELECTRICALS LTD. ENGINEERING & PROJECTS BU (NORTH) 3rd FLOOR, GULMOHARHOUSE, COMMUNITY CENTRE 161/B-4, GAUTAM NAGAR, YUSUF SARAI NEW DELHI – 110049	SREEMANY. SR. MANAGER (PROJECTS) CONTACT DETAILS : (+91) 9871025705. MAIL ID : srabans@bajajelectricals.com;	
11	ES28	FUSE BASE	1	E1068	INDO ASIAN	B-24, PHASE - II , NOIDA - 201305, U.P.	120-3042222	
		FUSE BASE	2	G01	GE-POWER	KAMAK TOWER, 3RD FLOOR, PLOT NO. 12-A, TVK INDUSTRIAL ESTATE, EKKADUTHANGAL, GUINDY, CHENNAI-600032	044-49681447	
		FUSE BASE	3	L01	L&T	32, SHIVAJI MARG, P.O. BOX- 6223, NEW DELHI- 110015	011-41419554/59	
		FUSE BASE	4	C01	C&S ELECTRIC LTD.	222, OKHLA IND. ESTATE, PH-III, NEW DELHI- 110020	011-3088 7520-29	
		FUSE BASE	5	S01	SIEMENS	RC-IN I S NR DEL AREA, JIL BUILDING, TOWER-B, PLOT NO. 78, SECTOR 18, GURGAON-122015, INDIA	0124-2842000, 9873424331 ;amit.bhadauria@siemens.com	
		FUSE BASE	6	A24	ABB	14, MATHURA ROAD, FARIDABAD, HARYANA- 121003	0129-2567580, 09871799449	
		FUSE BASE	7	S02	SPACEAGE SWITCHGEARS LTD.	68 & 13-A INDUSTRIAL DEVELOPMENT COLONY, MEHRAULI ROAD GURGAON, HARYANA-122001	0124-2302711, 4085091	
		FUSE BASE	8	S03	SCHNEIDER ELECTRIC INDIA PVT. LTD.	9TH FLOOR, BLDG. NO. 10, TOWER-C, DLF CYBER CITY, PH-II, GURGAON-122002	0124-3940400	
		FUSE BASE	9	G01	ALSTOM LTD	A-7, SEC-65, NOIDA	0120-479 0000	
		FUSE BASE	10	E1050	ESSEN DEINKI	FLAT NO. 502, SKYLINE HOUSE 85, NEHRU PLACE NEW DELHI	011-26217060	
12	ES29	HRC FUSES	1	E1068	INDO ASIAN	B-24, PHASE - II , NOIDA - 201305, U.P.	120-3042222	
		HRC FUSES	2	G01	GE-POWER	KAMAK TOWER, 3RD FLOOR, PLOT NO. 12-A, TVK INDUSTRIAL ESTATE, EKKADUTHANGAL, GUINDY, CHENNAI-600032	044-49681447	
		HRC FUSES	3	L01	L&T	32, SHIVAJI MARG, P.O. BOX- 6223, NEW DELHI- 110015	011-41419554/59	
		HRC FUSES	4	C01	C&S ELECTRIC LTD.	222, OKHLA IND. ESTATE, PH-III, NEW DELHI- 110020	011-3088 7520-29	
		HRC FUSES	5	S01	SIEMENS	RC-IN I S NR DEL AREA, JIL BUILDING, TOWER-B, PLOT NO. 78, SECTOR 18, GURGAON-122015, INDIA	0124-2842000, 9873424331 ;amit.bhadauria@siemens.com	
		HRC FUSES	6	A24	ABB	14, MATHURA ROAD, FARIDABAD, HARYANA- 121003	0129-2567580, 09871799449	
		HRC FUSES	7	S02	SPACEAGE SWITCHGEARS LTD.	68 & 13-A INDUSTRIAL DEVELOPMENT COLONY, MEHRAULI ROAD GURGAON, HARYANA-122001	0124-2302711, 4085091	
		HRC FUSES	8	S03	SCHNEIDER ELECTRIC INDIA PVT. LTD.	9TH FLOOR, BLDG. NO. 10, TOWER-C, DLF CYBER CITY, PH-II, GURGAON-122002	0124-3940400	
		HRC FUSES	9	G01	ALSTOM LTD	A-7, SEC-65, NOIDA	0120-479 0000	
		HRC FUSES	10	E1050	ESSEN DEINKI	FLAT NO. 502, SKYLINE HOUSE 85, NEHRU PLACE NEW DELHI	011-26217060	
13	FS33	IND.POWER & WLDG SOCKETS	1	C02	CROMPTON GREAVES	3RD FLOOR, EXPRESS BUILDING,9-10, BAHADUR SHAH ZAFAR MARG, NEAR ITO CROSSING,NEW DELHI-110002, INDIA	91 11 23460700 - 999 'Sunil.Das@cgglobal.com	
		IND.POWER & WLDG SOCKETS	2	E1207	CYCLO ELECTRIC DEVICE & SERV.CO.	: A-3, NEAR ANTHEM BIOSCIENCE, KSSIDC INDUSTRIAL AREA, BOMMASANDRA, BOMMASANDRA INDUSTRIAL AREA, BANGALORE, KARNATAKA 560099	Mr. H.Jaishanker +919845039081, 080 - 27833102 , 080 - 27833103 : +91 80 41460985 'cycloelectric@gmail.com	

S.no.	ITEM CODE	ITEM/SERVICE DESCRIPTION	SL NO.	VENDOR CODE	VENDOR NAME	ADDRESS	PHONE	REMARKS
		IND.POWER & WLDG SOCKETS	3	B04	BCH	20/4, MATHURA ROAD, FARIDABAD - 121006, HARYANA, INDIA	0(129)-4063000, 9015800189(Ramesh Giri) ramesh.giri@bchindia.com	
		IND.POWER & WLDG SOCKETS	4	B02	BEST & CROMPTON	Best & Crompton Engineering Ltd	Ph : +91 44 4551 4724 , MRKT	BEST &
		IND.POWER & WLDG SOCKETS	5	A03	AJMERA INDUSTRIES & ENGG. WORKS	AJMERA INDL. AND ENGG. WORKS. AJMERA HOUSE, A-61 / KHAIRANE MIDC. , TTC INDL. AREA, NAVI MUMBAI – 400705.	Tel : 022 27620299 / 97 / 96 mail@ajmera.net	
14	ES35	INDICATING LAMPS	1	B04	BCH	20/4, MATHURA ROAD, FARIDABAD, HARYANA-121006	0129-4293000	
		INDICATING LAMPS	2	C01	C&S ELECTRIC LTD.	222, OKHLA IND. ESTATE, PH-III, NEW DELHI-110020	6832259,6918834-37	
		INDICATING LAMPS	3	E1050	ESSEN DEINKI	FLAT NO. 502, SKYLINE HOUSE 85, NEHRU PLACE NEW DELHI	011-26217060	
		INDICATING LAMPS	4	E1153	VAISHNO(HOTLINE SWGR.& CONTROL)	G-19, SECTOR - 11, NOIDA - 201301, UTTAR PRADESH, INDIA	8377805157 9818338922	
		INDICATING LAMPS	5	A35	GE-POWER	KAMAK TOWER, 3RD FLOOR, PLOT NO. 12-A, TVK INDUSTRIAL ESTATE, EKKADUTHANGAL, GUINDY, CHENNAI-600032	9818338922	
		INDICATING LAMPS	6	S01	SIEMENS	RC-IN I S NR DEL AREA, JIL BUILDING, TOWER-B, PLOT NO. 78, SECTOR 18, GURGAON-122015, INDIA	0124-2842000, 9873424331 amit.bhadauria@siemens.com	
		INDICATING LAMPS	7	S03	SCHNEIDER ELECTRIC INDIA PVT. LTD.	9TH FLOOR, BLDG. NO. 10, TOWER-C, DLF CYBER CITY, PH-II, GURGAON-122002	0124-3940400	
15	ES36	JUNCTION BOXES (NON FLAME PROOF)	1	J01	JASPER ENGINREES PVT. LTD.	A-23, SECTOR - 8, NOIDA-201301	0120-4033520/533	
		JUNCTION BOXES (NON FLAME PROOF)	2	EC05	Electro Controls & Devices	M/S ELECTRO CONTROLS & DEVICES, F-41, SITE-C, SURAJPUR INDUSTRIAL AREA GREATER NOIDA, UTTAR PRADESH :201308	Mr. Sanjay Sharma (Chief Promoter) 0120-2569487, 2560100,2560300	
		JUNCTION BOXES (NON FLAME PROOF)	3	SRC01	M/s Shrenik & Co.	39A/3, PANCHRATNA INDUSTRIAL ESTATE, SARKHEJ-BAVLA ROAD, CHANGODAR, AHMEDABAD – 382 213	020-026708100	
		JUNCTION BOXES (NON FLAME PROOF)	4	PME-01	M/s PHOENIX MECANO LTD.,	388 BHARE, TALUKA MULSHI, POST GHOTAWADE, PIRANGOOT, INDUSTRIAL AREA, PUNE-412115	Awasthi(09971119006) Tel: ++91 20 6674 5103, Mobile: +91 90499 95985, Fax: ++91 20 6674 5126	
		JUNCTION BOXES (NON FLAME PROOF)	5	ACE01	Adroit Control Engineers Pvt.Ltd.	M/S ADROIT CONTROL ENGINEERS PVT.LTD. PLOT-3, KRISHNA INDL. AREA, SECTOR-25 FARIDABAD – 121004	011-47600700, 0129-4251400	
		JUNCTION BOXES (NON FLAME PROOF)	6	PME-01	M/s PHOENIX MECANO LTD.,	388 BHARE, TALUKA MULSHI, POST GHOTAWADE, PIRANGOOT, INDUSTRIAL AREA, PUNE-412115	Awasthi(09971119006) Tel: ++91 20 6674 5103, Mobile: +91 90499 95985, Fax: ++91 20 6674 5126 contact person : Vishwa bandhu E-mail:d.gupta@pmipl-online.com ;admin@pmipl-online.com	
		JUNCTION BOXES (NON FLAME PROOF)	7	MK01	MIKA ENGINEERS	BRANCH OFFICE : 'D'-101, DHEERAJ HERITAGE RESIDENCY II, SHASTRI NAGAR, SANTACRUZ (W), MUMBAI 400 054.	Director : Mr. Asgar Karimi Email: asgar@mikaengineers.com E-mail : mika@mtnl.net.inTelfax : 022-26610081/82/83/84Tel : 02527-249066/70 Cell : 099230 74373	TYPE-S ONLY
		JUNCTION BOXES (NON FLAME PROOF)	8	PME-01	M/s PHOENIX MECANO LTD.,	388 BHARE, TALUKA MULSHI, POST GHOTAWADE, PIRANGOOT, INDUSTRIAL AREA, PUNE-412115	TEL.- +912066745000 Awasthi(09971119006) Tel: ++91 20 6674 5103, Mobile: +91 90499 95985, Fax: ++91 20 6674 5126 contact person : Vishwa bandhu E-mail:d.gupta@pmipl-online.com ;admin@pmipl-online.com	
		JUNCTION BOXES (NON FLAME PROOF)	9	B05	BAJAJ ELECTRICALS	BAJAJ ELECTRICALS LTD. ENGINEERING & PROJECTS BU (NORTH) 3rd FLOOR, GULMOHARHOUSE, COMMUNITY CENTRE 161/B-4, GAUTAM NAGAR, YUSUF SARAI NEW DELHI – 110049	CONTACT PERSON : Mr. S. SREEMANY. SR. MANAGER (PROJECTS) CONTACT DETAILS : (+91) 9871025705. MAIL ID : srabans@bajajelectricals.com;	
		JUNCTION BOXES (NON FLAME PROOF)	10	A03	AJMERA INDUSTRIES & ENGG. WORKS	AJMERA INDL. AND ENGG. WORKS. AJMERA HOUSE, A-61 / KHAIRANE MIDC. , TTC INDL. AREA, NAVI MUMBAI – 400705.	Tel : 022 27620299 / 97 / 96 mail@ajmera.net	

S.no.	ITEM CODE	ITEM/SERVICE DESCRIPTION	SL NO.	VENDOR CODE	VENDOR NAME	ADDRESS	PHONE	REMARKS
		JUNCTION BOXES (NON FLAME PROOF)	11	SB02	S.B. ELECTRICAL ENGINEERING CORPORATION	03, SARDAR GRIHA BUILDING, LOHAR CHAWAL, MUMBAI-400002	022- 22069831; 022-66637259	
		JUNCTION BOXES (NON FLAME PROOF)	12	RT13	RITTAL INDIA PVT. LTD.	Espire Building ,Level -1 A-41, Mohan Co-Operative Industrial Estate ,Mathura Road, New Delhi -110044	Amit Bansal Phone: 011-42004000, D: 011-42004033 · Mobile: +91 9717772245 · mailto:amit.b@rittal-india.com www.rittal-india.com	
		JUNCTION BOXES (NON FLAME PROOF)	13	HP08	HPL ELECTRIC AND POWER LTD.	Works Address: Village Shavella, PO:Jabli, Teh-Kasauli, Dist-Solan, Himachal Pradesh-173209	Mr. Ashwani Kumar mailto:'ashwani@hplindia.com' M:9971127370	
16	ES37	JUNCTION BOXES (FLAME PROOF)	1	SS01	SUDHIR SWITCHGEAR	305/6, APEEJAY HOUSE, 130, BOMBAY SAMACHAR MARG, MUMBAI - 400 023. INDIA	Telephone Nos. : 40460000 (100 lines) Fax Nos. : ++-91-22-22049381 Email : md@sudhirswitchgears.com ; works@sudhirswitchgears.com ; scud@vsnl.com	
17	ES39	LIGHTING FIXTURES (NON LED)	2	E1206	BALIGA LIGHTING EQPT PVT LTD	63A,CP RAMASWAMY ROAD, PB NO 6910, CHENNAI-600018	44-24995505,22680990-4	
		LIGHTING FIXTURES (NON LED)	3	F04	ELEXPRO ELECTRICALS PVT/ LTD.	C 1/27 & 37 GIDC KABILPORE NAVSARI-396424	02637-265140, Mr. Jssk kumar	
		LIGHTING FIXTURES (NON LED)	4	B05	BAJAJ ELECTRICALS	BAJAJ ELECTRICALS LTD. ENGINEERING & PROJECTS BU (NORTH) 3rd FLOOR, GULMOHARHOUSE, COMMUNITY CENTRE 161/B-4, GAUTAM NAGAR, YUSUF SARAI NEW DELHI – 110049	CONTACT PERSON : Mr. S. SREEMANY. SR. MANAGER (PROJECTS) CONTACT DETAILS : (+91) 9871025705. MAIL ID : srabans@bajajelectricals.com;	
		LIGHTING FIXTURES (NON LED)	5	C02	CROMPTON GREAVES	3RD FLOOR, EXPRESS BUILDING,9-10, BAHADUR SHAH ZAFAR MARG, NEAR ITO CROSSING,NEW DELHI-110002, INDIA	91 11 23460700 - 999 Sunil.Das@cgglobal.com, Mr. Prashant Wewhare 9930095703	
		LIGHTING FIXTURES (NON LED)	6	E1051	EVERGREEN ENGG. CO.	EVERGREEN ENGG COMPANY WORKS-5, PLOT NO. 9,10,11,12, SURVEY NO. 242, CHINCH PADA, VASAI EAST-401208	(0250) 6458250	
		LIGHTING FIXTURES (NON LED)	7	P01	PHILIPS	9TH FLOOR,DLF 9B, DLF CYBER CITY, DLF PHASE-III,GURGAON-122002	01244606001, Sharad (+919871150447)	
		LIGHTING FIXTURES (NON LED)	8	WP01	WIPRO LTD.	WIPRO CONSUMER CARE AND LIGHTING, 5TH FLOOR, GODREJ ETERNIA -C, OLD PUNE-MUMBAI ROAD, SHIVAJINAGAR, PUNE -411005	020-66098700	
		LIGHTING FIXTURES (NON LED)	9	HP01	M/S HPL ELECTRIC & POWER PVT. LTD	M/S HPL ELECTRIC & POWER PVT. LTD. PLOT NO. 76-B,PHASE-IV, SEC-57, HSIIDC, INDL. AREA , KUNDLI, DIST.- SONEPAT (HARYANA) - 131028	mohitsharma@hplindia.com'	
		LIGHTING FIXTURES (NON LED)	10	SR01	SURYA ROSHNI LIMITED	PADMA TOWER, RAJENDRA PLACE, RAJENDRA PLACE NEW DELHI	011-25810093 ; 9810071832 (Akhilesh Agrawal) aagrawal@sroshni.com	
		LIGHTING FIXTURES (NON LED)	11	HI02	HAVELLS INDIA LIMITED	QRG TOWERS , 2D SECTOR-126, NOIDA- 201301	GIRISH KUMAR SHRIVASTAVA +91-9810528922	
		LIGHTING FIXTURES (NON LED)	12	HN13	M/s Halonix Technologies Limited	M/s Halonix Technologies Limited B-31 , Phase –II, Noida Distt. Gautam Budh Nagar (U.P.) Pin- 201305	Mr. Mohit Gautam 'Tel: +919568152111 'mohit.gautam@halonix.co.in'; 'rahul.singh@halonix.co.in'	
				LIGHTING FIXTURES (LED)	1	NE01	Neev Luminaries	B-6/3 Okhla Industrial Area Phase-2 New Delhi 110020
		LIGHTING FIXTURES (LED)	2	HI01	HAVELLS INDIA LIMITED	QRG TOWERS , 2D SECTOR-126, NOIDA- 201301	GIRISH KUMAR SHRIVASTAVA +91-9810528922, girish.srivastava@havelis.com\	
		LIGHTING FIXTURES (LED)	3	B05	BAJAJ ELECTRICALS	BAJAJ ELECTRICALS LTD. ENGINEERING & PROJECTS BU (NORTH) 3rd FLOOR, GULMOHARHOUSE, COMMUNITY CENTRE 161/B-4, GAUTAM NAGAR, YUSUF SARAI NEW DELHI – 110049	CONTACT PERSON : Mr. S. SREEMANY. SR. MANAGER (PROJECTS) CONTACT DETAILS : (+91) 9871025705. MAIL ID : srabans@bajajelectricals.com;	
		LIGHTING FIXTURES (LED)	4	SR01	SURYA ROSHNI LIMITED		1 011-25810093 ; 9810071832 (Akhilesh Agrawal) aagrawal@sroshni.com	

S.no.	ITEM CODE	ITEM/SERVICE DESCRIPTION	SL NO.	VENDOR CODE	VENDOR NAME	ADDRESS	PHONE	REMARKS
18	ES40	LIGHTING FIXTURES (LED)	5	P01	PHILIPS	9TH FLOOR,DLF 9B, DLF CYBER CITY, DLF PHASE-III,GURGAON-122002	01244606001, Sharad (+919871150447), Mr. Guruseelan M 8939693949, Mr Ashish Sethi 9007077089	
		LIGHTING FIXTURES (LED)	6	HP01	M/S HPL ELECTRIC & POWER PVT. LTD	M/S HPL ELECTRIC & POWER PVT. LTD. PLOT NO. 76-B,PHASE-IV, SEC-57, HSIIDC, INDL. AREA , KUNDLI, DIST.- SONEPAT (HARYANA) - 131028	mohitsharma@hplindia.com, Mr. Nitesh Verma 8851036938, Mr Ajay lakra 9560045423	
		LIGHTING FIXTURES (LED)	7	INS1	INSTA POWER	PLOT NO. - 457 PHASE - V, UDYOG VIHAR, GURGAON - 122016	124-4124000, Mr amit Bhardwar: 8800508090	
		LIGHTING FIXTURES (LED)	8	PT13	Pyrotech Electronics Pvt. Ltd.	M/s Pyrotech Electronics Pvt. Ltd(Unit -1) Led Light, Sensor Division F-16A, Road No.3 Mewar Industrial Area, Madri Udaipur -313003, Rajasthan,	Concern Person – Mr. Praveen sisodiya : 9314310042(psisodiya@pyrotechlighting.com) Ms Ritika 9509245814	
		LIGHTING FIXTURES (LED)	9	HN13	M/s Halonix Technologies Limited	M/s Halonix Technologies Limited B-31 , Phase –II, Noida Distt. Gautam Budh Nagar (U.P.) Pin- 201305	Mr. Mohit Gautam 'Tel: +919568152111 'mohit.gautam@halonix.co.in'; M: 9891868793'rahul.singh@halonix.co.in'	
		LIGHTING FIXTURES (LED)	10	JA13	M/s JAQUAR & COMPANY PVT. LTD.	M/s JAQUAR & COMPANY PVT. LTD. Plot No.3 , Sector M-11, IMT Manesar. Gurgaon- 122050 Haryana	Mr. Dhruv Kumar 'Tel: +919350043727 dhruv.kumar@jaquar.com ; gaurav.bhalla@jaquar.com : 9582950282	
		LIGHTING FIXTURES (LED)	11	CR13	M/s CROMPTON GREAVES CONSUMER ELECTRICALS LTD.	M/s CROMPTON GREAVES CONSUMER ELECTRICALS LTD.Tower-3, 1st Floor, East Wing Equinox Business Park LBS Marg, Kurla (West), Mumbai-400070	Mr S L Sivakumar 'Sivakumar L' <sivakumar.sl@crompton.co.in> M: 9176609363	
		LIGHTING FIXTURES (LED)	12	WI13	M/s WIPRO ENTERPRISES PRIVATE LTD.	M/s WIPRO ENTERPRISES PRIVATE LTD. L-8, MIDC Waluj, Aurangabad-431136, Maharashtra, India	Ms Dhanya K K 'dhanya.kk8@wipro.com' M 9891815476, Mr Puneet kalia 'puneet.kalia@wipro.com'	
19	ES41	LIGHTING FIXTURES (FLAME PROOF)	1	HI01	HAVELLS INDIA LIMITED	QRG TOWERS , 2D SECTOR-126, NOIDA- 201301	GIRISH KUMAR SHRIVASTAVA +91-9810528922	
		LIGHTING FIXTURES (FLAME PROOF)	2	B05	BAJAJ ELECTRICALS	BAJAJ ELECTRICALS LTD. ENGINEERING & PROJECTS BU (NORTH) 3rd FLOOR, GULMOHARHOUSE, COMMUNITY CENTRE 161/B-4, GAUTAM NAGAR, YUSUF SARAI NEW DELHI – 110049	CONTACT PERSON : Mr. S. SREEMANY. SR. MANAGER (PROJECTS) CONTACT DETAILS : (+91) 9871025705. MAIL ID : srabans@bajajelectricals.com;	
		LIGHTING FIXTURES (FLAME PROOF)	3	E1206	BALIGA ELECTRICALS	63A,CP RAMASWAMY ROAD, PB NO 6910, CHENNAI-600018	44-24995505,22680990-4	
20	ES42	LIGHTING LAMP (NON LED)	1	WP01	WIPRO LTD.	WIPRO CONSUMER CARE AND LIGHTING, 5TH FLOOR, GODREJ ETERNAI -C, OLD PUNE-	020-66098700	
		LIGHTING LAMP (NON LED)	2	E1050	ESSEN DEINKI	FLAT NO. 502, SKYLINE HOUSE 85, NEHRU PLACE NEW DELHI	9818338922	
		LIGHTING LAMP (NON LED)	3	B05	BAJAJ ELECTRICALS	BAJAJ ELECTRICALS LTD. ENGINEERING & PROJECTS BU (NORTH) 3rd FLOOR, GULMOHARHOUSE, COMMUNITY CENTRE 161/B-4, GAUTAM NAGAR, YUSUF SARAI NEW DELHI – 110049	CONTACT PERSON : Mr. S. SREEMANY. SR. MANAGER (PROJECTS) CONTACT DETAILS : (+91) 9871025705. MAIL ID : srabans@bajajelectricals.com;	
		LIGHTING LAMP (NON LED)	4	INS1	INSTA POWER	PLOT NO. - 457 PHASE - V, UDYOG VIHAR, GURGAON - 122016	124-4124000	
		LIGHTING LAMP (NON LED)	5	P01	PHILIPS	9TH FLOOR,DLF 9B, DLF CYBER CITY, DLF PHASE-III,GURGAON-122002	01244606001, Sharad (+919871150447)	
		LIGHTING LAMP (NON LED)	6	HI01	HAVELLS INDIA LIMITED	QRG TOWERS , 2D SECTOR-126, NOIDA- 201301	GIRISH KUMAR SHRIVASTAVA +91-9810528922	
		LIGHTING LAMP (NON LED)	7	HP01	HPL	M/S HPL ELECTRIC & POWER PVT. LTD. PLOT NO. 76-B,PHASE-IV, SEC-57, HSIIDC, INDL. AREA , KUNDLI, DIST.- SONEPAT (HARYANA) - 131028	mohitsharma@hplindia.com'	
		LIGHTING LAMP (NON LED)	8	SR01	SURYA ROSHNI LIMITED	PADMA TOWER, RAJENDRA PLACE, RAJENDRA PLACE NEW DELHI	011-25810093 ; 9810071832 (Akhilesh Agrawal) aagrawal@sroshni.com	
		LIGHTING LAMP (NON LED)	9	HN13	M/s Halonix Technologies Limited	M/s Halonix Technologies Limited B-31 , Phase –II, Noida Distt. Gautam Budh Nagar (U.P.) Pin- 201305	Mr. Mohit Gautam 'Tel: +919568152111 'mohit.gautam@halonix.co.in'; 'rahul.singh@halonix.co.in'	

S.no.	ITEM CODE	ITEM/SERVICE DESCRIPTION	SL NO.	VENDOR CODE	VENDOR NAME	ADDRESS	PHONE	REMARKS
21	ES43	LIGHTING LAMP (LED)	1	NE01	Neev Luminaries	D-115 , OKHLA INDUSTRIAL AREA, PHASE-1 NEW DELHI – 110020	Phone: +91 11 4060 4830 Fax: +91 11 4060 4831 info@neevenergy.in	
		LIGHTING LAMP (LED)	2	HI01	HAVELLS INDIA LIMITED	QRG TOWERS , 2D SECTOR-126, NOIDA- 201301	GIRISH KUMAR SHRIVASTAVA +91-9810528922	
		LIGHTING LAMP (LED)	3	B05	BAJAJ ELECTRICALS	BAJAJ ELECTRICALS LTD. ENGINEERING & PROJECTS BU (NORTH) 3rd FLOOR, GULMOHARHOUSE, COMMUNITY CENTRE 161/B-4, GAUTAM NAGAR, YUSUF SARAI NEW DELHI – 110049	CONTACT PERSON : Mr. S. SREEMANY. SR. MANAGER (PROJECTS) CONTACT DETAILS : (+91) 9871025705. MAIL ID : srabans@bajajelectricals.com;	
		LIGHTING LAMP (LED)	4	SR01	SURYA ROSHNI LIMITED	PADMA TOWER, RAJENDRA PLACE, RAJENDRA PLACE NEW DELHI	011-25810093 ; 9810071832 (Akhilesh Agrawal) aagrawal@sroshni.com	
		LIGHTING LAMP (LED)	5	P01	PHILIPS	9TH FLOOR,DLF 9B, DLF CYBER CITY, DLF PHASE- III,GURGAON-122002	01244606001, Sharad (+919871150447)	
		LIGHTING LAMP (LED)	6	HP01	M/S HPL ELECTRIC & POWER PVT. LTD	M/S HPL ELECTRIC & POWER PVT. LTD. PLOT NO. 76-B,PHASE-IV, SEC-57, HSIIDC, INDL. AREA , KUNDLI, DIST.- SONEPAT (HARYANA) - 131028	mohitsharma@hplindia.com	
		LIGHTING LAMP (LED)	7	INS1	INSTA POWER	PLOT NO. - 457 PHASE - V, UDYOG VIHAR, GURGAON - 122016	124-4124000	
		LIGHTING LAMP (LED)	8	PT13	Pyrotech Electronics Pvt. Ltd.	M/s Pyrotech Electronics Pvt. Ltd.(Unit -1) Led Light, Sensor Division F-16A, Road No.3 Mewar Industrial Area, Madri Udaipur -313003, Rajasthan,	Concern Person – Mr. Praveen sisodiya (psisodiya@pyrotechlighting.com) Ankit Kumar Sr. Engineer(North Region -Sales & Marketing) # +91- 7340061769, 8287897309	
		LIGHTING LAMP (LED)	9	HN13	M/s Halonix Technologies Limited	M/s Halonix Technologies Limited B-31 , Phase –II, Noida Distt. Gautam Budh Nagar (U.P.) Pin- 201305	Mr. Mohit Gautam 'Tel: +919568152111 'mohit.gautam@halonix.co.in'; 'rahul.singh@halonix.co.in'	
22	ES45	LIGHTING SWITCH , SOCKET & S/F UNIT	1	F04	ELEXPRO ELECTRICALS PVT/ LTD.	C 1/27 & 37 GIDC KABILPORE NAVSARI-396424	02637-265140, Mr. Jssk kumar	
		LIGHTING SWITCH , SOCKET & S/F UNIT	2	E1012	ANCHOR	STEEL HOUSE, B WING, PLOT NO. 24, MAHAL INDUSTRIAL ESTATE, MAHAKALI CAVES ROAD, NEAR PAPER BOX, ANDHERI (E), MUMBAI, MAHARASHTRA.- 400093	022-30418888.	
		LIGHTING SWITCH , SOCKET & S/F UNIT	3	E1076	KAYCEE	KAYCEE INDUSTRIES LTD. , C/O-CMS COMPUTERS LTD. , 35A, REAR BLDG. , KILOKARI, NEW DELHI-110014	Rajiv Sharma-9312004687	
		LIGHTING SWITCH , SOCKET & S/F UNIT	4	L01	L&T	32, SHIVAJI MARG, P.O. BOX- 6223, NEW DELHI- 110015	011-41419554/59	
		LIGHTING SWITCH , SOCKET & S/F UNIT	5	S01	SIEMENS	RC-IN I S NR DEL AREA, JIL BUILDING, TOWER-B, PLOT NO. 78, SECTOR 18, GURGAON-122015, INDIA	0124-2842000, 9873424331 amit.bhadauria@siemens.com	
		LIGHTING SWITCH , SOCKET & S/F UNIT	6	E1068	INDO ASIAN	B-24, PHASE - II , NOIDA - 201305, U.P.	120-3042222	
23	ES51	MCB	1	E1088	MDS SWITCHGEAR LTD	314-317SHAH NAHAR ESTATE	011 - 25793021	
		MCB	2	E1068	INDO ASIAN	B-24, PHASE - II , NOIDA - 201305, U.P.	120-3042222	
		MCB	3	S03	SCHNEIDER ELECTRIC INDIA PVT. LTD.	9TH FLOOR, BLDG. NO. 10, TOWER-C, DLF CYBER CITY, PH-II, GURGAON-122002	0124-3940400	
		MCB	4	E1120	S&S POWER SWITCHGEAR LTD,	NEW NO. 67, OLD NO. 19, DR. RANGA ROAD, MYLAPORE, CHENNAI - 600004	044 - 24988056, 044 - 24988057, 044 - 24988058	
24	ES55	MODULAR SWITCH BOARD	1	E1012	ANCHOR	STEEL HOUSE, B WING, PLOT NO. 24, MAHAL INDUSTRIAL ESTATE, MAHAKALI CAVES ROAD, NEAR PAPER BOX, ANDHERI (E), MUMBAI, MAHARASHTRA.- 400093	022-30418888.	
		MODULAR SWITCH BOARD	2	F04	ELEXPRO ELECTRICALS PVT/ LTD.	C 1/27 & 37 GIDC KABILPORE NAVSARI-396424	02637-265140, Mr. Jssk kumar	
		MODULAR SWITCH BOARD	3	HI01	HAVELLS INDIA LIMITED	QRG TOWERS , 2D SECTOR-126, NOIDA- 201301	GIRISH KUMAR SHRIVASTAVA +91-9810528922	
		RECEPTACLES - DECORATIVE	1	E1012	ANCHOR	STEEL HOUSE, B WING, PLOT NO. 24, MAHAL INDUSTRIAL ESTATE, MAHAKALI CAVES ROAD, NEAR PAPER BOX, ANDHERI (E), MUMBAI, MAHARASHTRA.- 400093	022-30418888.	
		RECEPTACLES - DECORATIVE	2	F04	ELEXPRO ELECTRICALS PVT/ LTD.	C 1/27 & 37 GIDC KABILPORE NAVSARI-396424	02637-265140, Mr. Jssk kumar	

S.no.	ITEM CODE	ITEM/SERVICE DESCRIPTION	SL NO.	VENDOR CODE	VENDOR NAME	ADDRESS	PHONE	REMARKS
25	ES59	RECEPTACLES - DECORATIVE	3	B05	BAJAJ ELECTRICALS	BAJAJ ELECTRICALS LTD. ENGINEERING & PROJECTS BU (NORTH) 3rd FLOOR, GULMOHARHOUSE, COMMUNITY CENTRE 161/B-4, GAUTAM NAGAR, YUSUF SARAI NEW DELHI – 110049	CONTACT PERSON : Mr. S. SREEMANY. SR. MANAGER (PROJECTS) CONTACT DETAILS : (+91) 9871025705. MAIL ID : srabans@bajajelectricals.com;	
		RECEPTACLES - DECORATIVE	4	A03	AJMERA INDUSTRIES & ENGG. WORKS	AJMERA INDL. AND ENGG. WORKS. AJMERA HOUSE, A-61 / KHAIRANE MIDC. , TTC INDL. AREA, NAVI MUMBAI – 400705.	Tel : 022 27620299 / 97 / 96 *mail@ajmera.net	
26	ES61	SWITCH BOX	1	E1012	ANCHOR	STEEL HOUSE, B WING, PLOT NO. 24, MAHAL INDUSTRIAL ESTATE, MAHAKALI CAVES ROAD, NEAR PAPER BOX, ANDHERI (E), MUMBAI, MAHARASHTRA. - 400093	022-30418888.	
		SWITCH BOX	2	F04	ELEXPRO ELECTRICALS PVT/ LTD.	C 1/27 & 37 GIDC KABILPORE NAVSARI-396424	02637-265140, Mr. Jssk kumar	
		SWITCH BOX	3	B05	BAJAJ ELECTRICALS	BAJAJ ELECTRICALS LTD. ENGINEERING & PROJECTS BU (NORTH) 3rd FLOOR, GULMOHARHOUSE, COMMUNITY CENTRE 161/B-4, GAUTAM NAGAR, YUSUF SARAI NEW DELHI – 110049	CONTACT PERSON : Mr. S. SREEMANY. SR. MANAGER (PROJECTS) CONTACT DETAILS : (+91) 9871025705. MAIL ID : srabans@bajajelectricals.com;	
		SWITCH BOX	4	A03	AJMERA INDUSTRIES & ENGG. WORKS	AJMERA INDL. AND ENGG. WORKS. AJMERA HOUSE, A-61 / KHAIRANE MIDC. , TTC INDL. AREA, NAVI MUMBAI – 400705.	Tel : 022 27620299 / 97 / 96 *mail@ajmera.net	
		SWITCH BOX	5	SB02	S.B. ELECTRICAL ENGINEERING CORPORATION	03, SARDAR GRIHA BUILDING, LOHAR CHAWAL, MUMBAI-400002	022- 22069831; 022-66637259	
27	ES62	TERMINAL BLOCKS	1	C01	WAGO-CONTROLS	C 27, GREATER NOIDA, SECTOR 58, C BLOCK, SECTOR 58, NOIDA, UTTAR PRADESH 201307	0120-2580409/10	
		TERMINAL BLOCKS	2	E1038	CONNECT WELL	309A/4, 3RD FLOOR, KALKAJI, OKHLA IND AREA PH-2, GOVINDPURI, NEW DELHI, DL 110019	9811881085 09871419996 011-65908877	
		TERMINAL BLOCKS	3	E1047	ELMEX CONTROLS PVT. LTD.	12,G.I.D.C.ESTATE,MUKARPURA ROAD,VADODARA-390010	9374631074	
		TERMINAL BLOCKS	4	E1050	ESSEN DEINKI	FLAT NO. 502, SKYLINE HOUSE 85, NEHRU PLACE NEW DELHI	011-26217060	
		TERMINAL BLOCKS	5	E1142	TECHNOPLAST	OPP.I.M.INTER COLLEGE, BEGUM SARAI KHURD ROAD, AMROHA - 244221, U.P.	PH:- 05922 264006 CELL NO:- 9012676000, 9319520799, 9319582467	
		TERMINAL BLOCKS	6	PME-01	M/s PHOENIX MECANO LTD.,	388 BHARE, TALUKA MULSHI, POST GHOTAWADE, PIRANGOOT, INDUSTRIAL AREA, PUNE-412115	TEL.- +912066745000 Awasthi(09971119006) Tel: ++91 20 6674 5103, Mobile: +91 90499 95985, Fax: ++91 20 6674 5126 contact person : Vishwa bandhu E- mail:d.gupta@pmipl-online.com ;admin@pmipl-online.com	
		TERMINAL BLOCKS	7	E1050	ESSEN DEINKI	FLAT NO. 502, SKYLINE HOUSE 85, NEHRU PLACE NEW DELHI	011-26217060	
28	ES63	TIMERS - PNEUMATIC	1	B04	BCH	20/4, MATHURA ROAD, FARIDABAD, HARYANA- 121006	0129-4293000	
		TIMERS - PNEUMATIC	2	G01	ALSTOM LTD	A-7, SEC-65, NOIDA	0120-479 0000	
		TIMERS - PNEUMATIC	3	L01	L&T	32, SHIVAJI MARG, P.O. BOX- 6223, NEW DELHI- 110015	011-41419554/59	
		TIMERS - PNEUMATIC	4	E1144	TELEMECHANIQUE/ SCHNEIDER ELECTRIC INDIA PVT. LTD.	9TH FLOOR, BLDG. NO. 10, TOWER-C, DLF CYBER CITY, PH-II, GURGAON-122002	0124-3940400	TAKEN OVER BY SCHNEIDER
		TIMERS - PNEUMATIC	5	S03	SCHNEIDER ELECTRIC INDIA PVT. LTD.	9TH FLOOR, BLDG. NO. 10, TOWER-C, DLF CYBER CITY, PH-II, GURGAON-122002	0124-3940400	
		TIMERS - PNEUMATIC	6	E01	ELECTRONIC AUTOMATION PVT. LTD.	20, KHB INDUSTRIAL AREA YELAHANKA BANGLORE-560064	080 -28567561 / 080 -28567562 / 080 -42802345	
29	ES64	TIMERS - ELECTRONIC	1	E1050	ESSEN DEINKI	FLAT NO. 502, SKYLINE HOUSE 85, NEHRU PLACE NEW DELHI	011-26217060	
30	ES67	RECEPTACLE (FLAME PROOF)	1	E1206	BALIGA ELECTRICALS	63A,CP RAMASWAMY ROAD, PB NO 6910, CHENNAI-600018	44-24995505,22680990-4	
		RECEPTACLE (FLAME PROOF)	2	SS01	SUDHIR SWITCHGEAR	305/6, APEEJAY HOUSE, 130, BOMBAY SAMACHAR MARG, MUMBAI - 400 023. INDIA	Telephone Nos. : 40460000 (100 lines) Fax Nos. : ++91-22-22049381 Email : md@sudhirswitchgears.com ; works@sudhirswitchgears.com ;scud@vsnl.com	

S.no.	ITEM CODE	ITEM/SERVICE DESCRIPTION	SL NO.	VENDOR CODE	VENDOR NAME	ADDRESS	PHONE	REMARKS
		RECEPTACLE (FLAME PROOF)	3	FFP01	FCG FLAME PROOF CONTROL GEAR	A1/53, SHAH & NAHAR INDUSTRIAL ESTATE, SITARAM JADHAV ROAD, LOWER PAREL (W), MUMBAI-400 013	Mr. N. G. Patel CMD Office No: +91-22-43443200 Fax No: +91-22-24960313	
31	ES68	RECEPTACLE (NON FLAME PROOF)	1	A03	AJMERA INDUSTRIES & ENGG. WORKS	AJMERA INDL. AND ENGG. WORKS. AJMERA HOUSE, A-61 / KHAIRANE MIDC., TTC INDL. AREA, NAVI MUMBAI - 400705.	Tel : 022 27620299 / 97 / 96 'mail@ajmerna.net	
		RECEPTACLE (NON FLAME PROOF)	2	C02	CROMPTON GREAVES	3RD FLOOR, EXPRESS BUILDING,9-10, BAHADUR SHAH ZAFAR MARG, NEAR ITO CROSSING,NEW DELHI-110002, INDIA	91 11 23460700 - 999 'Sunil.Das@cgglobal.com	
		RECEPTACLE (NON FLAME PROOF)	3	E1207	CYCLE ELECTRIC DEVICE & SERV.CO.	: A-3, NEAR ANTHEM BIOSCIENCE, KSSIDC INDUSTRIAL AREA, BOMMASANDRA, BOMMASANDRA INDUSTRIAL AREA, BANGALORE, KARNATAKA 560099	Mr. H.Jaishanker +919845039081, 080 - 27833102, 080 - 27833103 : +91 80 41460985 'cycloelectric@gmail.com	
		RECEPTACLE (NON FLAME PROOF)	4	B04	BCH	20/4, MATHURA ROAD, FARIDABAD - 121006, HARYANA, INDIA	0(129)-4063000, 9015800189(Ramesh Giri) 'ramesh.giri@bchindia.com	
		RECEPTACLE (NON FLAME PROOF)	5	B02	BEST & CROMPTON	BEST & CROMPTON ENGINEERING LTD 28C, AMBATTUR INDUSTRIAL ESTATE (NORTH) AMBATTUR, CHENNAI - 600 098	Ph : +91 44 4551 4724 , MRKT DGM Mr. VI Raj:- 9840593411 'bestcromptonviraj@gmail.com	
32	ES69	EMERGENCY LIGHTING UNIT (FIXED & PORTABLE TYPE)- NON FLAME PROOF	1	B05	BAJAJ ELECTRICALS	BAJAJ ELECTRICALS LTD. ENGINEERING & PROJECTS BU (NORTH) 3rd FLOOR, GULMOHARHOUSE, COMMUNITY CENTRE 161/B-4, GAUTAM NAGAR, YUSUF SARAI NEW DELHI - 110049	CONTACT PERSON : Mr. S. SREEMANY. SR. MANAGER (PROJECTS) CONTACT DETAILS : (+91) 9871025705. MAIL ID : srabans@bajajelectricals.com	
		EMERGENCY LIGHTING UNIT (FIXED & PORTABLE TYPE)- NON FLAME PROOF	2	PEP05	PROLITE AUTOGLO LIMITED,	PROLITE AUTOGLO LTD 25 SINGH INDUSTRIAL ESTATE NO. 3, RAM MANDIR ROAD., GOREGAON (W), MUMBAI, MAHARASHTRA 400104, INDIA	022-67868100 sales@prolite.com	
33	ES70	EMERGENCY LIGHTING UNIT (FIXED & PORTABLE TYPE)- FLAME PROOF	1					
34	ES71	24V SUPPLY MODULE WITH COMPLETE ACCESSORIES	1	E1103	POWER PACK ENTERPRISES	POWER PACK ENTERPRISES MR. NEHAL SHAH / MR. SHARAD SHAH (PARTNER) NO. 3, JAYSHREE SADAN, 1ST FLOOR, OLD NAGARDAS ROAD, ANDHERI EAST MUMBAI - 400069, MAHARASHTRA, INDIA	Call Us:08447573761 Mobile: +(91)-9821787821 +(91)-9821035604	
		24V SUPPLY MODULE WITH COMPLETE ACCESSORIES	2	E1066	INDCOIL	ADDRESS: PLOT NO. A- 150/ 151, 23RD U ROAD, WAGLE ESTATE, THANE WEST, CST RD, FRIENDS COLONY, HALLOW PUL, KURLA WEST, MUMBAI, MAHARASHTRA 400070	Phone:022 2583 8305	
		24V SUPPLY MODULE WITH COMPLETE ACCESSORIES	3	AI01	Ames Impex Electricals Pvt. Ltd	C-1B/1207, PHASE IV, GIDC NARODA, AHMEDABAD, GUJARAT 382330	Phone:079 2282 1648	
35	ES74	AMMETER	1	E1009	AUTOMATIC ELECTRIC LTD.	96 AB LONAVLA INDUSTRIAL ESTATE NANGARGAON, LONAVLA-410401	Phone : +91 2114323665 Fax : +91 2114273482	
		AMMETER	2	R01	RISHABH INST.PVT LTD	RISHABH INSTRUMENTS PVT. LTD. F-31, MIDC, SATPUR NASHIK - 422007 MAHARASHTRA INDIA	marketing@rishabh.co.in 91-253 2202202/203 Fax: 91 253 2351064.	
		AMMETER	3	NK09	M/s Newtek Electricals	M-90, M.I.D.C, Waluj, Aurangabad 431136, Maharashtra, India	Tel/Fax: +91 240 2551555 E-mail: mkt.north@newtekelectricals.com , sales@newtekelectricals.com Mr Sanjeev Aggarwal (9958897890)	
36	ES75	VOLTMETER	1	E1009	AUTOMATIC ELECTRIC LTD.	96 AB LONAVLA INDUSTRIAL ESTATE NANGARGAON, LONAVLA-410401	Phone : +91 2114323665 Fax : +91 2114273482	
		VOLTMETER	2	R01	RISHABH INST.PVT LTD	RISHABH INSTRUMENTS PVT. LTD. F-31, MIDC, SATPUR NASHIK - 422007 MAHARASHTRA INDIA	marketing@rishabh.co.in 91-253 2202202/203 Fax: 91 253 2351064.	
		VOLTMETER	3	NK09	M/s Newtek Electricals	M-90, M.I.D.C, Waluj, Aurangabad 431136, Maharashtra, India	Tel/Fax: +91 240 2551555 E-mail: mkt.north@newtekelectricals.com , sales@newtekelectricals.com Mr Sanjeev Aggarwal (9958897890)	
37	ES80	PVC WIRES			BIS APPROVED MAKE			
38	ES81	PEDESTAL FAN & CEILING FAN			REPUTED MAKE			
39	ES82	EXIT SIGN (FLAME PROOF)			REPUTED MAKE			
40	ES83	EXIT SIGN (NON FLAME PROOF)			REPUTED MAKE			

S.no.	ITEM CODE	ITEM/SERVICE DESCRIPTION	SL NO.	VENDOR CODE	VENDOR NAME	ADDRESS	PHONE	REMARKS
41	ES84	LADDER				REPUTED MAKE		
42	ES86	PHOTOELECTRIC SWITCH				REPUTED MAKE		
43	ES87	DICHORIC SPOT LIGHTING FIXTURE				REPUTED MAKE		
44	ES88	HAND LAMP UNIT				REPUTED MAKE		
45	ES89	LIGHTING DESIGNER	1	AT13	AVAIDS TECHNOVATORS PVT. LTD.	4A/58, SHANKAR ROAD, NEW DELHI-110060	Mr. Rajendra Panda M: 9910481854 (email: rajendra@avaids.com)	
		LIGHTING DESIGNER	2	BE13	BAJAJ ELECTRICALS LTD.	801 (8th floor), Rustomjee Aspire, Bhanu Shankar Yagnik Marg, Off Eastern Express Highway Sion (E), Mumbai 400022	Mr. S. SREEMANY. SR. MANAGER (PROJECTS) CONTACT DETAILS : (+91) 9871025705. (email: srabans@bajajelectricals.com)	
		LIGHTING DESIGNER	3	KS13	KELSATEK SOLUTIONS PVT. LTD.	50/1 4TH FLOOR, CHURCH STREET, BANGALORE-560001	Mr. S S Mudaliar Sr. VP M: 6380471362 (email: mudaliar@kelsatek.com)	
		LIGHTING DESIGNER	4	SE13	M/s SUMANAM ENGINEERING SERVICES CONSULTANT	1, ADITHYA, KOWDIAR, TRIVANDRUM 695003	Mr. Anshad S Phone: 471-2437588, (email: shaw@sumanam.org)	
		LIGHTING DESIGNER	5	SM13	SPAN MANUFACTURING COMPANY LTD	27 First Floor, Bhiku Building, Murari Ghag Marg, Prabhadevi, Mumbai-400025	Ms Surbhi Jindal M: 9811026321 (email: spanmanufacturing@gmail.com, info@dalighthub.com)	Lighting System designer only for FGD, R&M and Hydro projects
		LIGHTING DESIGNER	6	CL13	CITELUM INDIA PVT. LTD	Y-14A, GREEN PARK MAIN, NEW DELHI-110016	Mr. Satyabrata Meher M: 8155001095, (email: smeher@citelum.in)	Lighting System designer only for FGD, R&M and Hydro projects
		LIGHTING DESIGNER	7	SR13	M/s SURYA ROSHNI LTD	Padma Tower 1, Rajendra Place, New Delhi-110008	Mr. Saurabh Gupta 9999433167, (email: saurabh.gupta@surya.in), AKHILESH AGRAWAL (aagrawal@surya.in)	
		LIGHTING DESIGNER	8	HP13	M/s HPL ELECTRIC & POWER PVT. LTD.	WINDSOR BUSINESS PARK, B-1D, SECTOR-10 NOIDA-201301 (UP)	Name : Mr. Mahesh Sharma Designation: Sr. GM (HOD Projects) Email : msharma@hplindia.com Contact : 9818282236 Ashwani Kumar Mob-9971127370 Email: ashwani@hplindia.com	

NOTE: Make of all the equipment / instrument under this specification shall be subjected to owner's approval in the event of order. Owner reserves the right to accept/ reject any make or sub-vendor and to add new sub-vendors for the project after award of contract. Approval, rejection or addition of makes shall not have any price implication to the owner after award of contract.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS AND
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-TS-475-558-E006

VOLUME II

SECTION - I

2X660 MW THDC KHURJA TG

REV. 0

DATE:

ANNEXURE – B

SCOPE MATRIX FOR BROAD ACTIVITIES

SCOPE MATRIX FOR BROAD ACTIVITIES				
Sl. No.	Activities	Contractor	Associate	Remark (if any)
1	System Design			
2	Supply: - (a) Fixtures & Lamps (b) Other Items (as required for System completion)			
3	Supervision of Erection & commissioning			
4	Design review & changes based on site feedback for establishing correctness of the system at site			

Notes: -

1. Bidder to indicate Division of work (DOW)/ scope matrix between contractor & associate by indicating "Yes"/ "No" against each activity in the appropriate column, same to be furnished duly signed & stamped along with technical offer.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS AND
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SECTION – II

STANDARD TECHNICAL REQUIREMENTS



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 1 OF 38

**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS & MISCELLANEOUS ITEMS**



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 2 OF 38

CONTENTS

<u>CLAUSE</u>	<u>DESCRIPTION</u>
1.0	INTENT OF SPECIFICATION
2.0	CODES & STANDARDS
3.0	LIGHTING SYSTEM DESCRIPTION (CONCEPTUAL VIEW)
4.0	SYSTEM DESIGN ENGINEERING
4.1	ENGINEERING INPUTS
4.2	DESIGN CRITERIA
4.3	ENGINEERING OUTPUTS
5.0	LUMINAIRES, ACCESSORIES AND LAMPS
5.1	GENERAL REQUIREMENTS OF LUMINAIRES
5.2	LUMINAIRE & OTHER ITEMS
5.3	CONTROLGEAR BOX (NON-INTEGRAL TYPE)
5.4	REFLECTORS
5.5	LAMP HOLDERS
5.6	STARTER HOLDERS
5.7	BALLASTS
5.8	STARTERS
5.9	CAPACITORS
5.10	LAMPS
5.11	JUNCTION BOXES
5.12	RECEPTACLES
5.13	CEILING FANS & REGULATORS
5.14	LIGHTING CONTROL SWITCHBOXES
5.15	CABLE GLANDS
5.16	CABLE LUGS
5.17	FLEXIBLE METALLIC CONDUITS AND FITTINGS
5.18	PVC CONDUITS
6.0	SURFACE TREATMENT
7.0	PACKING
8.0	GUARANTEED PERFORMANCE REQUIREMENTS
9.0	INSPECTION & TESTING
10.0	SPARES
11.0	TOOLS & TACKLES
12.0	DOCUMENTATION
	ANNEXURE-I: LUMINAIRE DETAILS



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 3 OF 38

1.0 INTENT OF SPECIFICATION

- 1.1 The requirements given in specification for supply of equipment and system design engineering shall be fully complied with.
- 1.2 For the equipment of supply in vendor's scope, the "design" shall broadly cover the selection of components, materials, sizes etc. and complete responsibility of establishing the correctness of equipment design rests with the vendor.
- 1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship, and shall be capable of performing required function in a manner acceptable to Purchaser, who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material, which in his judgement is not in full accordance herewith.
- 1.4 Make of all equipment and components shall be to the approval of Purchaser. Bidder to comply to Sub-vendor list enclosed as Annexure to Section I, however same shall be subjected to end client approval without any commercial implication.

2.0 CODES & STANDARDS

- 2.1 The material shall comply with all currently applicable safety codes and statutory regulations of India as well as of the locality where the material is to be installed.
- 2.2 The material, construction, manufacture, inspection and testing shall conform to the latest revisions of standards as specified in Data Sheet-A.
- 2.3 In case of conflict between the applicable reference standard and this specification, stringent requirement shall govern.

3.0 LIGHTING SYSTEM DESCRIPTION (CONCEPTUAL VIEW)

- 3.1 All areas of plant (indoor and outdoor) shall be provided with suitable lighting arrangement to meet the functional requirements by use of various types of luminaires so as to achieve the desired quality and level of illumination.
- 3.2 Lighting system shall also cover the low voltage power services such as power receptacles and single phase feeders.
- 3.3 Lighting system shall be fed through various power sources such as AC Normal, AC Emergency and DC Emergency supply to achieve the desired reliability.
- 3.4 Power tapped from various sources shall be distributed through lighting distribution boards and lighting panels upto the various luminaires and power outlet sockets / feeders.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 4 OF 38

4.0 SYSTEM DESIGN ENGINEERING

Engineering shall be done by the vendor only during the contract engineering stage as the same is covered in his scope. During tender stage, bidder shall make his quotation on the basis of BOQ furnished by the purchaser with the tender document.

4.1 ENGINEERING INPUTS : Complete engineering shall be done by the vendor on the basis of documents listed below. The engineering inputs shall be furnished by purchaser. However, furnishing of these inputs shall not absolve the vendor of responsibility to visit site and get acquainted with actual site conditions.

4.1.1 Indoor Areas

- a) Room dimensions (details as covered in various layout drawings)
- b) Lighting System Design Data (LSDD) covering typical values for various types of indoor areas, indicating :
 - i. Required average illumination level
 - ii. Reflection factors for walls, ceiling and floor
 - iii. Maintenance factor
 - iv. Type of luminaire
 - v. Mounting height of luminaire
 - vi. Height of working plane
- c) AC Emergency lighting requirements
- d) DC lighting requirements
- e) Requirement of sockets
- f) Requirement of exhaust fans and fan points

4.1.2 Outdoor Areas

- a) Area geometry (details as covered in various layout drawings)
- b) Lighting System Design Data (LSDD) covering typical values for various types of outdoor areas, indicating:
 - i. Average illumination level
 - ii. Type of luminaire
 - iii. Pole heights / mounting height
 - iv. AC Emergency lighting requirement



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 5 OF 38

- v. DC lighting requirements
- vi. Maintenance factor
- c) Requirement of sockets

4.1.3 Other inputs

- a) Plot plan, Main equipment plan and TG hall floor plans (to assess quantum of area lighting drawings)
- b) Suggestive location of LDBs
- c) Suggestive power distribution scheme (SLDs)
- d) Control schemes
- e) Single phase feeder details
- f) No. of sockets / criteria for computation of no. of sockets / location of sockets etc.
- g) LDB/WDB details
- h) LP details
- i) Poles & Masts details
- j) Conduit sizes
- k) Wire sizes
- l) Earthing material sizes

4.2 DESIGN CRITERIA:

4.2.1 General Requirements of Design

- a) Lighting system shall be provided to ensure adequate visual performance, safety and reliability and shall be free from excessive glare and flicker from discharge lamps. Particular attention shall be paid to ensure that level of illumination is satisfactory in all respects including viewing of all instruments, alarms, annunciators and indicating lamps.
- b) Complete system design shall be done on the basis of inputs provided by the purchaser and in line with the laid down criteria.
- c) Requirements of sockets shall be as per the criteria / number of sockets given by the purchaser during detailed engineering stage.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 6 OF 38

- d) Complete power distribution system shall be designed keeping following criteria in view :
- Simplicity
 - Controlled voltage drop
 - Cost effectiveness

4.2.2 Sources of Power Supply

- a) The illumination of various indoor and outdoor areas in the main plant and off site areas shall comprise of one or more of the following systems:
- Normal AC Lighting System
 - Emergency AC Lighting System
 - DC Lighting System
- b) Arrangement and distribution of power shall depend upon the functional requirements of areas and therefore supply from all types of power sources shall not be made available to all areas. Lighting & LV power services in different areas shall be provided as per Annexure-B enclosed.
- c) 24V AC lighting for maintenance purposes (for hand lamps and/or hand operated tools) shall be supplied from 240/24V fixed/ portable lighting module.

4.2.3 Lighting philosophy

a) Normal AC Lighting System

Normal AC lighting system 415V, 3 phase, 4 wire, will be fed from lighting panels (LPs) which in turn will be fed from the lighting distribution boards (LDBs). Street lights/ flood lights shall be fed from Street Lighting Panel (SLP), Welding receptacles shall be fed from Welding DB/ MCC in offsite areas.

b) Emergency AC Lighting System

This system shall be provided for certain important areas in the main plant. The lighting fixtures connected to this system shall be normally "ON" along with the normal AC system. These will be fed from emergency lighting panels (ELPs) which in turn will be fed from 3-phase, 4-wire supply from the emergency lighting distribution boards (ELDB'S). These lights will go off for a few seconds in case of AC supply failure at Emergency Switchgear, but shall be automatically restored when Emergency Switchgear is energized by Diesel generator set.

c) DC Lighting System

At strategic locations in the main plant, a few lighting fixtures fed from 220V DC supply, shall be provided to enable safe movement of operating personnel and access to important control points during an emergency, when both the normal AC and Emergency Lighting system fail. These lighting fixtures will be fed from 220V DC LPs which in turn will be fed from DC LDBs.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 7 OF 38

The supply to the DC lighting panels shall be automatically switched ON in case of loss of AC supply at station service switchgear as well as Emergency switchgear. The DC supply will be automatically switched OFF after about 3 minutes following the restoration of supply to normal AC or emergency AC lighting system.

In auxiliary /off site buildings, emergency DC lighting is to be provided through self contained DC emergency fixture at strategic locations. The fixtures shall be switched 'ON' automatically in case of failure of AC supply.

d) Street Lighting/ Flood Lighting

Street lights / flood lights will be fed from Street Lighting Panel (SLP). The number of street lights / flood lights shall be grouped in such a way that they will be fed from the nearest SLP available. Street lights shall have provision of automatic switching ON and OFF in any one of the following modes and as per the purchaser's scheme:

- i. Manual
- ii. Automatic through 00 - 24 hrs time switch
- iii. Automatic through combination of 00 - 24 hrs time switch and a remote sensing device for monitoring external illumination level. Each SLP shall be provided with a time switch and a remote light sensing device.

4.2.4 Number of Luminaires

- a) All calculations shall be done as per the input data covered under "Engineering Inputs".
- b) Total AC luminaires

Total number of AC luminaires for indoor and outdoor areas shall be calculated on the basis of point to point method by an established computer program. Optimisation criteria shall form part of street lighting calculations.

For AC emergency lighting, a specified percentage of total AC luminaires shall be considered as AC emergency luminaires. The percentage shall be informed during detail engineering.

4.2.5 Layout Considerations

a) General Layout Considerations

- i. Layout of equipment such as LDBs and LPs shall be on the basis of following criteria :
 - Ease of operation
 - Maintainability
 - Aesthetics
- ii. Luminaires shall be located to meet the functional requirements of the area. Aesthetics shall form part of layout considerations.
- iii. Due considerations shall be given to the mounting arrangement depending upon location and type of area.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 8 OF 38

- iv. While preparing lighting system layout drawings for air conditioned control rooms/areas having false ceilings, the vendor shall be required to interface with the Air Conditioning / Ventilation Duct layout and false ceiling layout drawings to avoid fouling / interference.
- v. The poles shall be located 1.5m away from the road edge. The buried cable shall run in hume pipe / duct bank wherever it is crossing the roads.
- vi. 240V AC, 5/15A universal socket (at least two number) shall be provided in office, store, cabin etc. The receptacles shall be provided at interval of 20m or part thereof for hand tools etc. One no. 20A, 240V AC industrial type receptacle shall be provided at suitable location in all other area as required. The receptacles shall be controlled through switch/MCBs. In hazardous area, receptacles shall be flame proof.
- vii. Suitable nos. of 63A/125A, 3 phase, 415V industrial receptacle with switch shall be provided at specific points in power plant area for welding purposes. At least one 63A/125A receptacle shall be provided in each off-site building.
- viii. 1200mm/ 1400mm sweep ceiling fans with stepped electronic regulator shall be provided for office room, store rooms and social buildings which are not covered by air-conditioned and ventilation system.
- ix. All fans including pedestal fans shall comply to relevant IS.

b) Conduit System

- i. Unless indicated otherwise, conduits shall originate from respective lighting panels and shall continue upto the luminaires for all indoor areas.
- ii. Conduits shall run in straight runs, parallel to building columns, walls etc. as far as practicable.
- iii. Unnecessary bends and crossings shall be avoided.
- iv. In the corrosive environment, conduit installations shall be made with corrosion proof conduits. Such requirements shall be clearly indicated while preparing BOQ.
- v. Conduits in control room and other air-conditioned areas shall be surface mounted on the roof above false ceiling. However vertical drops of conduits shall be through column flanges or grooved to the wall, finally covered for better aesthetics.

c) Wiring

- i. Each circuit from LP shall be taken in a separate conduit.
- ii. Wiring of AC normal, AC emergency & DC emergency lighting system shall be carried out in separate conduits.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 9 OF 38

- iii. Receptacle wiring shall be distinct from lighting conduits. No two phase circuits shall be run in the same conduit. However different circuits of same phase may be laid in the same conduit.
- iv. Maximum three nos. of receptacles shall be loop-in & loop-out in a circuit.
- v. Filling area of wires in conduit shall not exceed 40% of the conduit area.
- vi. Wiring shall be done with following conductor sizes:
 - Luminaires – 2.5 sq. mm
 - 5A plug & socket – 2.5 sq. mm
 - 5/15A and 20A plug & socket – 4 sq.mm
- vii. Wiring shall be designed for the uniformly distributed spread of luminaires on each phase i.e. R,Y,B. Distribution of luminaires on these phases shall be such so that there is generally uniform light intensity in the event of failure of one or two phases.
- viii. Luminaires located in offices, stores, laboratories, toilets etc. shall be individually or group controlled.

d) Cabling

- i. Cables shall be considered wherever it is not desirable to run the insulated wires due to long runs or for any other valid reason.
- ii. Cable Schedule shall be prepared for all cable connections.

4.3 ENGINEERING OUTPUTS:

Vendor shall prepare and submit following documents and drawings for purchaser's approval :

- a) Lighting calculations for indoor areas covering details such as room dimensions (length, width, height), illumination level, reflection factors (walls, ceiling, floor), maintenance factor, type of luminaire, mounting height of luminaire, room index, coefficient of utilisation, no. of luminaires (AC Normal & AC Emergency), lumen output of each luminaire, reference drawings and remarks.
- b) Lighting calculations for outdoor areas covering average illumination level, type of luminaire, chart for illumination level at various points in the area; location (coordinates), number and height of poles; type, number (normal + emergency) and orientation of luminaires etc. Calculated values of average and minimum illumination level as obtained through computer package shall also be furnished. Dot density plots for lux level shall be furnished if available in the computer package.
- c) Single line diagrams of power distribution upto Lighting Panels. Separate drawing for complete lighting distribution shall also be prepared by vendor.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 10 OF 38

- d) Loads on each phase of LP and LDB with consideration of diversity factor for sockets.
- e) Layout drawings for each indoor area indicating location of luminaires, sockets, fan points, exhaust fans, LDBs and LPs. Details of type of luminaires, source of power supply (AC Normal, AC Emergency, DC Normal and DC Emergency). Bill of Material shall also be covered which shall include unit wise requirements of luminaires and other items.
- f) Layout drawings for each outdoor area indicating location of poles / towers, orientation of luminaires, sockets and LPs. Details of pole height / mounting height, type of luminaires, source of power supply (AC Normal, AC Emergency, DC Emergency). Bill of Material shall also be covered for various types of luminaires.
- g) Conduit layout drawings with wiring and load distribution details as superimposed on the area layout drawings indicated above. Drawings shall include Bill of Material for conduits, wires etc.
- h) Wiring and load distribution details for outdoor areas.
- i) Master Bill of Material (to be submitted at regular intervals of engineering progress) including all items required for the complete lighting system viz. lighting fixtures, lamps, Lighting DBs, Welding DBs, lighting panels, conduits, PVC wires etc.
- j) In case of revised inputs or site feedback, preparation and submission of revised engineering outputs shall also be in the scope of vendor.
- k) Calculation for selection of number and size of containers
- l) Packing procedures and drawings.

5.0 LUMINAIRES, ACCESSORIES AND LAMPS

5.1 GENERAL REQUIREMENTS OF LUMINAIRES

- a) All luminaires and accessories shall be designed for continuous operation and shall be suitable for the system design data given in Data Sheet A.
- b) Luminaires shall be complete with accessories mounted inside the luminaire assembly. Lamps shall be supplied separately as per BOQ.
- c) All luminaires and accessories shall be suitable for operation in the atmospheric conditions prevailing at site.
- d) Power factor for fluorescent lamp luminaires shall be 0.9 or more and that for HPMV/ HPSV luminaires shall be 0.85 or more. Power factor correction capacitors shall be provided for this purpose.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 11 OF 38

- e) Luminaires shall be designed for minimum glare. No bright spots should appear from the lamp or from the reflectors.
- f) All accessories shall be wired upto a terminal block or a separate weather proof metallic terminal box suitable for 2.5 sq. mm. copper wire termination.
- g) All internal wiring shall be of PVC or silicon rubber insulation, capable of withstanding the maximum temperature to which it will be subjected under specified service conditions without deterioration.
- h) All luminaires and accessories including the breathing holes shall be vermin proof.
- i) Surface Treatment:
 - All surfaces after manufacture shall be thoroughly cleaned and degreased. Pre-treatment of surfaces shall be as per the applicable standard. Pretreated surfaces shall be free from rust, sharp edges, scales and burrs.
 - Finish of surfaces shall be non-porous, smooth and unfaded.
- j) All metal parts of the luminaires shall be bonded and connected to the earthing terminal. Earthing terminal shall be suitable for connecting 14 SWG GI wire.
- k) Flood lights shall be provided with base frame / base plate for mounting on structural steel members / wall.
- l) All weather proof luminaires shall have the control gear housed in a weather proof enclosure with necessary gaskets, mounting bracket, locking screws etc.

5.2 LUMINAIRE TYPES & OTHER ITEMS

5.2.1 General requirements depending upon type of luminaire are listed below. Specific requirements of each luminaire are indicated in "Luminaire Details" enclosed as Annexure-I.

a) Channel Mounted Luminaires (Fluorescent Luminaires)

- Channel mounted luminaires, except the special purpose luminaires, shall have CRCA sheet steel base plate / rail / channel / box / side panels / housing as per "Luminaire Details". Sheet shall be completely stove enameled unless mentioned vitreous enameled in "Luminaire Details". Colour of enamel shall be grey on all non-reflecting surfaces and white on reflecting surfaces.
- Twin fluorescent luminaires shall be wired in lead-lag circuit to minimise stroboscopic effect.
- Luminaires suitable for surface mounting shall also be suitable for pendant mounting. Knockouts of 20mm ET conduit fixation shall be provided for this purpose.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 12 OF 38

b) Decorative Fluorescent Luminaires

- Decorative luminaires shall be provided with one of the following as per “Luminaire Details” :
 - i. Perspex acrylic diffuser.
 - ii. High purity, anodised aluminium, mirror optic reflectors with anodised aluminium matt finish transverse fins to control glare.
 - iii. Opal polystyrene louvers and sheet steel side panels.
 - iv. Vertical metallic louvers finished in stove enamelled white and with sheet steel side panels.
- End plates of decorative luminaires shall be of high impact polystyrene or sheet metal finished in black colour.
- Diffusers and louvers for the fluorescent lamps shall be made of high impact polystyrene sheet and shall have no yellowing property over a prolonged period of use.
- Recessed type decorative luminaires shall be suitable for mounting with gypsum boards / luxalon / plaster of Paris/aluminium frame false ceiling of standard size as per Data Sheet A and “Luminaire details”.

c) Industrial Fluorescent Luminaires (General Purpose)

- Additional reflectors, wherever provided, shall be easily removable type.

d) Industrial Fluorescent Luminaires (Special Purpose)

- Luminaires for chemical vapour (acidic / alkaline) laden environment shall be of cast aluminium controlgear box and end boxes. Controlgear housing shall have detachable, one piece neoprene gasket cover to make it weather proof. Design shall be suitable for chemically charged environment.
- Luminaires for corrosive and dust laden environment shall be made of tray type sheet steel housing and transparent acrylic visor supported by a galvanised sheet steel frame, fitted to the housing with gasket all around. Cable entry shall be from the side of luminaire. Luminaire shall be totally dust and vapour proof.
- Luminaires for highly corrosive environment shall have with sheet aluminium/ polycarbonate housing. controlgear housing, CRCA sheet steel controlgear tray with a stove enamelled white reflector. A clear acrylic cover of dish shape, secured to canopy by stainless steel toggle and neoprene gasket lining, shall be provided at the bottom.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 13 OF 38

- Luminaires for drip proof environment such as street lighting fluorescent luminaire shall have sheet aluminium canopy, a detachable reflector-cum-controlgear housing, clear ribbed acrylic cover held in aluminium frame. Luminaire shall have the degree of protection IP:55 unless mentioned otherwise in Data Sheet A. Luminaire shall be suitable for side entry mounting with the pole bracket arm.

e) Bay Type Luminaires

- Luminaires shall be designed for following indoor applications:
 - i) High bay
 - ii) Medium bay
 - iii) Low bay
- Luminaires shall have top mounted, cast aluminium controlgear housing. Housing shall have cooling fins and canopy for easy access to the components. Canopy shall be hinged at one end and wing screw bolted at the other end.
- Controlgear shall be connected to the detachable lamp housing at the bottom such that heat dissipation is proper and distributed.
- Lamp housing-cum-reflector shall be made from spun aluminium, electrochemically brightened and anodised.
- Lamp housing for the dust laden environment shall be totally enclosed type. A clear toughened glass cover shall be attached to the lamp housing with an aluminium frame and neoprene gasket. Luminaire shall be provided with a safety chain for toughened glass.
- Mounting arrangement shall consist of MS brackets with an anti-vibration eye-bolt.
- Side mounted controlgear box shall be provided for low bay luminaires, if mentioned in "Luminaire Details".

f) Well Glass Luminaires

- Well glass luminaires shall be suitable for dust and vapour laden environment.
- Luminaires shall be provided with a die-cast aluminium canopy and heat resistant well glass, fitted with a ring type gasket.
- All well glass luminaires shall be provided with vitreous enamelled reflector.
- Zinc plated MS wire guard shall be provided for protection of well glass.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 14 OF 38

- Separate side mounted and top connected control gear box shall be provided for use with HPMV & HPSV lamps.
- Integral control gear box, where applicable, shall be of die cast aluminium material with one piece neoprene gasket between the box and its cover to make it dust and vapour proof.
- Luminaires shall be conduit mounted type for incandescent lamps and surface mounting type for HPMV & HPSV lamps.

g) Flame Proof Well Glass Luminaires

- Housing material shall be cast aluminium alloy LM6. Housing outer surface shall be provided with cooling fins.
- Flame proof luminaires shall be provided with heavy toughened well glass cemented in a retaining ring.
- Zinc-coated / chrome-plated MS chain connected to the main body and glass retaining ring shall be provided.
- A detachable terminal box at the top shall be provided.
- Neoprene gaskets, where needed, shall be provided for weather proof construction and indoor and outdoor application.
- Two cable entries of 20mm ET conduit shall be provided with one flame proof plug.
- Luminaires shall be suitable for the hazardous areas as classified in Data Sheet A. Design of flame proof luminaire shall be supported by the type test report for flame proofness from a government or government approved independent laboratory.

h) Street Lighting Luminaires (Other than Fluorescent Luminaire)

- These luminaires shall be suitable for street lighting and general purpose outdoor area lighting.
- Luminaire housing shall be one piece cast aluminium alloy to accommodate lamp housing and controlgear for lamp wattage upto 150 watts. For lamp wattage above 150 watts, controlgear housing shall be of cast aluminium alloy whereas lamp housing shall be of deep drawn aluminium.
- Inside finish of the lamp housing shall be stove enamelled white. Optical control shall be provided with two high purity, electro brightened and anodised side reflectors.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 15 OF 38

- Clear acrylic bowl fitted with a rubber gasket and easily removable type shall be secured to the lamp housing.
- Provision shall be made for adjustment of lamp location for proper focussing.
- Luminaires shall be suitable for mounting with pole bracket arm.

i) Flood Lighting Luminaires

- Flood light lamp housing and reflector shall be separate from controlgear box. Requirements of controlgear box are specified elsewhere.
- Lamp reflectors shall be of high purity spun aluminium attached to the cast aluminium lamp holder housing at the rear. Lamp holder housing shall be provided with cooling fins.
- Reflector shall be closed from the front by heat resistant toughened glass and synthetic "S" type weather proof gasket.
- Luminaire shall be provided with special lamp centering and focussing device ensuring good beam control.
- MS mounting bracket shall allow fixation of the flood light in any position in a horizontal plane and the flood light can be locked in at any set angle in the vertical plane. Cast iron base and / or two protector scales shall also be provided where specified in "Luminaire Details"
- Design shall permit replacement of lamp from the rear without disturbing the previously set aiming angles. Special guide pins shall also be provided for protecting the lamps from damage while replacing.

j) Halogen Flood Lighting Luminaire

- Luminaires shall be compact in design with aluminium alloy housing and three piece highly polished and anodised reflector assembly.
- Toughened glass panel in the front shall be provided with silicon gaskets.
- Lamp replacement from the front is also acceptable.

k) Post Top Lanterns

- Luminaire shall comprise of a spun aluminium canopy, opal acrylic diffuser and a cast aluminium spigot.
- Controlgear shall be integral type and shall be housed in the spigot.
- Luminaire shall be supplied without mounting pole.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 16 OF 38

l) Bulk Head (Flame Proof)

- Bulk head luminaires shall be used for the locations where explosion or fire hazard exists.
- Luminaire shall be made of cast iron housing with integral terminal box.
- Front of the luminaire shall be covered with flat toughened glass cemented into a retaining ring.
- Lamp replacement shall be from the front.
- Controlgear box for HPMV lamps shall be integral to the housing.
- MS fixing straps shall be provided for mounting.
- Luminaire shall be stove enameled grey outside and white inside.
- Terminal box shall be provided with 20 mm ET conduit entry.
- Complete luminaire shall be suitable for the hazardous area as classified in Data Sheet A. Type test certificate for flame proofness test from government or government approved independent laboratory shall be submitted.

m) Bulk Head (Weather Proof)

- Luminaire shall be suitable for indoor / outdoor applications having weather proof features.
- The luminaire shall comprise of die cast aluminium alloy body of dish shape.
- Luminaire shall have a heat resistant prismatic cover held in a weather proof gasket.
- Luminaire shall be stove enamelled grey outside and white inside.
- Glass cover shall have a galvanised wire protection.
- Luminaire shall be provided with locking arrangement with Allen key to prevent pilferage.
- Luminaire shall be suitable for use with incandescent lamp upto 100W.
- Provision for 20 mm ET conduit entry shall be provided at the bottom.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE: 08.09.2016

SHEET 17 OF 38

n) LED type Luminaires:

- LED Luminaires shall be used for the lighting if specified in BOQ as part of NIT.
- In false ceiling area LED luminaires shall be recessed mounting type & in non-false ceiling area the LED luminaires shall be surface mounting type.
- The individual lamp wattage for LED shall be upto 3 watt.
- The LED chip efficacy shall be min 120 Lm/W. The luminaire efficacy shall be not less than 70Lm/W.
- The LED used in the luminaires shall have colour rendering index (CRI) of Min 80. Colour designation of LED shall be “cool day light” (min 5700K) type.
- The LED luminaire shall have minimum life of 25,000 burning hours with 80% of lumen maintenance at the end of the life.
- The beam angle for LED chip shall be 120 degrees.
- The max. junction temperature of LED shall be 85 deg C, further the lumen maintenance at this temperature shall be min 90%.
- The THD of LED Luminaires shall be less than 10%. Further the EMC shall be as per IS 14700. The power factor of the luminaire shall not be less than 0.9.
- The marking on luminaire & safety requirements of luminaire shall be as per IS standards.
- Suitable heat sink with proper thermal management shall be designed & provided in the luminaire.
- The connecting wires used inside the system, shall be low smoke halogen free, fire retardant PTFE cable.
- Fuse protection shall be provided in input side specifically for LED luminaires.
- Care shall be taken in the design that there is no water stagnation anywhere. The entire housing shall be dust and water proof protection as per IS 12063.
- Driver Circuit: LED modules and drivers shall be compatible to each other. The LED module driver's ratings and makes shall be as recommended by corresponding LED manufacturer. LED Drivers may have following control & protections:
 - Suitable precision current control of LED.
 - Open Circuit Protection



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 18 OF 38

- Short Circuit Protection
- Over Temperature Protection
- Overload Protection

o) Emergency Lighting Luminaires

- The luminaire shall be automatic having in-built battery.
- Battery shall have integral charging unit.
- Charger shall be suitable for operation as per system design data.
- The battery enclosure shall be suitably painted and ventilated for the performance with sealed lead acid battery, as applicable.

5.3 CONTROLGEAR BOX (NON-INTEGRAL TYPE)

- a) Boxes shall have weatherproof construction and shall be provided with one piece neoprene gasket.
- b) Boxes shall be provided with HRC fuse mounted on a removable tray. Boxes shall be provided with all necessary components having a neat layout arrangement such that it is possible to test, inspect or replace any component without difficulty.
- c) Boxes shall be suitable for mounting on structures, walls and columns.
- d) Suitable number of terminals shall be provided for looping-in and looping-out of cable connections and also connections to the luminaire(s).
- e) Cable / conduit knock-outs shall be for each loop-in and loop-out connection and also connection to the luminaire(s).

5.4 REFLECTORS

- a) Reflectors shall be made of sheet steel or aluminium as applicable.
- b) The aluminium reflectors shall be made of high purity aluminium sheet. Sheet will be polished, electrochemically brightened and anodised.
- c) Wherever reflectors are separate from housing, they shall be securely attached to the luminaire by means of easily accessible fastening devices such that they are readily removable from the housing for maintenance.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 19 OF 38

5.5 LAMP HOLDERS

- a) Holders shall be resistant to wear and shall be smooth in operation.
- b) Contacts shall be of durable quality.
- c) Holders shall hold the lamp under condition of shock and vibration.
- d) Lamp holders for fluorescent lamp shall be spring loaded, bi-pin, rotor type with low contact resistance.
- e) Live parts of the holder shall not be exposed when the lamp is inserted or removed in case of fluorescent luminaires.
- f) Lamp holders for HPMV & HPSV lamps shall be of porcelain material.
- g) Holders shall be screw type for HPSV & HPMV lamps. Holders for incandescent lamps shall be screw type, unless mentioned otherwise in Data sheet A.
- h) Lamp holders for incandescent lamps shall be of brass or porcelain.

5.6 STARTER HOLDERS

- a) Starter holders shall be designed and manufactured as per the applicable standard.

5.7 BALLASTS

- a) Fluorescent fixtures shall have electronic ballasts. Ballasts shall be totally enclosed type.
- b) Ballasts shall be easily removable type.
- c) Core shall be made of low loss, electrical grading stampings.
- d) End connections shall be made available in a terminal block, rigidly fixed to the ballast enclosure.
- e) Ballasts shall be free from humming.
- f) Ballast shall be provided separately for each lamp in a multi-lamp luminaire.
- g) Tappings shall be provided to set the voltage within range for HPMV & HPSV luminaires.

5.8 STARTERS

- a) Starters shall be made of aluminium material. Plastic or any other material if used shall be subject to purchaser's approval.
- b) Starters shall have bi-metal electrodes.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 20 OF 38

- c) Starter shall be replaceable without the use of any tool and without disturbing any accessory or lamp.
- d) Starters shall have high mechanical strength.
- e) Starters shall be provided with radio interference suppressing capacitors.
- f) Starters shall have brass contacts.

5.9 CAPACITORS

- a) Capacitors shall have constant value of capacitance, suitable for operation at supply voltage.
- b) Capacitors shall be hermetically sealed, preferably in a metal enclosure to prevent seepage of impregnant and ingress of moisture.

5.10 LAMPS

- a) Lamps shall be suitable for use in any position.
- b) Lamps shall be capable of withstanding small vibrations without breakage to filaments / electrodes and lead-in wire.

5.10.1 Type of Lamps

- a) Fluorescent Lamp
 - i. Anode rings shall be provided to prevent blackening of the ends.
 - ii. Lamp caps shall be two pin type at each end.
- b) Incandescent (GLS) Lamps
 - i. Incandescent lamps shall be "clear" type.
- c) Mercury Vapour Lamps
 - i. Lamp caps shall be screw type.
- d) Sodium Vapour Lamps
 - i. Lamps shall be ovoid shaped with diffusing powder coating.
 - ii. Lamps shall be provided with external igniters and rapid restart facility.
 - iii. Lamp caps shall be screw type.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 21 OF 38

e) Halogen Lamps

- i. Lamps shall be double ended linear type.
- ii. Lamps shall be of immediate start type.
- iii. Design of lamps shall ensure high performance and high efficiency.

5.11 JUNCTION BOXES

a) Junction boxes with terminals shall be supplied for branching and terminating lighting wires/cables whenever required, as specified.

b) Construction Features

- i. The junction boxes shall be fabricated out of material & thickness as specified in Datasheet-A and shall be of rectangular shape. The cover shall be hinged or bolted with captive nuts and bolts and shall be provided with neoprene gasket lining all over.
- ii. The junction boxes shall be provided with suitable knock outs/ gland plates for conduit/ cable connection. The conduit connection shall be properly sealed. The junction boxes meant for cable connection shall be complete with removable gland plates, glands and cable lugs, as required. The junction boxes shall be provided with two earthing terminals suitable for GI earthing wires.
- iii. The junction boxes shall be weather proof type conforming to IP-55..
- iv. The boxes and cover shall be hot dip galvanised. Junction boxes for corrosive areas like DM Plant, water treatment plant etc. shall have additional epoxy/acrylic coating of thickness not less than 50microns on outer surface.
- v. The junction boxes shall be suitable for mounting on wall, columns, etc. The brackets, bolts, nuts, screws and any other erection accessories required for erection shall be included.

c) Terminals

- i. Multiway terminal blocks of approved type and make complete with galvanised screws, nuts, washers and marking strips shall be furnished for terminating the lighting wires.
- ii. All the terminals blocks shall be of 650V grade one piece construction with insulating barriers. These terminals shall be made of copper alloy and shall be stud type. Each terminal provided on junction box shall be suitable for terminating two numbers of aluminium conductors of the size as specified without any damage to the conductors or looseness.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 22 OF 38

d) The junction boxes shall be of following types:

Type	Description
JB-F	Provided with four (4) way stud type terminals for terminating upto 2 nos. 10 mm ² stranded aluminium conductors on each terminal, suitable for outdoor installations.
JB-FE	Same as above but with an additional epoxy coating of 50 micron thickness.
JB-S	Provided with four (4) way stud type terminals, each terminal suitable for terminating upto two nos. of 3.5Cx50 mm ² stranded aluminium conductors & with one no.6A HRC fuse and link.

5.12 RECEPTACLES

- a) Receptacle unit shall consist of socket outlet with associated switch and plug. The socket outlet and switch shall be flush mounted on a box which shall be suitable for mounting on wall or steel structures.
- b) Receptacle boxes shall be fabricated from material with thickness mentioned in Data Sheet A.
- c) Steel boxes shall be hot dip galvanised/ painted as specified in Datasheet-A and as per the requirements of applicable standard corresponding to the sheet thickness.
- d) The boxes shall have conduit knock-outs and shall be suitable for cable entry of the size to be specified by purchaser during detailed engineering.
- e) The boxes shall be provided with neoprene rubber gaskets to make them moisture and dust proof.
- f) Suitable loop-in and loop-out terminals shall be provided inside the box. Terminals for incoming and outgoing shall be suitable for the size of conductor of cables.
- g) The receptacle units shall be of the following types:
 - I. Type RA: It shall have the following:
 - i. 20A, 240V, 1-phase, 2 pole, 3-pin (third pin scrapping earth) porcelain, metal clad socket with a metallic cover tied to it.
 - ii. Rotary, heavy duty 20A switch conforming to applicable standard.
 - iii. Shrouded, die-cast aluminium plug.
 - iv. It shall be combined interlocked weather proof industrial unit.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 23 OF 38

v. Mechanical interlock shall be provided as follows :

- Switch can be put ON only when plug is fully engaged.
- Plug can be withdrawn only when switch is in OFF position.
- Cover can be opened only when switch is in OFF position.

vi. The arrangement should ensure that water does not enter the plug when socket is ON.

vii. Loop-in loop-out terminals shall be provided inside the box suitable for 10 mm² Al conductor.

II. Type RB: It shall have the following:

- i. Combination of 5A & 15A, 240V, 1-phase, 2 pole, 3-pin, third pin grounded socket with integral piano key type 15A switch, flush mounted on decorative bakelite (6 mm thick)/ perspex (3 mm thick) sheet as cover of the boxes.
- ii. Loop-in loop-out terminals similar to type RA shall be provided. These will be located in office areas.

III. Type RC: It shall have the following:

- i. 63A, 415V, 3-phase-neutral earth, metal clad socket with cover
- ii. Rotary, heavy duty 63A switch conforming to applicable standard.
- iii. Shrouded, die-cast aluminium plug
- iv. It shall be combined, interlocked weather proof industrial unit.
- v. Mechanical interlock shall be same as that are applicable for RA type receptacles
- vi. The receptacle boxes shall be suitable for entry and exit of 3.5CX70 mm² Al conductor PVC cable and loop-in loop-out terminals for the same shall be provided such that not more than one core is terminated at one terminal. Removable, undrilled cable gland plate shall be provided. Tinned copper lugs and double compression cable glands shall also be supplied by the bidder.

IV. Type RD: It shall have the following:

- i. 125A, 415V, 3-phase-neutral earth, metal clad socket with cover.
- ii. Rotary, heavy duty 125A switch conforming to applicable standard.
- iii. Shrouded, die-cast aluminium plug



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 24 OF 38

iv. It shall be combined, interlocked weather proof industrial unit.

v. Mechanical interlock shall be same as that are applicable for RC type receptacles

vi. The receptacle boxes shall be suitable for entry and exit of 3.5CX95 mm² Al conductor PVC cable and loop-in loop-out terminals for the same shall be provided such that not more than one core is terminated at one terminal. Removable, undrilled cable gland plate shall be provided. Tinned copper lugs and double compression cable glands shall also be supplied by the bidder.

V. Type RE: It shall have the following:

i. 5A, 240V, 1-phase, 2 pole, 3-pin, third pin grounded socket with integral piano key type 5A switch, flush mounted on decorative bakelite (6 mm thick)/ perspex (3 mm thick) sheet as cover of the boxes.

ii. Loop-in loop-out terminals similar to type RA shall be provided. These will be located in office areas.

5.13 CEILING FAN & REGULATORS

a) The bidder shall supply the following ceiling fans complete with suspension rod, canopy and accessories and regulators:

i. 1200 mm sweep

ii. 1400 mm sweep

b) The fan motor shall be totally enclosed. The motor winding shall be of copper wire provided with double or reinforced class-E insulation.

c) The fan shall have three (3) well balanced blades. Precaution shall be taken in the manufacture of fan as well as regulators to ensure reasonable degree of silence at all speeds.

d) The regulator shall be electronic type with stepped/smooth (stepless) control of approved make.

5.14 LIGHTING CONTROL SWITCH-BOXES

a) The switch-boxes shall be of bent steel construction, fabricated of 1.6 mm thick MS steel with 6 mm thick decorative bakelite or 3 mm thick perspex sheet cover. The boxes shall be hot dip galvanised.

b) The switch-boxes shall be suitable for surface mounting as well as flush mounting in brick walls. They shall be flush mounted in the walls in the office areas where false ceiling is provided.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 25 OF 38

- c) Switch-boxes shall have conduit knock-out on two sides. Adequate provision shall be made for ventilation of these boxes. Conduit knock-out sizes shall be as per conduit layout drgs.
- d) Switches shall be of piano-key type having quick-make, quick-break mechanism, provided with position marking, suitable for mounting on insulating plate. The switches shall be suitable for 1-phase, 240V, 50 Hz supply. They shall conform to relevant standards. The switches shall be supplied loose and shall be fixed at site according to requirement.
- e) All components housed in the switch-boxes shall be wired to an outgoing junction box by 1.5 mm² Cu wire. The junction box shall have adequate nos. of terminals.
- f) The size of switch-boxes shall be adequately chosen to accommodate the no. of switches and fan regulator boxes specified below. Fan regulators shall be supplied separately.
- Type SWB1 - Switch board with 1 no. 5A switch, JB type SW1.
 - Type SWB2 - 3 nos. 5A switches and 1 no. fan regulator, JB type SW2.
 - Type SWB2a - 4 nos. 5A switches, JB type SW2.
 - Type SWB3 - 7 nos. 5A switches, 3 nos. fan regulator, JB type SW3.
 - Type SWB3a - 8 nos. 5A switches, JB type SW3.

JB details for lighting control switch boxes are as below:

JB-SW1 Provided with four (4) way stud type terminals, each terminal suitable for terminating upto two nos. of 10 mm² stranded aluminium conductor.

JB-SW2 Similar to the JB-SW1 but provided with ten (10) way terminals.

JB-SW3 Similar to the JB-SW1 but provided with eighteen (18) way terminals.

5.15 CABLE GLANDS

- Whether specifically mentioned or not, cable glands of suitable sizes shall be supplied along with each equipment for power and control cables.
- Rubber components used in the gland shall be of neoprene.
- Name / trade name of manufacturer, type no. and applicable range of outer diameter of cable shall be engraved / indelibly printed on the cable gland.

5.16 CABLE LUGS

- All equipment shall be supplied with the power and control cable lugs of suitable size, whether specifically mentioned or not.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 26 OF 38

- b) Name / trade name and size of lug shall be engraved/ indelibly printed on each cable lug.

5.17 FLEXIBLE METALLIC CONDUITS AND FITTINGS

- a) Flexible metallic conduits shall generally conform to the requirements of IS:3480.
- b) Flexible conduits shall be made of strip steel, which shall be of cold rolled mild steel. The strip shall be of uniform width and thickness throughout.
- c) The strip for making flexible conduit shall be wound tightly and so overlapped in subsequent helicals that no openings are seen in normal position.
- d) The surface of the strip shall be thoroughly cleaned before application of protective coating. Pre-treatment, before galvanization, shall conform to IS:6005.
- e) The strip shall be electro-galvanized to a minimum thickness of 25 microns as per IS 3480.
- f) Flexible conduits shall be lead coated for application in high temperature zones if specifically mentioned in Data Sheet A.
- g) The conduit shall have uniform diameter throughout its length. The internal surface of all conduits shall be free from burrs and sharp edges and suitable for pulling insulated cables and wires without damage.

5.18 PVC CONDUITS

- a) PVC conduits shall generally conform to the requirements of IS: 9537(Part I & Part III).

6.0 SURFACE TREATMENT

- 6.1 All metal parts and the surfaces (exterior & interior) of equipment, unless stated otherwise in case of reflectors, shall be degreased by dipping in hot alkaline solution and rubbed with wire brush to remove oil & scale from them & then rinsed in water. Alternatively, they may be shot / sand blasted.
- 6.2 Parts shall be pickled by dipping in hydrochloric acid tank to remove the rust from the surfaces formed during storage of sheets & then rinsed to remove traces of the acid. The cleaning and pretreatment of all metal parts shall be as per applicable standard.
- 6.3 The surfaces to be painted shall then be prepared by phosphatizing to protect them from further rusting & to create a good bond with the paint. The pretreatment shall conform to the applicable standard.
- 6.4 All parts shall then be subjected to a coat of red oxide primer paint.
- 6.5 All inside and outside surfaces of panel shall be spray painted with synthetic enamel of the shade as per Data Sheet A.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE: 08.09.2016

SHEET 27 OF 38

- 6.6 Electrostatic or powder painting shall be acceptable subject to purchaser's approval.
- 6.7 Wherever possible, finished parts shall be coated with peelable compound by spraying method to protect the finished product from scratches, grease, dirty and oily spots during handling and transportation.

7.0 PACKING

- 7.1 Vendor shall furnish packing procedure along with packing drawing at contract stage for applicable items for purchaser approval.
- 7.2 Containers adequate for storing individual P.O. quantity material at site are to be supplied. Vendor shall furnish suitable justification to purchaser during detailed engineering for the number and size of containers being supplied.
- 7.3 Specification for the sea worthy packing, if enclosed, for the export jobs shall form part of the specification.

8.0 GUARANTEED PERFORMANCE REQUIREMENTS

- 8.1 The vendor shall guarantee satisfactory performance of the equipment supplied under all conditions and requirement as laid down by this specification.
- 8.2 Vendor shall ensure satisfactory performance for lighting system designed by them at site.

9.0 INSPECTION & TESTING

- 9.1 Bidder shall confirm compliance with the BHEL Standard Quality Plan (PE-QP-999-558-E006) without any deviations. The equipment which are not covered in the Quality Plan shall be tested as per the QP to be submitted by bidder. In case bidder has reference QP agreed with ultimate customer, same can be submitted for specific project after award of contract for BHEL/ ultimate customer's approval. There shall be no commercial implication to BHEL on account of any changes in QP during contract stage.
- 9.2 All the components and completely assembled equipment shall be tested as per the latest edition of standards. Charges for these tests shall be deemed to be included in equipment price.
- 9.3 All the specified type and routine tests shall be carried out to verify the rating and performance of the equipment. Where valid type test certificates in evidence of equipment performance claimed are available & approved by purchaser, the requirements for conducting type tests may be waived. The general arrangement of object under test shall be to purchaser's approval.
- 9.4 All manufacturing processes viz. machining, sheet forming, electroplating, wire routing, cleating & crimping, assembly, surface preparation shall conform to good manufacturing practices.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 28 OF 38

9.5 Inspection for dimensional & visual checks especially of the following, with respect to contract drawings, documents & standards shall be conducted:

- a) General sturdiness & rigidity of equipment
- b) Surface finishing
- c) Gasketting
- d) Inter-changeability
- e) Constructional features viz. location, accessibility & marking of components, segregation, accessibility to live parts (shrouding) etc.
- f) Completeness of scope

9.6 Equipment shall be liable for rejection if tolerances on the values of dimensions, power consumption, impedances, temperature rise etc. exceed the specified values by purchaser and / or standards.

10.0 SPARES

- 10.1 Mandatory spares (if applicable) are indicated in BOQ-cum-price schedule.
- 10.2 Erection & commissioning spares are included in the bidder's scope of supply. BE&C spares are indicated in BOQ-cum-price schedule.
- 10.3 A list of recommended O&M spares quantities for a duration of 3 years A shall be filled up in the applicable schedule / format and submitted by bidder along with offer. However, the acceptance of the same shall not be binding on purchaser.

11.0 TOOLS AND TACKLE

- 11.1 Tools & tackle which are essential to facilitate assembly, adjustments, erection, maintenance & dismantling of equipment shall be provided as part of equipment supplied.
- 11.2 The above tools shall be supplied along with the initial consignment of equipment so as to be available prior to erection but may not be used for erection purposes.
- 11.3 Vendor shall also submit a list of recommended tools and tackle. Acceptance of these tools and tackle shall not be a binding on the purchaser.
- 11.4 Schedule of tools & tackle shall be filled up by bidder.

12.0 DOCUMENTATION

12.1 Documents to be submitted by the vendor immediately after award of contract

- a) Bar chart of activities of manufacture, testing, inspection and despatch.

12.2 Documents to be submitted during detailed engineering of contract

- 12.2.1 Engineering documents (refer clause 4.3) to be generated by the vendor, if applicable.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 29 OF 38

- a) Lighting calculations for indoor areas.
- b) Lighting calculations for outdoor areas.
- c) SLD of power distribution upto LPs.
- d) Power load on each LP & LDB
- e) Layout drawings for indoor areas
- f) Layout drawings for outdoor areas.
- g) Conduit layout drawings.
- h) Wiring and load distribution details for outdoor areas.
- i) Master Bill of Material.
- j) Packing Procedure & drawing.
- k) Calculation for selection of no. & size of container.

12.2.2 Other documents :

- a) Final Quality Plans
- b) Technical data sheet
- c) Polar curves, zonal flux diagram and CoU charts of luminaires.
- d) Complete design calculations for arriving at number of luminaires.
- e) Fixing / mounting details of luminaires and other items.
- f) General arrangement drawings of following:
 - i. Luminaires
 - ii. Receptacles
 - iii. 24 V Supply module
- g) Field Quality Plan as per General Technical Conditions.
- h) Control Scheme for fluorescent, HPMV and HPSV luminaires.
- i) Schematic drawings for LDBs / LPs.
- j) Type test certificates.
- k) Catalogues / leaflets

12.3 Operation and Maintenance (O&M) manual :

The document shall comprise of installation, operating and maintenance instructions for various items / components. The O&M manual shall include the following :

- a) Write ups / instructions / procedures for
 - i. Storage at site.
 - ii. Unpacking.
 - iii. Handling at site.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE: 08.09.2016

SHEET 30 OF 38

- iv. Erection.
- v. Pre-commissioning / commissioning tests.
- vi. Operating procedures.
- vii. Maintenance procedures.
- viii. Precautions to be taken during operation and maintenance work.
- ix. Trouble shooting charts covering problems, cause and solution.
- b) Approved Technical Data Sheets.
- c) Technical leaflet of various items / components.
- d) Copies of the type, acceptance and routine test certificates in bound volume.
- e) Details of all components liable to be replaced during the life of the equipment.
- f) List of maintenance tools required.
- g) List of testing equipment required.

12.4 AS BUILT DRAWINGS

- a) Preparation of as-built drawings shall not be in the scope of vendor.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

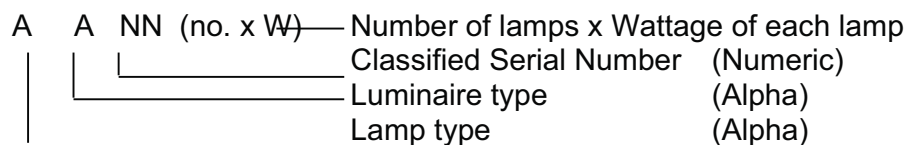
SHEET 31 OF 38

ANNEXURE-I

LUMINAIRE DETAILS

LUMINAIRE CODING SCHEME

1.0 Code Structure



2.0 Lamp types

- a) F - Fluorescent
- b) M - Mercury Vapour
- c) S - Sodium Vapour
- d) T - Tungsten
- e) H - Halogen

3.0 Luminaire types

- a) C - Channel Mounted (Fluorescent)
- b) B - Bay Mounted
- c) W -Well Glass
- d) S - Street Lighting
- e) F - Flood Lighting
- f) H - Bulk Head
- g) P - Post Top Lantern
- h) E - Emergency Lighting
- i) X - Others

4.0 Serial Numbers

- a) 01 - 20 General Purpose (Industrial)
- b) 21 - 40 Decorative
- c) 41 - 50 Vapour Proof
- d) 51 - 60 Dust Proof
- e) 61 - 70 Drip Proof
- f) 81 - 90 Corrosion Proof
- g) 91 - 99 Flame Proof

NOTES :

1. Flood lighting luminaires to have non-integral control gearbox.
2. All other luminaires shall have integral control gearbox, unless specifically mentioned otherwise in enclosed sheets.
3. For more details of each luminaire, refer specification.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 32 OF 38

1.0 Fluorescent Lamp Luminaires

- | | | | |
|------|------|--------|---|
| 1.1 | FC01 | 1 x 28 | Fluorescent, industrial box type base without any cover. |
| 1.2 | FC02 | 2 x 28 | Fluorescent, industrial box type base without any cover. |
| 1.3 | FC03 | 1 x 28 | Fluorescent, industrial box type base and stove enamelled side reflectors. |
| 1.4 | FC04 | 2 x 28 | Fluorescent, industrial box type base and stove enamelled side reflectors. |
| 1.5 | FC05 | 1 x 28 | Fluorescent, industrial box type base and vitreous enamelled side reflectors. |
| 1.6 | FC06 | 2 x 28 | Fluorescent, industrial box type base and vitreous enamelled/ anodized glossy side reflectors. |
| 1.7 | FC07 | 1 x 18 | Fluorescent, industrial box type base and vitreous enamelled side reflectors operating on 220V DC input supply. |
| 1.8 | FC21 | 1 x 28 | Fluorescent, decorative with 3 side perspex acrylic diffuser. |
| 1.9 | FC22 | 2 x 28 | Fluorescent, decorative with 3 side perspex acrylic diffuser. |
| 1.10 | FC23 | 1 x 28 | Fluorescent, decorative, recessed type with perspex acrylic diffuser. |
| 1.11 | FC24 | 2 x 28 | Fluorescent, decorative, recessed type with perspex acrylic diffuser. |
| 1.12 | FC25 | 1 x 28 | Fluorescent, decorative, recessed type with mirror optic reflector. |
| 1.13 | FC26 | 2 x 28 | Fluorescent, decorative, recessed type with mirror optic reflector. |
| 1.14 | FC27 | 2 x 28 | Fluorescent, decorative with opal polystyrene louvers. |
| 1.15 | FC28 | 2 x 28 | Fluorescent, decorative, recessed type with opal polystyrene louvers. |
| 1.16 | FC29 | 2 x 28 | Fluorescent, decorative with vertical metallic louvers. |
| 1.17 | FC30 | 4 x 14 | Fluorescent, decorative, recessed type, 600 x 600 size with perspex acrylic diffuser. |
| 1.18 | FC31 | 4 x 20 | Fluorescent, decorative, recessed type, 600 x 600 size with opal polystyrene louvers. |



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 33 OF 38

- | | | | |
|------|------|--------|---|
| 1.19 | FC32 | 2 x 28 | Fluorescent, decorative, surface mounted with mirror optic reflector. |
| 1.20 | FC33 | 1 x 18 | Fluorescent, decorative, recessed type with mirror optic reflector operating on 220V DC input supply. |
| 1.21 | FC34 | 1 x 18 | Fluorescent, dust proof, totally enclosed type with sheet steel housing operating on 220V DC input supply |
| 1.22 | FC41 | 2 x 28 | Fluorescent, vapour proof with end boxes and controlgear box of cast Al. |
| 1.23 | FC51 | 2 x 28 | Fluorescent, dust proof, totally enclosed type with sheet steel housing. |
| 1.24 | FC61 | 1 x 28 | Fluorescent, street light with sheet aluminium canopy and ribbed acrylic cover. |
| 1.25 | FC62 | 2 x 28 | Fluorescent, street light with sheet aluminium canopy and ribbed acrylic cover. |
| 1.26 | FC81 | 2 x 28 | Fluorescent, corrosion proof, totally enclosed type with sheet aluminium/ polycarbonate housing. |

2.0 High Pressure Mercury Vapour (HPMV) Lamp Luminaire

- | | | | |
|------|------|----------|--|
| 2.1 | MB01 | 1 x 250 | Mercury, high bay, industrial type. |
| 2.2 | MB02 | 1 x 400 | Mercury, high bay, industrial type. |
| 2.3 | MB03 | 1 x 1000 | Mercury, high bay, industrial type. |
| 2.4 | MB04 | 1 x 250 | Mercury, high bay, totally enclosed industrial type. |
| 2.5 | MB05 | 1 x 400 | Mercury, high bay, totally enclosed industrial type. |
| 2.6 | MB06 | 1 x 250 | Mercury, high bay with non-integral controlgear box. |
| 2.7 | MB07 | 1 x 400 | Mercury, high bay with non-integral controlgear box. |
| 2.8 | MB11 | 1 x 250 | Mercury, medium bay, industrial type. |
| 2.9 | MB12 | 1 x 400 | Mercury, medium bay, industrial type. |
| 2.10 | MB13 | 1 x 250 | Mercury, medium bay, totally enclosed industrial type. |
| 2.11 | MB14 | 1 x 400 | Mercury, medium bay, totally enclosed industrial type. |



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 34 OF 38

- | | | | |
|------|------|---------|--|
| 2.12 | MB17 | 1 x 80 | Mercury, low bay, industrial type. |
| 2.13 | MB18 | 1 x 125 | Mercury, low bay, industrial type. |
| 2.14 | MB19 | 1 x 80 | Mercury, low bay, totally enclosed industrial type. |
| 2.15 | MB20 | 1 x 125 | Mercury, low bay, totally enclosed industrial type. |
| 2.16 | MW41 | 1 x 80 | Mercury, well glass, vapour proof with vitreous enamelled reflector. |
| 2.17 | MW42 | 1 x 125 | Mercury, well glass, vapour proof with vitreous enamelled reflector. |
| 2.18 | MW51 | 1 x 80 | Mercury, well glass, dust proof with vitreous enamelled reflector. |
| 2.19 | MW52 | 1 x 125 | Mercury, well glass, dust proof with vitreous enamelled reflector. |
| 2.20 | MW91 | 1 x 80 | Mercury, well glass, flame proof with vitreous enamelled reflector and cast aluminium alloy LM6 housing. |
| 2.21 | MW92 | 1 x 125 | Mercury, well glass, flame proof with vitreous enamelled reflector and cast aluminium alloy LM6 housing. |
| 2.22 | MW93 | 1 x 80 | Mercury, well glass, flame proof with vitreous enamelled reflector and cast aluminium alloy LM6 housing |
| 2.23 | MW94 | 1 x 125 | Mercury, well glass, flame proof with vitreous enamelled reflector and cast aluminium alloy LM6 housing. |
| 2.24 | MW95 | 1 x 80 | Mercury, well glass, flame proof increased safety luminaire with vitreous enamelled reflector and cast aluminium alloy LM6 housing for Div.-2 areas. |
| 2.25 | MW96 | 1 x 125 | Mercury, well glass, flame proof increased safety luminaire with vitreous enamelled reflector and cast aluminium alloy LM6 housing for Div. 2 areas. |
| 2.26 | MW98 | 1 x 125 | Mercury, well glass, flame proof increased safety luminaire with vitreous enamelled reflector and cast aluminium alloy LM6 housing |
| 2.27 | MS61 | 1 x 125 | Mercury, street light with one piece cast aluminium body. |
| 2.28 | MS62 | 1 x 250 | Mercury, street light with two piece cast aluminium body. |
| 2.29 | MS63 | 1 x 400 | Mercury, street light with two piece cast aluminium body. |



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 35 OF 38

- 2.30 MF61 1 x 250 Mercury, flood light, general purpose.
2.31 MF62 1 x 400 Mercury, flood light, heavy duty type.
2.32 MF63 2 x 400 Mercury, flood light, heavy duty type.
2.33 MP21 1 x 80 Mercury, post top lantern
2.34 MP22 1 x 125 Mercury, post top lantern

3.0 High Pressure Sodium Vapour (HPSV) Lamp Luminaire

- 3.1 SB01 1 x 150 Sodium, high bay, industrial type.
3.2 SB02 1 x 250 Sodium, high bay, industrial type.
3.3 SB03 1 x 400 Sodium, high bay, industrial type.
3.4 SB04 1 x 150 Sodium, high bay, totally enclosed industrial type.
3.5 SB05 1 x 250 Sodium, high bay, totally enclosed industrial type.
3.6 SB06 1 x 400 Sodium, high bay, totally enclosed industrial type.
3.7 SB07 1 x 150 Sodium, high bay with non-integral controlgear box.
3.8 SB08 1 x 250 Sodium, high bay with non-integral controlgear box.
3.9 SB09 1 x 400 Sodium, high bay with non-integral controlgear box.
3.10 SB11 1 x 150 Sodium, medium bay, industrial type.
3.11 SB12 1 x 250 Sodium, medium bay, industrial type.
3.12 SB13 1 x 150 Sodium, medium bay, totally enclosed industrial type.
3.13 SB14 1 x 250 Sodium, medium bay, totally enclosed industrial type.
3.14 SB17 1 x 70 Sodium, low bay, industrial type.
3.15 SB18 1 x 150 Sodium, low bay, industrial type.
3.16 SB19 1 x 70 Sodium, low bay, totally enclosed industrial type.
3.17 SB20 1 x 150 Sodium, low bay, totally enclosed industrial type.
3.18 SW41 1 x 70 Sodium, well glass, vapour proof with vitreous enamelled/
powder coated type reflector.



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 36 OF 38

- | | | | |
|------|------|---------|---|
| 3.19 | SW42 | 1 x 150 | Sodium, well glass, vapour proof with vitreous enamelled/ powder coated type reflector. |
| 3.20 | SW51 | 1 x 70 | Sodium, well glass, dust proof with vitreous enamelled reflector. |
| 3.21 | SW52 | 1 x 150 | Sodium, well glass, dust proof with vitreous enamelled reflector. |
| 3.22 | SW91 | 1 x 70 | Sodium, well glass, flame proof with vitreous enamelled reflector and cast aluminium alloy LM6 housing. |
| 3.23 | SW92 | 1 x 150 | Sodium, well glass, flame proof with vitreous enamelled reflector and cast aluminium alloy LM6 housing. |
| 3.24 | SW93 | 1 x 70 | Sodium, well glass, flame proof with vitreous enamelled reflector and cast aluminium alloy LM6 housing. |
| 3.26 | SW95 | 1 x 70 | Sodium, well glass, flame proof increased safety luminaire with vitreous enamelled reflector and cast aluminium alloy LM6 housing for Div. 2 areas. |
| 3.27 | SW96 | 1 x 150 | Sodium, well glass, flame proof increased safety luminaire with vitreous enamelled reflector and cast aluminium alloy LM6 housing for Div. 2 areas. |
| 3.28 | SS61 | 1 x 70 | Sodium, street light with one piece cast aluminium body. |
| 3.29 | SS62 | 1 x 150 | Sodium, street light with one piece cast aluminium body. |
| 3.30 | SS63 | 1 x 250 | Sodium, street light with two piece cast aluminium body. |
| 3.31 | SS64 | 1 x 400 | Sodium, street light with two piece cast aluminium body. |
| 3.32 | SF61 | 1 x 250 | Sodium, flood light, general purpose. |
| 3.33 | SF62 | 1 x 400 | Sodium, flood light, general purpose. |
| 3.34 | SF63 | 1 x 250 | Sodium, flood light, heavy duty type. |
| 3.35 | SF64 | 1 x 400 | Sodium, flood light, heavy duty type. |
| 3.36 | SF65 | 2 x 250 | Sodium, flood light, heavy duty type. |
| 3.37 | SF66 | 2 x 400 | Sodium, flood light, heavy duty type. |
| 3.38 | SP21 | 1 x 70 | Sodium, post top lantern. |



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 37 OF 38

4.0 Tungsten Lamp Luminaires

- | | | | |
|------|------|---------|--|
| 4.1 | TW41 | 1 x 100 | Tungsten, well glass, vapour proof with vitreous enamelled reflector. |
| 4.2 | TW42 | 1 x 200 | Tungsten, well glass, vapour proof with vitreous enamelled reflector. |
| 4.3 | TW51 | 1 x 100 | Tungsten, well glass, dust proof with vitreous enamelled reflector. |
| 4.4 | TW52 | 1 x 200 | Tungsten, well glass, dust proof with vitreous enamelled reflector. |
| 4.5 | TW91 | 1 x 100 | Tungsten, well glass, flame proof with vitreous enamelled reflector. |
| 4.6 | TW92 | 1 x 200 | Tungsten, well glass, flame proof with vitreous enamelled reflector. |
| 4.7 | TW95 | 1 x 100 | Tungsten, well glass, increased safety (Div. 2) with vitreous enamelled reflector. |
| 4.8 | TW96 | 1 x 200 | Tungsten, well glass, increased safety (Div. 2) with vitreous enamelled reflector. |
| 4.9 | TB21 | 1 x 60 | Tungsten, bulk head, weather proof. |
| 4.10 | TB22 | 1 x 100 | Tungsten, bulk head, weather proof. |
| 4.11 | TB91 | 1 x 100 | Tungsten, bulk head, flame proof. |
| 4.12 | TB92 | 1 x 200 | Tungsten, bulk head, flame proof. |
| 4.13 | TP21 | 1 x 200 | Tungsten, post top lantern. |
| 4.14 | TE02 | 1 x 20 | Tungsten, portable emergency unit with rechargeable battery. |
| 4.15 | TE02 | 1 x 40 | Tungsten, portable emergency unit with rechargeable battery. |
| 4.16 | TX01 | 1 x 60 | Tungsten, dispersive vitreous enamelled reflector. |
| 4.17 | TX02 | 1 x 100 | Tungsten, dispersive vitreous enamelled reflector. |
| 4.18 | TX03 | 1 x 75 | Decorative recessed mounting luminaire suitable for comptalux lamp. |
| 4.19 | TX04 | 1 x 100 | Decorative recessed mounting luminaire suitable for comptalux lamp. |



**TECHNICAL SPECIFICATION FOR
LIGHTING FIXTURES, LAMPS &
MISCELLANEOUS ITEMS**

SPECIFICATION NO. PE-SS-999-558-E006

VOLUME II

SECTION II

REVISION: 0

DATE:

SHEET 38 OF 38

4.20 TX05 2 x 100 Double obstruction aviation light of cast Al. alloy with red glass.

5.0 Halogen

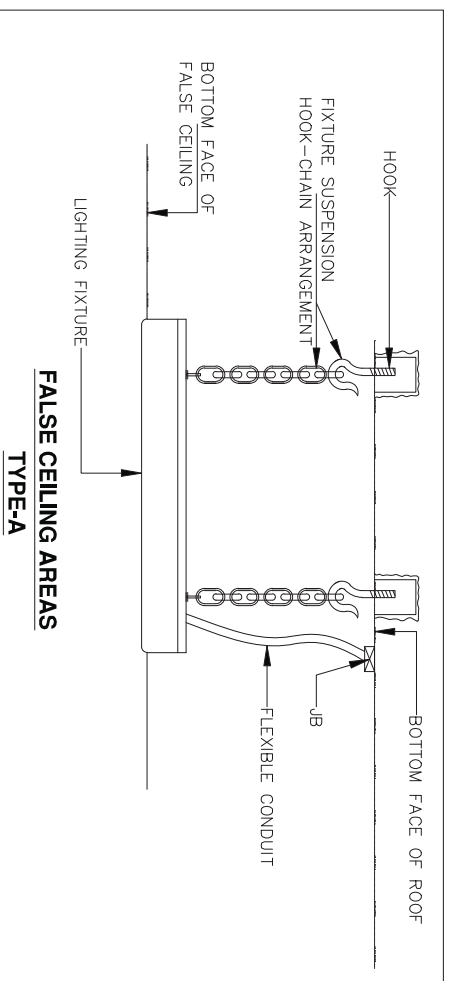
5.1 HF61 1 x 300 Halogen, flood light, drip proof.

5.2 HF62 1 x 500 Halogen, flood light, drip proof.

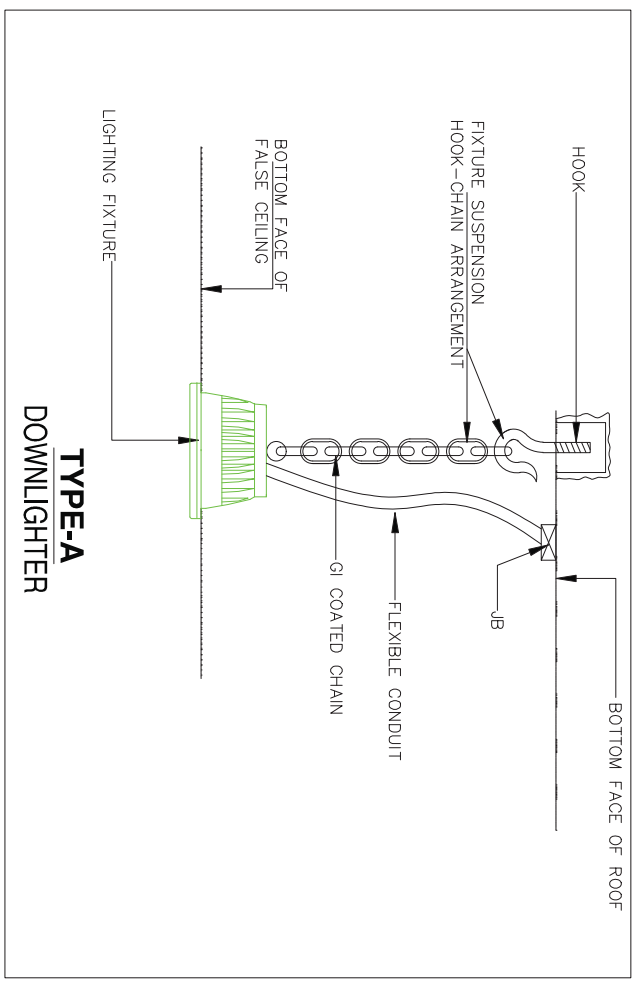
5.3 HF63 1 x 750 Halogen, flood light, drip proof.

5.4 HF64 1 x 1000 Halogen, flood light, drip proof.

ANNEXURE-1

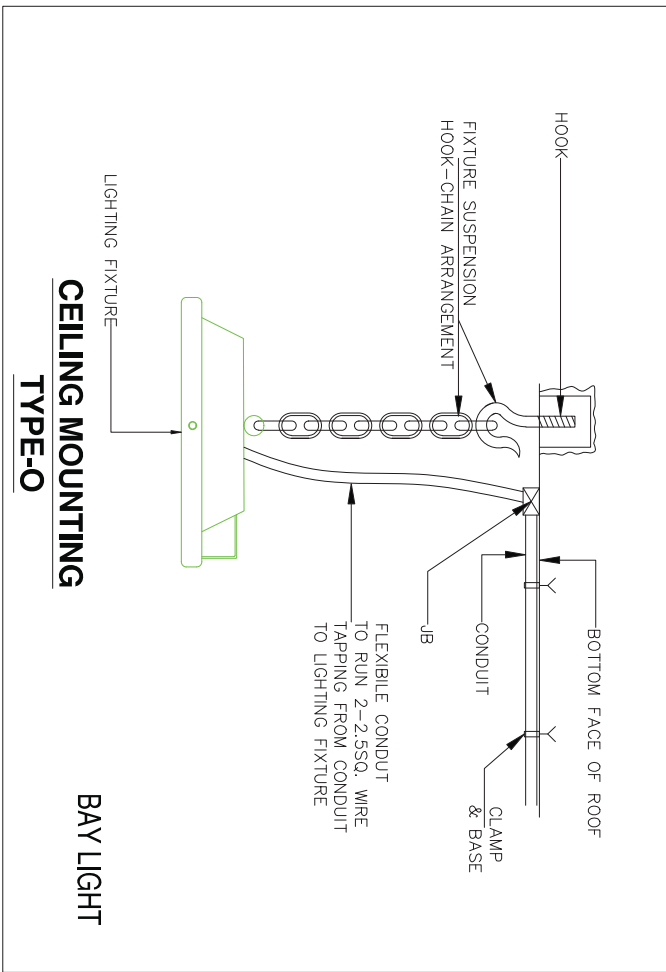
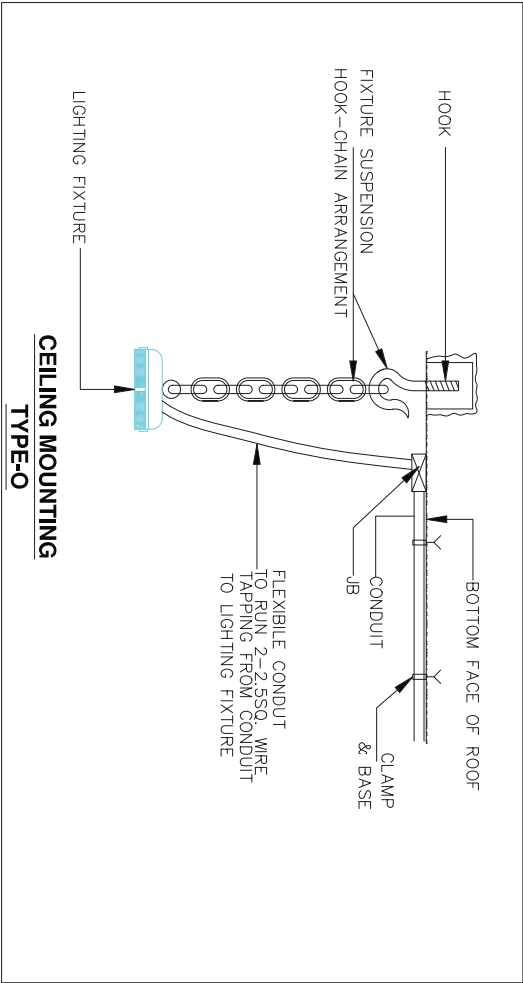
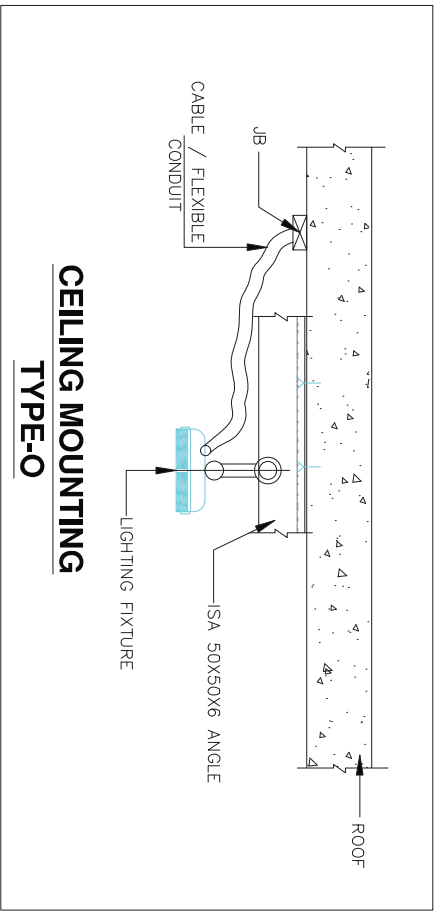


This is a typical mounting arrangement dwgs/ details for guidance only. Final Mounting arrangement dwg shall be made by the successful bidder during detailed Engineering. It is to be noted that GI Conduit 20mm Dia and Flexible PVC Coated Conduit, Structural Steel shall be provided by BHEL. Balance all other accessories clamps/ chains/ clips/ steel rope/ pins etc required for mounting as per typical mounting arrangement for their fixtures shall be part of fixtures only and shall be provided by the Bidders.

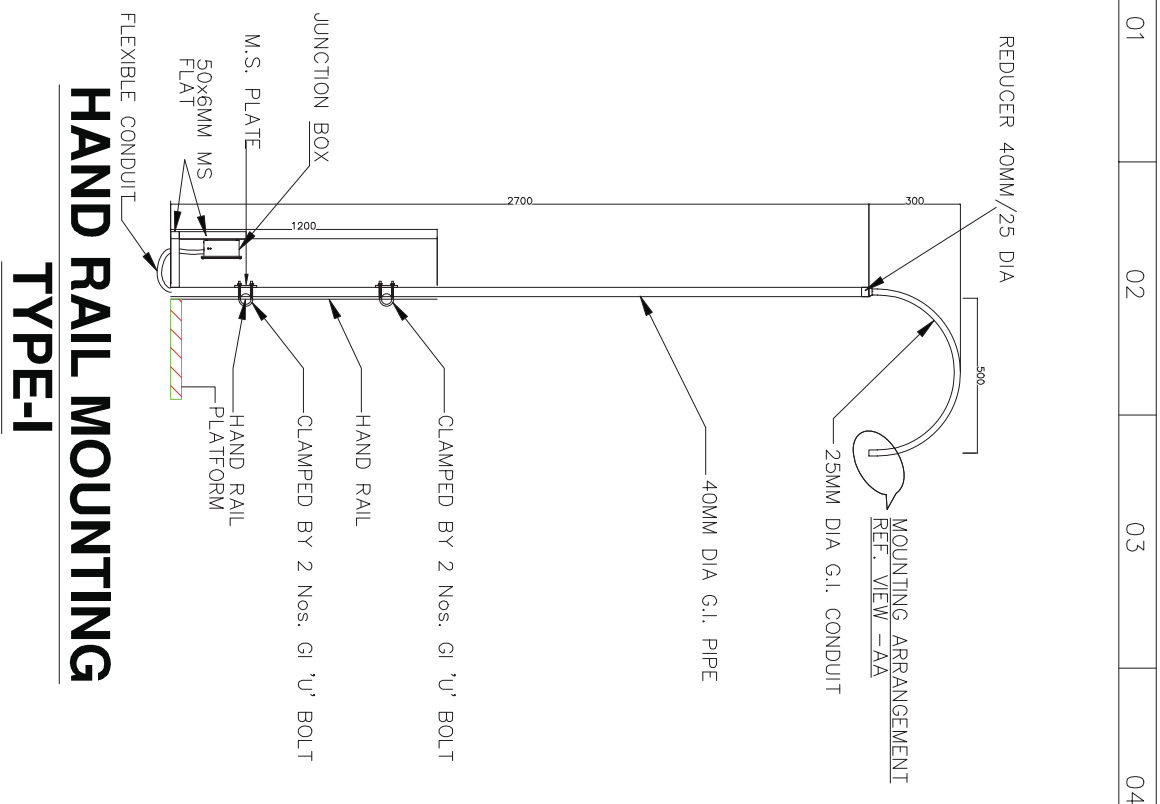


2. In lighting layout, Mounting arrangement also shown. If any Discrepancy found on both documents then Consult with Design Incharge/Site Incharge.
3. During the Material shop in drawings the contractor may be change or vary as per site requirement.
4. If any change in the arrangement of site or drawing or change the arrangement with prior inform to BHEL site Incharge.
5. All structural steel parts/supporting parts shall be hot dip galvanized as per IS 800/15.

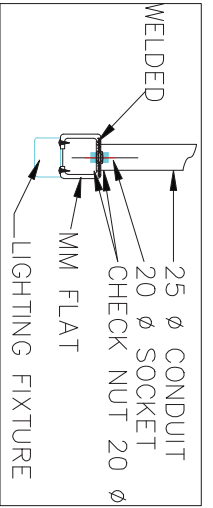
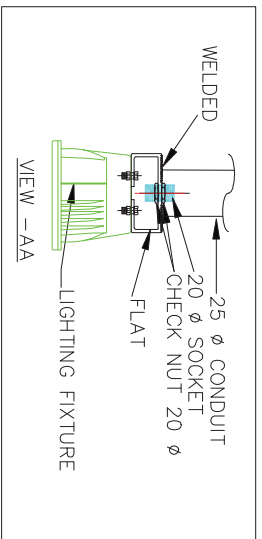
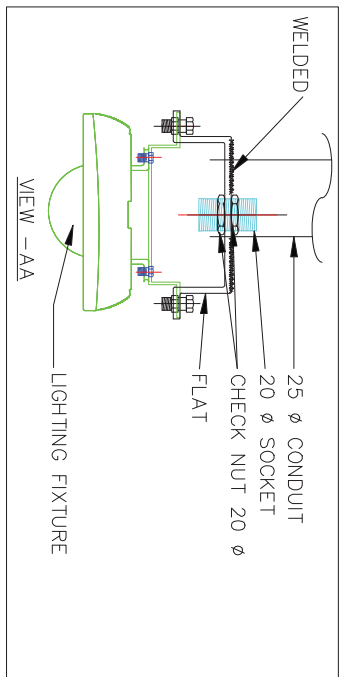
SIZE-A4



- General Notes:
1. Mounting arrangement can be changed/ modified on site as per site requirements.
 2. In Lighting layout, Mounting arrangement also shown. If any Descrpecy found on both documents then Consult with Design Incharge/ Site Incharge.
 3. Quantity and Material shown in drawings are inclusive only and may be change or vary as per site requirement.
 4. If any new type of mounting required at site then we can optimized or change the arrangement with prior inform to BHFL site Incharge.
 5. All structural steel parts/supporting parts shall be hot dip galvanized as per BQd/IS.

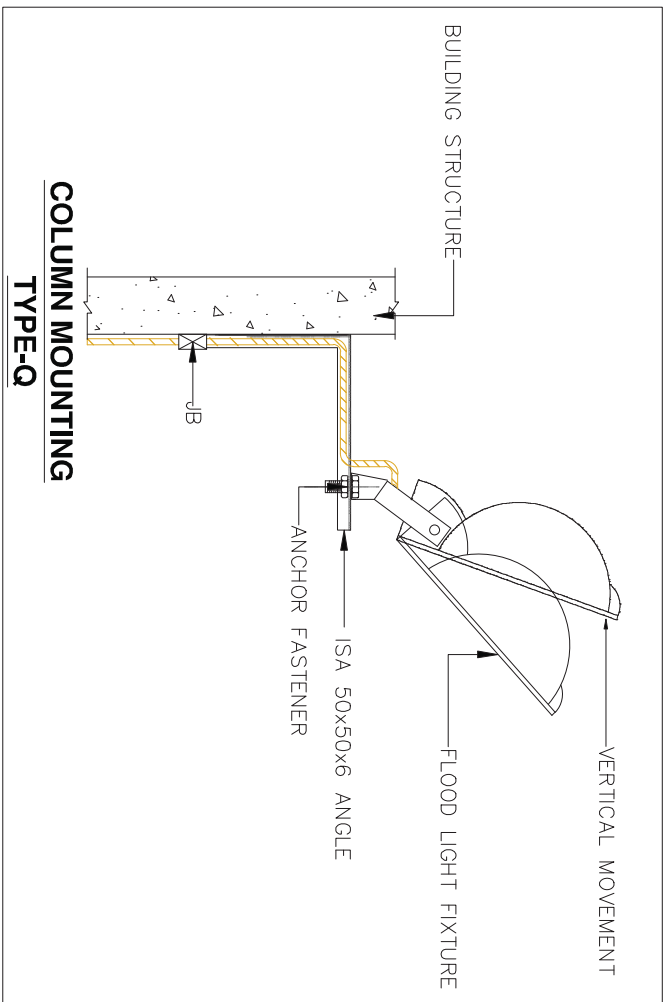
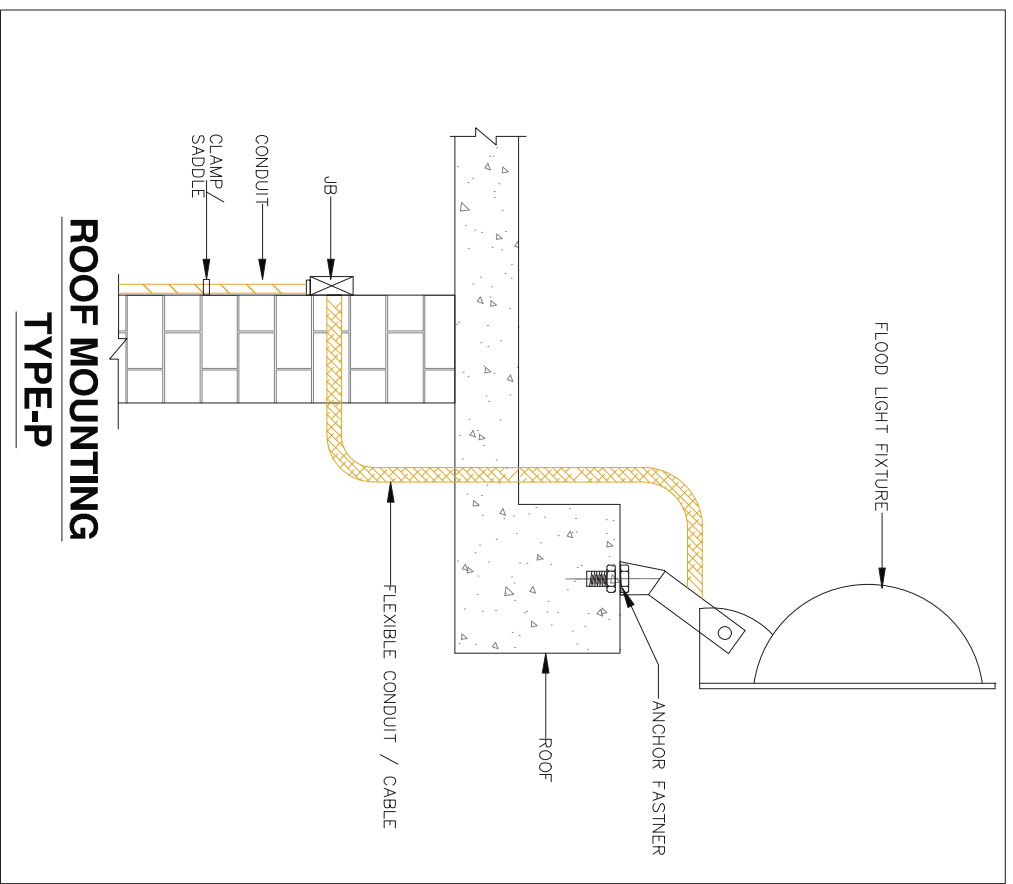


HAND RAIL MOUNTING TYPE-I



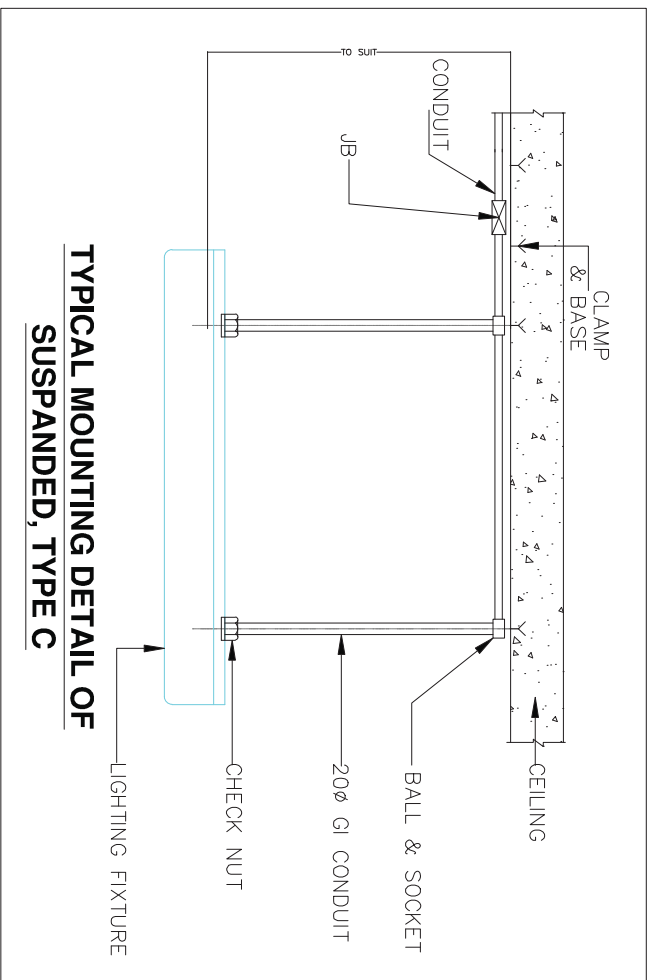
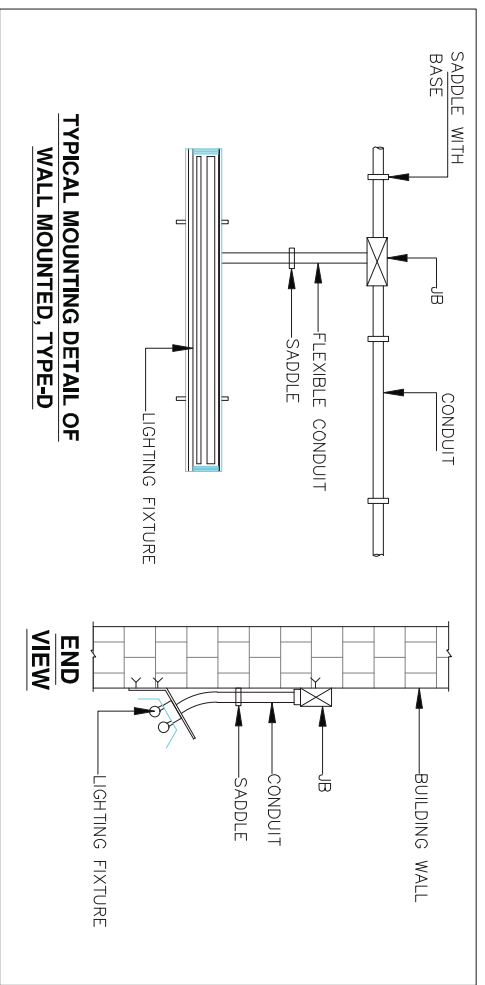
- General Notes:
1. Mounting arrangement can be changed/ modified on site as per site requirements.
 2. In Lighting layout, Mounting arrangement also shown. If any Discrepancy found on both documents than Consult with Design Incharge/Site Incharge.
 3. Depending on Material shown in drawings site Incharge may be change or vary as per site requirement.
 4. If any new material shown in drawings site Incharge may be change or vary as per requirement.
 5. All structural steel parts/supporting parts shall be hot dip galvanized as per IS 800/15.

SIZE-44



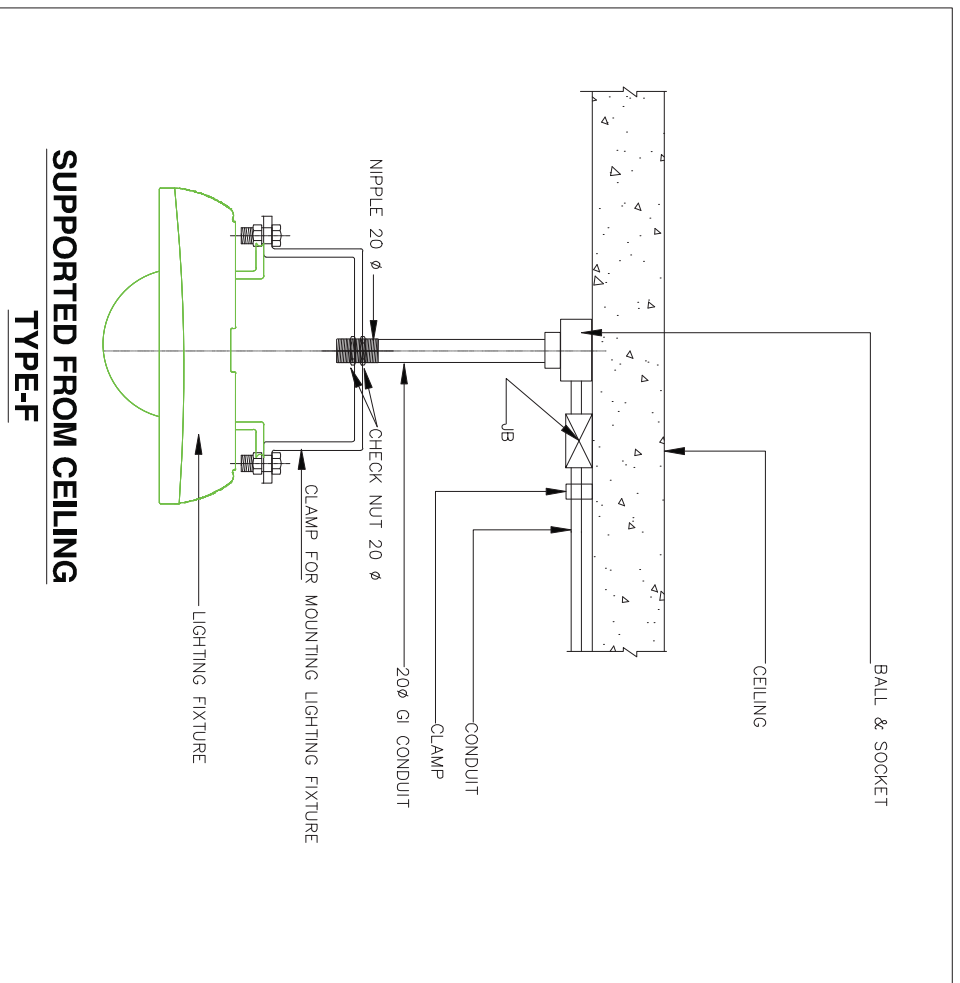
- General Notes:
1. Mounting arrangement can be changed/ modified on site as per site requirements.
 2. In Lighting layout, Mounting arrangement also shown. If any Discrepancy found on both documents then Consult with Design Incharge/Site Incharge.
 3. Drawing and Material should be arranged as per drawings site or change the arrangement with prior inform to BHHL site Incharge.
 4. If any special parts are required for the arrangement or change the arrangement with prior inform to BHHL site Incharge.
 5. All structural steel parts/supporting parts shall be hot dip galvanized as per IS 800/15.

SIZE-44

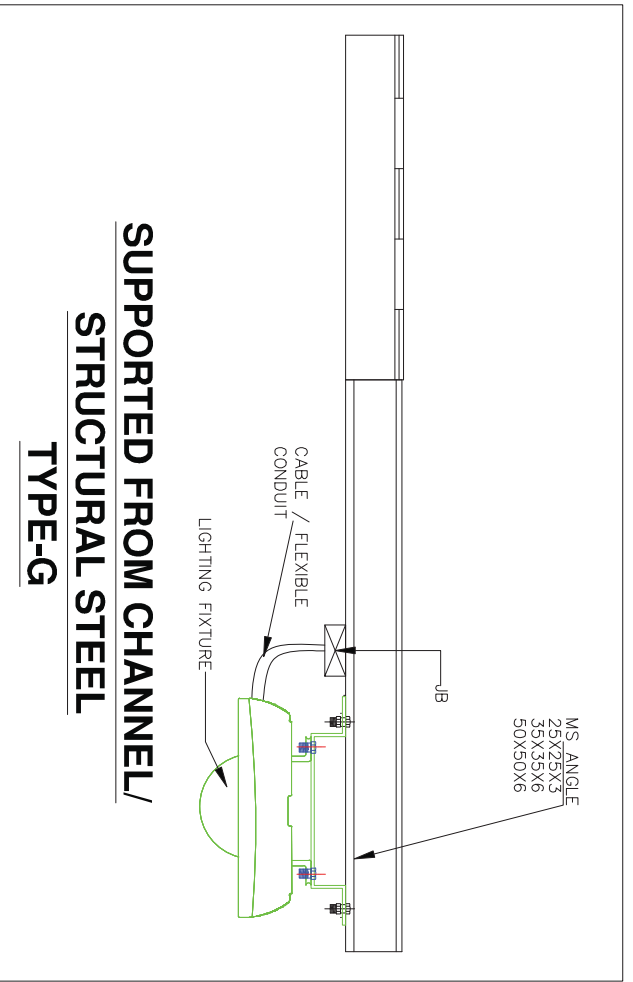


- General Notes:
1. Mounting arrangement can be changed/ modified on site as per site requirements.
 2. In Lighting layout, Mounting arrangement also shown. If any Discrepancy found on both documents than Consult with Design Incharge/Site Incharge.
 3. Mounting Material shown in drawings shall be inclusive only as per site requirement.
 4. If any new material shown in drawings shall be approved or changed on prior inform to BHLL site Incharge.
 5. All structural steel parts/supporting parts shall be hot dip galvanized as per IS 800/15.

SIZE-A4



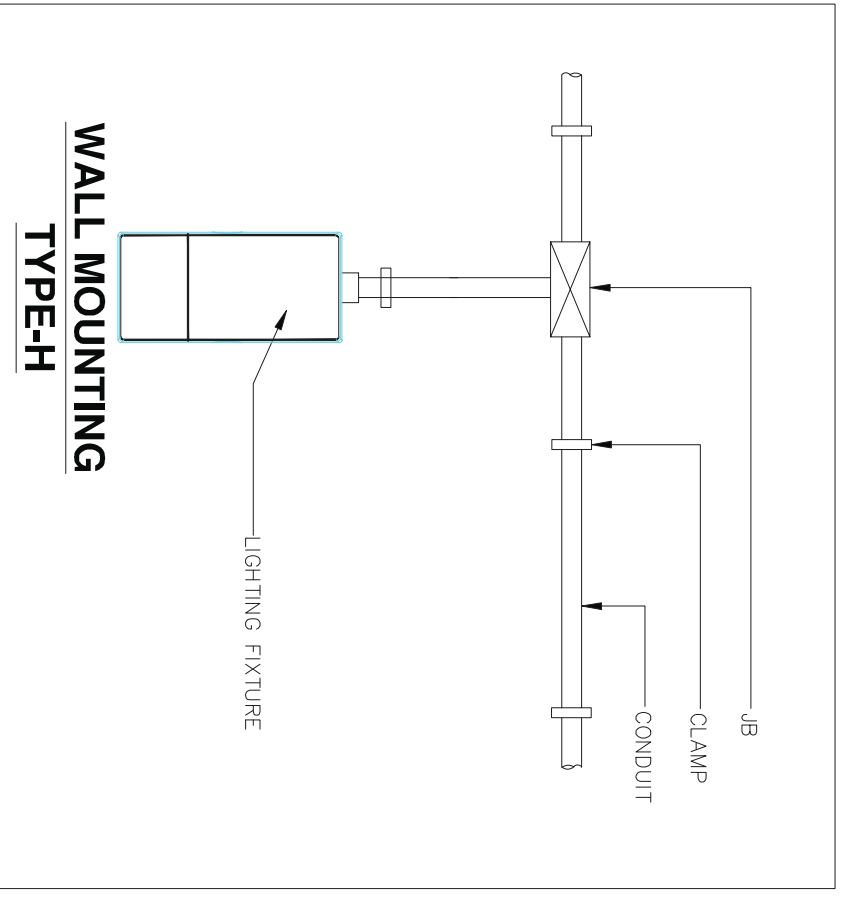
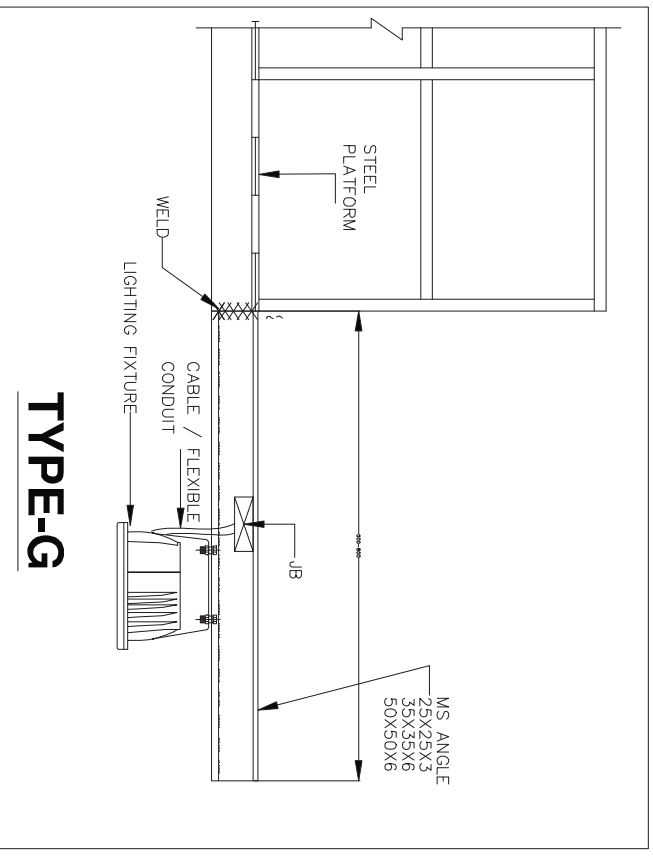
**SUPPORTED FROM CEILING
TYPE-F**



**SUPPORTED FROM CHANNEL/
STRUCTURAL STEEL
TYPE-G**

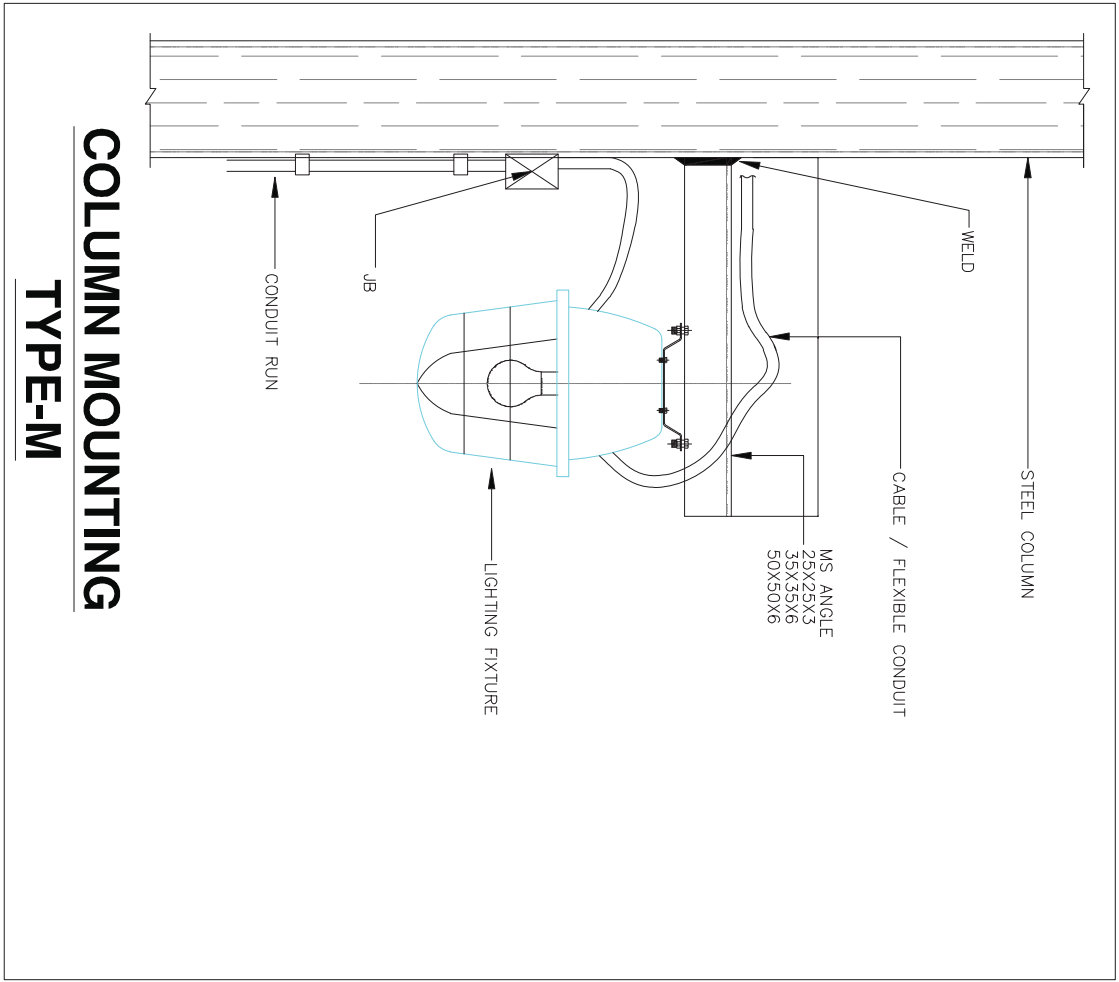
- General Notes:
1. Mounting arrangement can be changed/ modified on site as per site requirements.
 2. In Lighting layout, Mounting arrangement also shown. If any Discrepancy found on both documents then Consult with Design Incharge/Site Incharge.
 3. Mounting Material shown in drawings shall be as per site requirement.
 4. If any change in mounting arrangement on site then arrangement shall be changed or approved or change the arrangement with prior inform to BHLL site Incharge.
 5. All structural steel parts/supporting parts shall be hot dip galvanized as per IS 800/15.

SIZE-A4

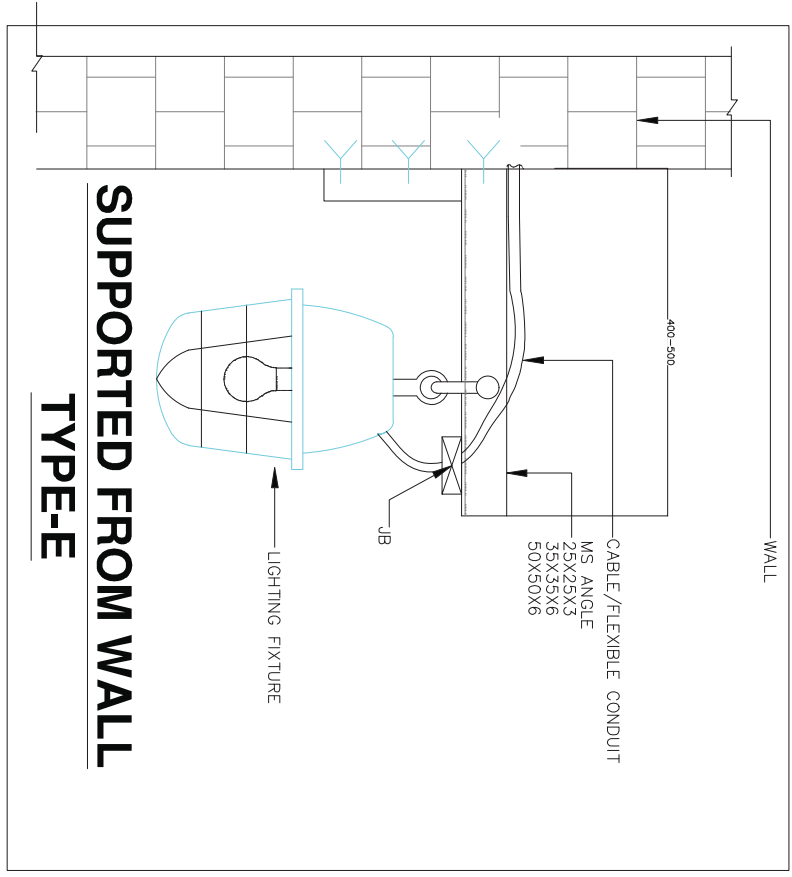


- General Notes:
1. Mounting arrangement can be changed/ modified on site as per site requirements.
 2. In Lighting layout, Mounting arrangement also shown. If any Discrepancy found on both documents then Consult with Design Incharge/Site Incharge.
 3. Mounting Material shown in drawings shall be inclusive only or may be change or vary as per site requirement.
 4. If any new plan or drawing is required on site then the arrangement shall be approved by BHFL site Incharge.
 5. All structural steel parts/supporting parts shall be hot dip galvanized as per IS 800/15.

SIZE-A4



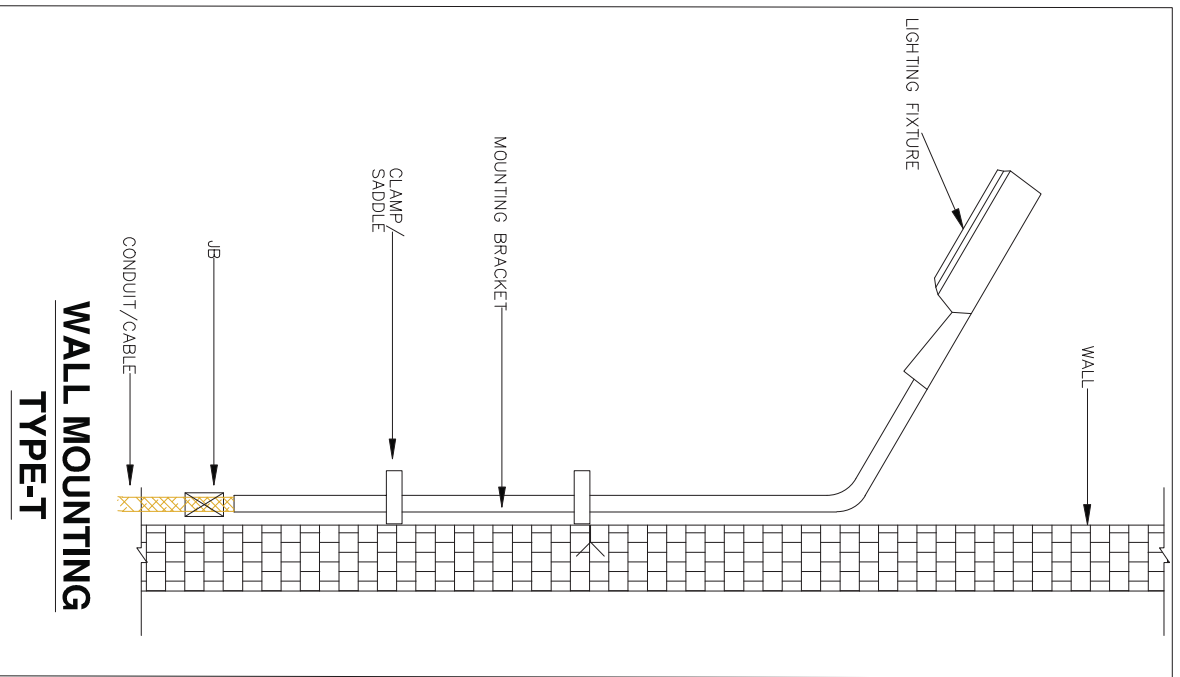
COLUMN MOUNTING TYPE-M



SUPPORTED FROM WALL TYPE-E

- General Notes:
1. Mounting arrangement can be changed/ modified on site as per site requirements.
 2. In Lighting layout, Mounting arrangement also shown. If any Discrepancy found on both documents than Consult with Design Incharge/Site Incharge.
 3. Quantity and Material shown in drawings are indicative only and may be change or vary as per site requirement.
 4. If any new type of mounting required at site than we can optimized or change the arrangement with prior inform to BHEL site incharge.
 5. All structural steel parts/supporting parts shall be hot dip galvanized as per B00/TS.

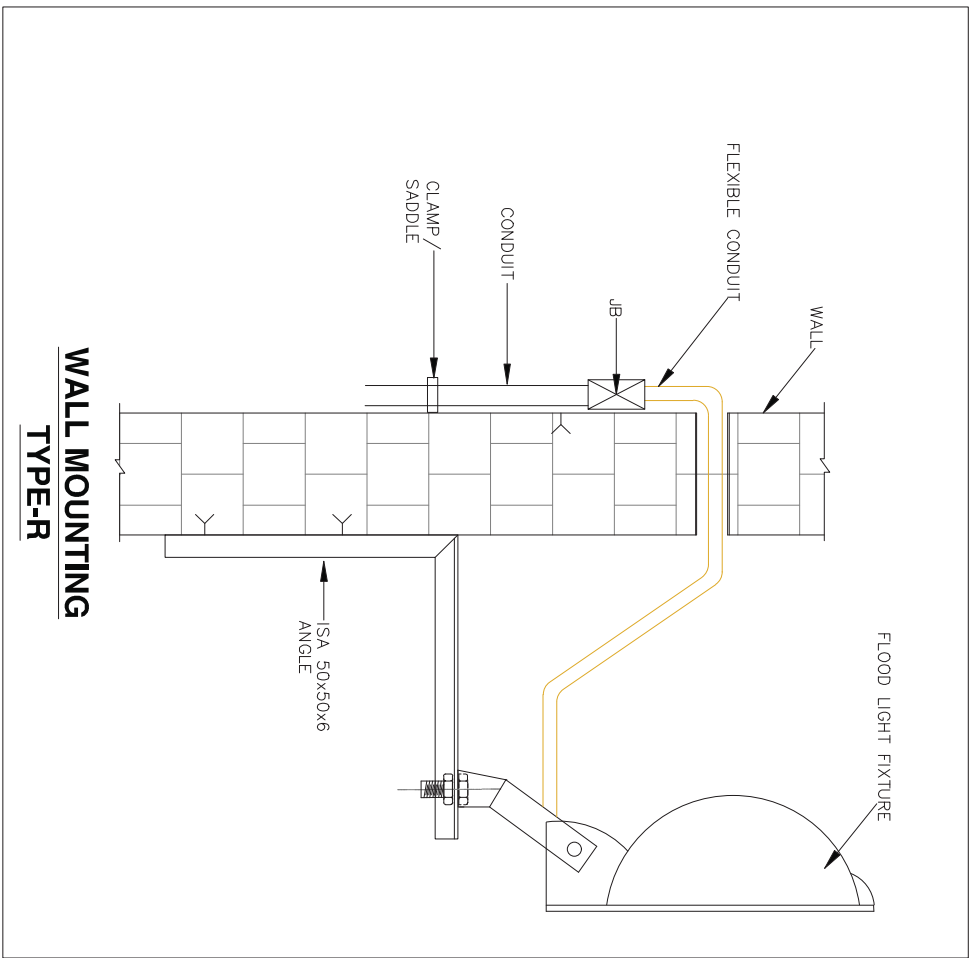
SIZE-A4



General Notes:

1. Mounting arrangement can be changed/ modified on site as per site requirements.
2. In lighting layout, Mounting arrangement also shown. If any discrepancy found on both documents then Consult with Design Incharge/Site Incharge.
3. Quantity and Material shown in drawings are indicative only and may be change or vary as per site requirement.
4. If any new type of mounting required at site then we can optimized or change the arrangement with prior inform to BHEL site Incharge.
5. All structural steel parts/supporting parts shall be hot dip galvanized as per BDD/TS.

SIZE-A4



**WALL MOUNTING
TYPE-R**

- General Notes:
1. Mounting arrangement can be changed/ modified on site as per site requirements.
 2. In lighting layout, Mounting arrangement also shown. If any discrepancy found on both documents then Consult with Design incharge/Site incharge.
 3. Quantity and Material shown in drawings are indicative only and may be change or vary as per site requirement.
 4. If any new type of mounting required at site then we can optimized or change the arrangement with prior inform to BHHL site incharge.
 5. All structural steel parts/supporting parts shall be hot dip galvanized as per B00/7S.

SIZE-A4



ITEM : LIGHTING FIXTURES (Conventional and LED type)

STANDARD QUALITY PLAN

QP.No:0000-999-QOE-S-062

REVIEWED BY

APPROVED BY

Rev No.: 01

SWAPNESWAR MISHRA

Date: 02/11/18

VIKRAM TALWAR

VALID UPTO: 01/11/18

SUNIL MAJANI



Sl No	COMPONENT & OPERATIONS	CHARACTERISTICS / INSTRUMENTS	CLASS OF CHECK	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	REMARKS			
					6M	65N				M	C	N	II

Note: 1) Lighting fixture supplier to ensure that constructional features of the lighting fixture (conventional & LED type) are as per NTPC specification requirements
 2) Lighting fixture supplier to maintain all quality control records identified in this QP whether it is identified for NTPC verification or witness or no.

Conventional type Lighting Fixture

A	Bought out items / in-process checks												
1	Lamps	Make, rating & type	Major	Visual	1 sample per type	1 sample per type	NTPC specification requirements for rating & type, Make to be BIS approved with CML number	NTPC specification requirements for rating & type, Make to be BIS approved with CML number		V	-	-	
1.1	Electronic Ballast (if applicable)	a Certificate of compliance	Major	Visual	-	-	NTPC specification requirements	Certificate of compliance by ballast manufacturer / lighting fixture supplier that ballast meets all NTPC specification requirements	Certificate of compliance	V	-	-	
		b THD and pf check	Major	Electrical	Min 1 std.	-	NTPC specification requirements	THD <= 0% , pf >= 0.9 for FH type and pf >= 0.95 for other type of fluorescent lighting fixtures	Inspection report	P/V *	-	-	P/V * - means test will be performed either by lighting fixture supplier or their sub-vendor as Verified by lighting fixture supplier
1.2	Castings	Freedom from defects	Major	Visual	Min 1 std.	-	NTPC specification requirements	Castings shall be free from any defects such as blow holes, surface blisters, cracks and cavities etc.	Inspection report	P/V *	-	-	P/V * - means test will be performed either by lighting fixture supplier or their sub-vendor as Verified by lighting fixture supplier
1.3	Sheet metal forming and fabrication	Freedom from defects	Major	Visual	Min 1 std.	-	NTPC specification requirements	sheet metal fabrication / forming etc should be as per manufacturer drgs	Inspection report	P/V *	-	-	P/V * - means test will be performed either by lighting fixture supplier or their sub-vendor as Verified by lighting fixture supplier
1.4	Pre-treatment and powder coating	Pre-treatment process checks, Powder coating finish, thickness, uniformity of coating and adhesion	major	Visual, chemical & mech	Min 1 std.	-	Manufacturer standard, NTPC specification requirements	Nominal coating thickness 50 microns or more	Inspection report	P/V *	-	-	P/V * - means test will be performed either by lighting fixture supplier or their sub-vendor as Verified by lighting fixture supplier

LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. * M: MANUFACTURER/ SUB-SUPPLIER; C: MAIN SUPPLIER, N: NTPC; P: PERFORM; W: WITNESS AND V: VERIFICATION. CHP: CUSTOMER HOLD POINT BY NTPC SHALL BE IDENTIFIED UNDER AGENCY COLUMN "V" AS 'W'.

Format No.: QS-01-QAI-T-10/F3-R0

Engg. Div./QA&I



ITEM : LIGHTING FIXTURES (Conventional and LED type)

STANDARD QUALITY PLAN

QP.No:800-999-Q0 :S-062

REVIEWED BY

APPROVED BY

Rev No: 00

SWAPNESWAR MSHRA

Date: 02/11/15

VIKRAM TALWAR

VALID UPTO: 01/11/16

SUNIL MALAN



Sl No	COMPONENT & OPERATIONS	CHARACTERISTICS / INSTRUMENTS	CLASS OF CHECK	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD				REMARKS
					6.M	5.ON			P	M	C	N	
2	3	4	5	6	7	8	9	10	11	12	13	14	
3	Acceptance Tests on conventional Lighting fixture	a) Details of lot offered and Certificate of compliance that lighting fixture supplier has inspected the offered lot as per their own standard.	Majcr	Visual	-	-	lighting fixture supplier to submit the details of lot offered for NTPC inspection (Type of lighting fixtures, their batch number, sub-vendor name, quantity)	COC	List	P	V	V	The list may be used by NTPC for sample selection
		b) Lamp make	Majcr	Visual	100%	100%	Make to be BIS approved with CML number	Make to be BIS approved with CML number	Certificate of compliance	V	V	V	
		c) Constructional features including: Internal wiring, terminal block, earthing terminal, safety chain (if applicable)	Majcr	Visual	1 sample per type	1 sample per type	NTPC specification and NTPC approved data sheet/drg.	NTPC specification and approved data sheet/drg.	Inspection report	P	W	W	
		d) Electronic Ballast (if applicable for offered lighting fixtures) THD and pf check	Majcr	Electrical	1 sample per type	1 sample per type	NTPC specification	THD <= 10% , pf >= 0.9 for FH type and pf >= 0.95 for other type of fluorescent lighting fixtures	Inspection report	P	W	W	At lighting fixture supplier test lab
		e) Resistance to moisture test in case of lighting fixtures having IP 24 and above rating	Majcr	Mechanical	1 sample per type	1 sample per type	NTPC approved data Sheet	IS 10322 Part 1	Inspection report	P	W	W	
		f) Resistance to dust (applicable if IP5X and above)	Majcr	Optical	Mnfr std.	Mnfr std.	NTPC approved Data sheet and accepted type test report	Certificate of compliance	Certificate of compliance	P/V *	V	V	P/V * - means test will be performed either by lighting fixture supplier or their sub-vendor and Verified by lighting fixture supplier
		g) Photometry check	Majcr	Optical	Mnfr std.	Mnfr std.	NTPC accepted type test reports	Certificate of compliance for the batch : not offered lighting fixture LOR is not be less than 90% (refer IS 16100) with reference to type test reports	Certificate of compliance	P/V *	V	V	P/V * - means test will be performed either by lighting fixture supplier or their sub-vendor and Verified by lighting fixture supplier
		h) Dimensions	Majcr	Visual	1 sample per type	1 sample per type	NTPC specification and approved data sheet/drg.	NTPC specification and approved data sheet/drg.	Inspection report	P	W	W	
		i) HV & IR test	Majcr	Visual	#	#	IS 10322 part 1	IS 10322 part 1	Inspection report	P	W	W	# As per Table 1 (Inspection Level S2) and Table 2C/AQL 2.5 of IS 2500

LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/ SUB-SUPPLIER; C: MAIN SUPPLIER, N: NTPC
 P: PERFORM W: WITNESS AND V: VERIFICATION. CHP: CUSTOMER HOLDPOINT BY NTPC SHALL BE IDENTIFIED UNDER AGENCY COLUMN "N" AS "W".

Format No.: QS-01-QAI-P-10/F3-R0

Engg. Div/QA&I



ITEM : LIGHTING FIXTURES (Conventional and LED type)

STANDARD QUALITY PLAN

QP.No:000099-QOE-S-462

REVIEWED BY

APPROVED BY

Rev No.: 01

SWAPNESWAR MISHRA

Date: 02/11/15

VIKRAM TALWAR

VALID UPTO: 01/11/18

SUNIL MALANI



COMPONENT & OPERATIONS	CHARACTERISTICS / INSTRUMENTS	CLASS OF CHECK	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMA OF RECORD				REMARKS
				Mfr Std	GCN			D	A	C	N	
2	3	4	5	6M	6CN	7	8	9	10	11	12	
LED type Lighting fixture												
Bought out items / in-process checks												
LED Chip	LED chip efficacy	Major	Visual	Mfr Std	Mfr Std	NTPC Spec, Appd. Data sheet/ LM 80 report	NTPC Spec/ Appd Data sheet	LM 80 report	Y	V	V	At the time of final inspection
	LED chip CRI and CCT	Major	Visual	Mfr Std	Mfr Std	NTPC Spec, Appd. Data sheet/ LM 80 report	NTPC Spec/ Appd Data sheet	LM 80 report	Y	V	V	At the time of final inspection
	Reported TM21 (L80) lifetime of LED chip	Major	Visual	Mfr Std	Mfr Std	NTPC Spec, Appd. Data sheet/ LM 80 report	NTPC Spec/ Appd Data sheet	LM 80 report	Y	V	V	At the time of final inspection
LED Driver	a Compatibility with LED module/chip, controls & protection features as per NTPC spec	Major	Visual	-	-	NTPC spec requirements	Certificate of compliance by LED driver manufacturer / lighting fixture supplier that driver meets all NTPC specification requirements	Certificate of compliance	Y	V	V	
	b THD and pf check	Major	Electrical	Mfr std.	-	NTPC specification	THD < 1% and pf >= 0.9	Inspection report	Y	-	-	P/V * - means test will be performed either by lighting fixture supplier or their sub-vendor and Verified by lighting fixture supplier
Castings	Freedom from defects	Major	Visual	Mfr std.	-	NTPC specification requirements	Castings shall be free from any defects such as blow holes, surface blisters, cracks and cavities etc.	Inspection report	Y	-	-	P/V * - means test will be performed either by lighting fixture supplier or their sub-vendor and Verified by lighting fixture supplier
Sheet metal forming and fabrication	Freedom from defects	Major	Visual	Mfr std.	-	NTPC specification requirements	sheet metal fabrication / forming etc should be as per manufacturer standards and good engg practices	Inspection report	Y	-	-	P/V * - means test will be performed either by lighting fixture supplier or their sub-vendor and Verified by lighting fixture supplier
Pre-treatment and powder coating	Pre-treatment process checks, Powder coating finish, thickness, uniformity of coating and adhesion	major	Visual, chemical & mech	Mfr std	-	Mfr standard, NTPC specification requirements	Nominal coating thickness 50 microns or more	Inspection report	Y	-	-	P/V * - means test will be performed either by lighting fixture supplier or their sub-vendor and Verified by lighting fixture supplier

LEGEND: * RECORDS, IDENTIFIED WITH "MCK" (Y) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/ SUB-SUPPLIER; C: MAIN SUPPLIER, N: NTPC; P: PERFORM W: WITNESS AND V: VERIFICATION. CHP: CUSTOMER HOLD POINT BY NTPC SHALL BE IDENTIFIED UNDER AGENCY COLUMN "N" AS "W".

Format No.: Q5-01-QAI-P-10/F3-R0

Engg. Div./QA&I



ITEM : LIGHTING FIXTURES
(Conventional and LED type)

STANDARD QUALITY PLAN

QP.NO:000-999-QCE-S-062

REVIEWED BY

APPROVED BY

Rev No.: 00

SWAPNESWAR NSHRA

Date: 02/11/15

VIKRAM TALWAR

VALID upto: 01/11/18

SUNIL MALANI



Sl No	COMPONENT & OPERATIONS	CHARACTERISTICS / INSTRUMENTS	CLASS OF CHECK	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD				REMARKS
					6 M	6 CN			P*	V**	C	N	
B	Acceptance Tests on LED Lighting fixture	a Details of lot offered and Certificate of compliance that lighting fixture supplier has inspected the offered lot as per their own standard	Major	visual	-	-	lighting fixture supplier to submit the details of lot offered for NTPC inspection (Type of lighting fixtures, their batch number, sub-vendor name, quantity)	-	List	P	V	V	The list may be used by NTPC for sample selection
		b LED chip make	Major	visual	-	-	NTPC accepted type test reports (LM80/LM79) report	Certificate of compliance	Certificate of compliance	V	V	V	
		c Constructional features including: Internal wiring, terminal block, earthing terminal, safety chain (if applicable)	Major	visual	1 sample per type	1 sample per type	NTPC specification and NTPC approved data sheet/drg.	NTPC specification and approved data sheet/drg.	Inspection report	P	W	W	
		e Resistance to moisture test in case of lighting fixtures having IP X4 and above rating	Major	mechanical	1 sample per type	1 sample per type	NTPC approved data Sheet	IS 10:22 Part I	Inspection report	P	W	W	
		f Resistance to dust (applicable if IP5X and above)	Major	optical	Mnfr std.	Mnfr std.	NTPC accepted type test reports	Certificate of compliance	Certificate of compliance	P/V*	V	V	P/V* - means test will be performed either by lighting fixture supplier or their sub-vendor and Verified by lighting fixture supplier
		f Photometry check	Major	optical	Mnfr std.	Mnfr std.	NTPC accepted type test reports, LM 79, IS 16106, IS 16107	Certificate of compliance for the batch that offered lighting fixture LOR and lighting fixture efficacy is not be less than 90% (refer IS 16107) with reference to type test reports	Certificate of compliance	P/V*	V	V	P/V* - means test will be performed either by lighting fixture supplier or their sub-vendor and Verified by lighting fixture supplier

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Format No.: QS-01-QAI-P-10/F3-R0

Engg. Dir./QA&I



ITEM : LIGHTING
FIXTURES
(Conventional and LED type)

STANDARD QUALITY PLAN

QP.NO:000-999-QC-S-062

REVIEWED BY

APPROVED BY

Rev No.: 00

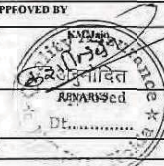
SWANESHWAR MISHRA

Date: 07/11/15

VIKRAM TALWAR

VALID UPTO: 07/11/18

SUNIL MALANI



Sl No	COMPONENT & OPERATIONS	CHARACTERISTICS / INSTRUMENT	CLASS OF CHECK	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD				
					6 M	6 C/N							
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	g	Dimensions	Major	Visual	1 sample per type	1 sample per type	NTPC specification and approved data sheet/drg.	NTPC specification and approved data sheet/drg.	Inspection report	P	W	W	
	i	LED driver: THD and pf check	Major	Electrical	1 sample per type	1 sample per type	NTPC specification	THD < 10% and pf >= 0.9	Inspection report	P	W	W	At lighting fixture supplier test lab
	j	LED driver: Precision current control check	Major	Electrical	1 sample per type	1 sample per type	NTPC specification	NTPC specification and NTPC approved data sheet	Inspection report	P	W	W	
	k	LED driver: Open circuit protection simulation check	Major	Electrical	1 sample per type	1 sample per type	NTPC specification	NTPC specification and NTPC approved data sheet	Inspection report	P	W	W	
	l	LED driver: Short circuit protection simulation check	Major	Electrical	1 sample per type	1 sample per type	NTPC specification	NTPC specification and NTPC approved data sheet	Inspection report	P	W	W	
	m	LED driver: Over temperature protection simulation check	Major	Electrical	1 sample per type	1 sample per type	NTPC specification	NTPC specification and NTPC approved data sheet	Inspection report	P	W	W	
	n	LED driver: Overload protection simulation check	Major	Electrical	1 sample per type	1 sample per type	NTPC specification	NTPC specification and NTPC approved data sheet	Inspection report	P	W	W	
	o	LED driver: Surge protection compliance check	Major	Electrical	-	-	NTPC specification	Certificate of compliance that surge protection is provided	Certificate of compliance	V	V	V	

Note: Packing shall be witnessed as per Annexure-I to Quality Plan

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Format No.: QS-01-QAI-P-10/F3-R0

Engg. Dir./QA&I

**PACKING SPECIFICATIONS- LIGHTING FIXTURES, LAMPS & MISC. ITEMS
ANNEXURE-I**

PACKING

1. The material shall be packed to ensure protection against damage during transit, storage for prolonged periods and handling.
2. Lighting Fixtures, Lamps, Receptacles, Switchboards, 24V Supply modules, 24V sockets, Junction Boxes, Exit signs shall be clean and dry prior to packaging.
3. All items specified at sl. No.2 above shall be supplied in packed cartons. The tapes used for packing shall not bleed, leave residue, or damage the item when removed.
4. Fixtures & other lighting material shall be wrapped in weather proof material such as polythene sheets, air bubble sheets/ thermocol etc. The lighting fixtures shall be placed in a corrugated paperboard/ fibreboard container/ mono carton.
5. The mono cartons shall be wrapped or bagged or tied in place in master cartons. The master carton shall be taped and then wrapped with cushioning material.
6. The dimensions of cartons shall be as per manufacturer's recommendations.
7. For items like step ladder, wheel mounted ladder and flexible conduits, packing shall be as per manufacturer standard.

Note: In case Manufacturer has a different packing standard which is **equivalent or better** same to be submitted for approval during contract stage.

Annexure-2

CRITERIONS UNDER GRIHA FOR ILLUMINATION SYTEM

The various Criterions followed under GRIHA for illumination system are listed as below:

A. Criterion 8: Energy Efficiency as per GRIHA

Energy Efficiency as per GRIHA shall be followed in the designing of Illumination system. The clauses under the Criterion 8 are as follows:

1. Ensure that the project meets the **mandatory requirements of ECBC** & all fans must be BEE star rated-Mandatory.
2. Demonstrate that 100% of outdoor lighting fixtures (lamps+lamp housing) meet the luminous efficacy requirements of GRIHA. All lamps and lamp housings must demonstrate luminous efficacy of at least 75 lumens/Watt. (1 point)
3. Points for additional reduction in the energy Performance Index (EPI) is as below:

Reduction from EPI benchmark	Points
10%	2
20%	3
30%	5
40%	7
50%	10

Energy Performance Index Benchmarks (EPI) – (kWh/ m2/year)

Climate Classification	Day time occupancy	24 hours Occupancy
	5 Days a week	7 Days a week
Commercial/Institutional/Academic/Hospital buildings		
Moderate	75	225
Composite / Warm and humid / hot and dry	90	300
Residential buildings/Hostels		
Moderate	50	
Composite / Warm and humid / hot and dry	70	

4. The documents shall be submitted showing the lumen output and wattage of luminaire to comply the same.

To comply with Criterion 8.1.1 of GRIHA, mandatory requirements of ECBC shall be followed. The same is listed in clause no: 6.2 of Lighting & Controls & 7.2 of Electrical & Renewable Energy systems ECBC as below:

6.2 Mandatory Requirements of Lighting & Controls of ECBC

6.2.1 Lighting Control

6.2.1.1 Automatic Lighting Shutoff

(a) 90% of interior lighting fittings in building or space of building shall be equipped with automatic control device.

Automatic control device shall function on either

- i) A scheduled basis at specific programmed times. An independent program schedule shall be provided for areas of no more than 2,500 m² and not more than one floor, or,
- ii) Occupancy sensors that shall turn off the lighting fixtures within 15 minutes of an occupant leaving the space. Light fixtures controlled by occupancy sensors shall have a wall-mounted, manual switch capable of turning off lights when the space is occupied.

(b) Additionally, occupancy sensors shall be provided in in all meeting room, conference hall and storage spaces.

6.2.1.2 Space Control

Each space enclosed by ceiling-height partitions shall have at least one control device to independently control the general lighting within the space. Each control device shall be activated either manually by an occupant or automatically by sensing an occupant. Each control device shall

(a) control a maximum of 250 m² for a space less than or equal to 1,000 m², and a maximum of 1,000 m² for a space greater than 1,000 m².

(b) have the capability to override the shutoff control required in § 6.2.1.1 for no more than 2 hours, and

(c) be readily accessible and located so the occupants can see the control.

6.2.1.3 Control in Daylight Areas

(a) Luminaires, installed within day lighting extent from the window shall be equipped with either a manual control device to shut off luminaires, installed within day lit area, during potential daylight time of a day or automatic control device that:

- i. Has a delay of minimum 5 minutes, or,
- ii. Can dim or step down to 50% of total power.

(b) Overrides to the daylight controls shall not be allowed.

6.2.1.5 Exterior Lighting Control

(a) Lighting for all exterior applications shall be controlled by a photo sensor or astronomical time switch that is capable of automatically turning off the exterior lighting when daylight is available or the lighting is not required.

6.2.2 Exit Signs

Internally-illuminated exit signs shall not exceed 5 Watts per face.

In addition to the mandatory requirements, the prescriptive requirement of ECBC shall be considered which includes:

- Interior Lighting Power
- Building area Method
- Space function method
- Installed Interior lighting Power
- Exterior Lighting Power

6.3 Prescriptive Requirements

6.3.1 Interior Lighting Power

The installed interior lighting power for a building or a separately metered or permitted portion of a building shall be calculated in accordance with 6.3.4 and shall not exceed the interior lighting power allowance determined in accordance with either 6.3.2 or 6.3.3. Tradeoffs of interior lighting power allowance among portions of the building for which a different method of calculation has been used are not permitted.



6.3.2 Building Area Method

Determination of interior lighting power allowance (watts) by the building area method shall be in accordance with the following:

Determine the allowed lighting power density for each appropriate building area type from Table 6-1 for ECBC Buildings

- (a) Calculate the gross lighted carpet area for each building area type.
- (b) The interior lighting power allowance is the sum of the products of the gross lighted floor area of each building area times the allowed lighting power density for that building area type.

Table 6-1 Interior Lighting Power for ECBC Buildings – Building Area Method

<i>Building Type</i>	<i>LPD (W/m²)</i>	<i>Building Area Type</i>	<i>LPD (W/m²)</i>
Office Building	9.50		
Hospitals	9.70		
Library	12.2		
		Warehouse	7.08
Dining: cafeteria/fast food	11.5		
		Workshop	14.1
Fire station	9.70	Automotive facility	9.00
Manufacturing facility	12.0	Parking garage	3.00
In cases where both a general building area type and a specific building area type are listed, the specific building area type shall apply.			

6.3.3 Space Function Method

Determination of interior lighting power allowance (watts) by the space function method shall be in accordance with the following:

(a) Determine the appropriate building type and the allowed lighting power density from Table 6-4 for ECBC Buildings. In cases where both a common space type and building specific space type are listed, building specific space type LPD shall apply.

(b) For each space, enclosed by partitions 80% or greater than ceiling height, determine the gross carpet area by measuring to the face of the partition wall. Include the area of balconies or other projections. Retail spaces do not have to comply with the 80% partition height requirements.

(c) The interior lighting power allowance is the sum of the lighting power allowances for all spaces. The lighting power allowance for a space is the product of the gross lighted carpet area of the space times the allowed lighting power density for that space.

Table 6-4 Interior Lighting Power for ECBC Buildings – Space Function Method

<i>Category</i>	<i>LPD (W/m²)</i>	<i>Lamp category</i>	<i>LPD (W/m²)</i>
Common Space Types			
Restroom	7.70	Stairway	5.50
Storage	6.80	Corridor/Transition	7.10
Conference/ Meeting	11.5	Lobby	9.10
Parking Bays (covered/ basement)	2.20	Parking Driveways (covered/ basement)	3.00
Electrical/Mechanical	7.10	Workshop	17.1
Business			
Enclosed	10.0	Open Plan	10.0
Banking Activity Area	12.6	Service/Repair	6.80
Assembly			
Dressing Room	9.10	Fitness Area - Gymnasium	13.70
Exhibit Space - Convention Centre	14.0	Museum - General Exhibition	16.40
Seating Area - Convention Centre	6.40	Museum - Restoration	18.3

6.3.4 Installed Interior Lighting Power

The installed interior lighting power calculated for compliance with §6.3 shall include all power used by the luminaires, including lamps, ballasts, current regulators, and control devices except as specifically exempted in §6.1.

Exception to §6.3.4: If two or more independently operating lighting systems in a space are controlled to prevent simultaneous user operation, the installed interior lighting power shall be based solely on the lighting system with the highest power.

6.3.5 Exterior Lighting Power

Connected lighting power of exterior lighting applications shall not exceed the lighting power limits specified in Table 6-7 for ECBC Buildings. Trade-offs between applications are not permitted.

Table 6-7 Exterior Building Lighting Power for ECBC Buildings

<i>Exterior lighting application</i>	<i>Power limits</i>
Building entrance (with canopy)	10 W/m ² of canopied area
Building entrance (w/o canopy)	90 W/ linear m of door width
Building exit	60 W/lin m of door width
Building façade	5.0 W/m ² of vertical façade area
Emergency signs, ATM kiosks, Security areas façade	1.0 W/m ²
Driveways and parking (open/ external)	1.6 W/m ²
Pedestrian walkways	2.0 W/m ²
Stairways	10.0 W/m ²
Landscaping	0.5 W/m ²
Outdoor sales area	9.0 W/m ²

7.2 Mandatory Requirements of Electrical and Renewable Energy Systems

7.2.1 Transformers

7.2.1.1 Maximum Allowable Power Transformer Losses

Power transformers of the proper ratings and design must be selected to satisfy the minimum acceptable efficiency at 50% and full load rating.

Permissible total loss values shall not exceed

<i>Rating (kVA)</i>	<i>Impedance (%)</i>	<i>Max. Total Loss (W)</i>	
		50% Load	100 % Load
16	4.5	150	480
25	4.5	210	695
63	4.5	380	1,250
100	4.5	520	1,800

7.2.1.3 Voltage Drop

Voltage drop for feeders shall not exceed 2% at design load. Voltage drop for branch circuit shall not exceed 3% at design load.

7.2.4 Check-Metering and Monitoring

- (a) Services exceeding 1000 kVA shall have permanently installed electrical metering to record demand (kVA), energy (kWh), and total power factor. The metering shall also display current (in each phase and the neutral), voltage (between phases and between each phase and neutral), and total harmonic distortion (THD) as a percentage of total current.

(b) Services not exceeding 1000 kVA but over 65 kVA shall have permanently installed electric metering to record demand (kW), energy (kWh), and total power factor (or kVARh).

(c) Services not exceeding 65 kVA shall have permanently installed electrical metering to record energy (kWh).

7.2.5 Power Factor Correction

All 3 phase shall maintain their power factor at the point of connection as follows:

- (a) 0.97 for ECBC Building

check capacitor bank requirement

7.2.6 Power Distribution Systems

The power cabling shall be sized so that the distribution losses do not exceed

- (a) 3% of the total power usage in ECBC Buildings

B. Criterion 9: Renewable Energy Utilization

Solar PV - on site renewable energy to offset 2.5% of the total annual energy consumption of internal artificial lighting & HVAC system.

C. Criterion 11: Achieving indoor comfort requirements

Artificial lighting design calculations and lighting layout drawings shall be submitted for evaluation that the lighting levels meet the NBC 2005 recommended levels and uniformity of 0.4- Mandatory

D. Criterion 28: Smart metering and Monitoring

Basic Metering requirements of GRIHA-Mandatory


It is mandatory to ensure regular monitoring of project's energy consumption by installing digital meters at the following point sources at the project level for:

- Utility Grid
- On site renewable energy system
- Diesel Genset, Gas Genset etc.
- Each Building Level

consider data store facility also.

Extended Metering Requirements:


Sub-meter* the following points to monitor energy consumption:

- HVAC central plant- AHU, Cooling tower, Chillers (BTU meters) and/or distributed units (split/window ACs)
- Lighting (Indoor and outdoor) 
- UPS
- Basement parking lighting

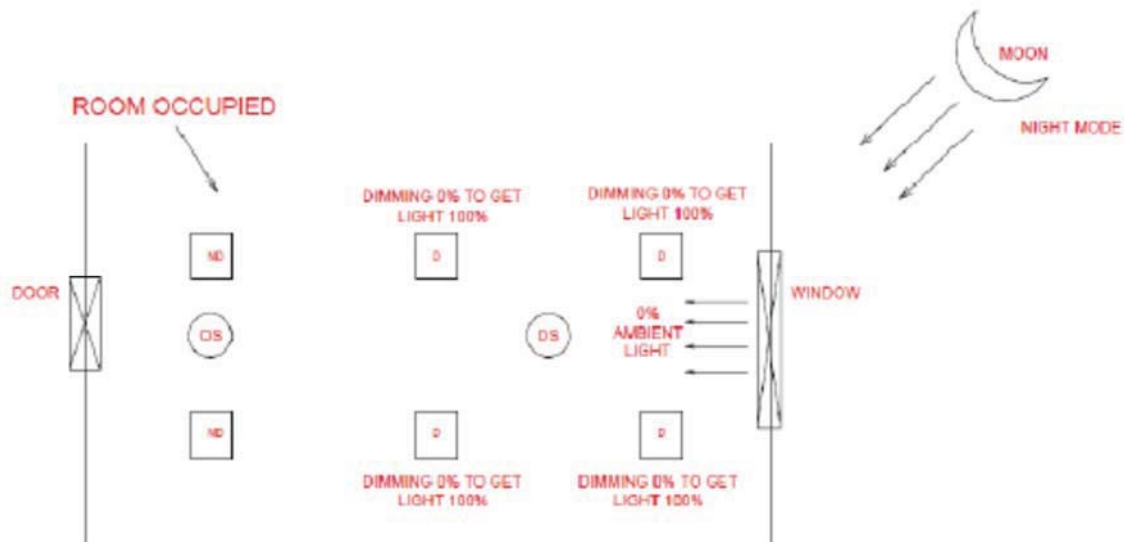
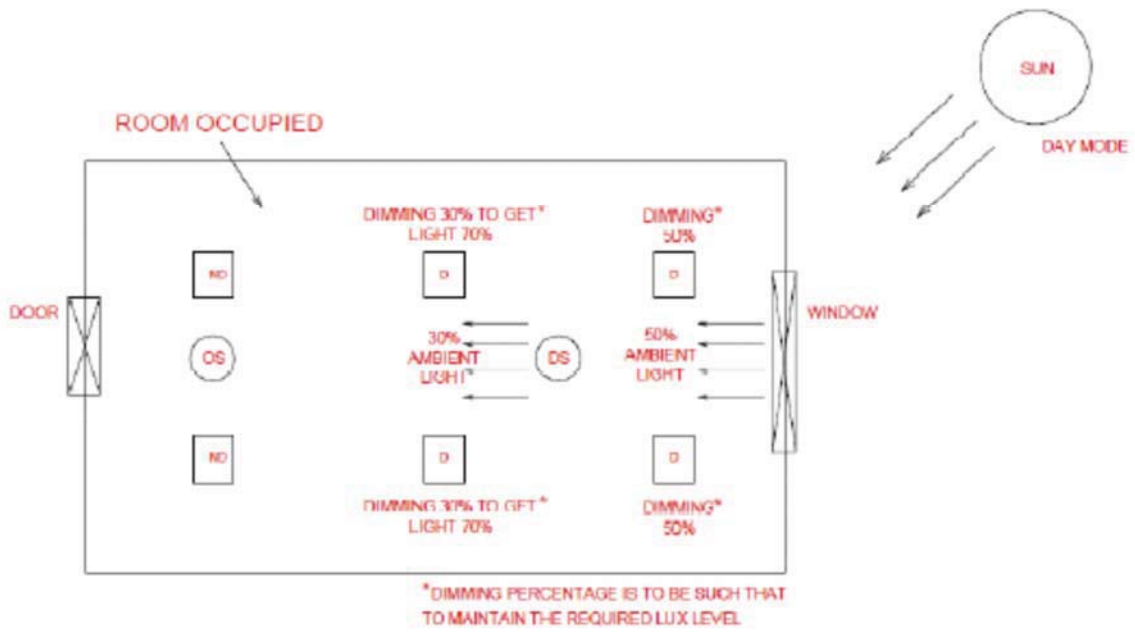
CONTROL SYSTEM FOR GREEN BUILDING

The purpose of this document is to brief the lighting control system for Green Buildings viz. Service Building, Admin Building and the Training Centre of 1 X 660 MW PANKI Thermal Power Plant.

Purpose of the lighting control (as per GRIHA concept) shall met the followings:

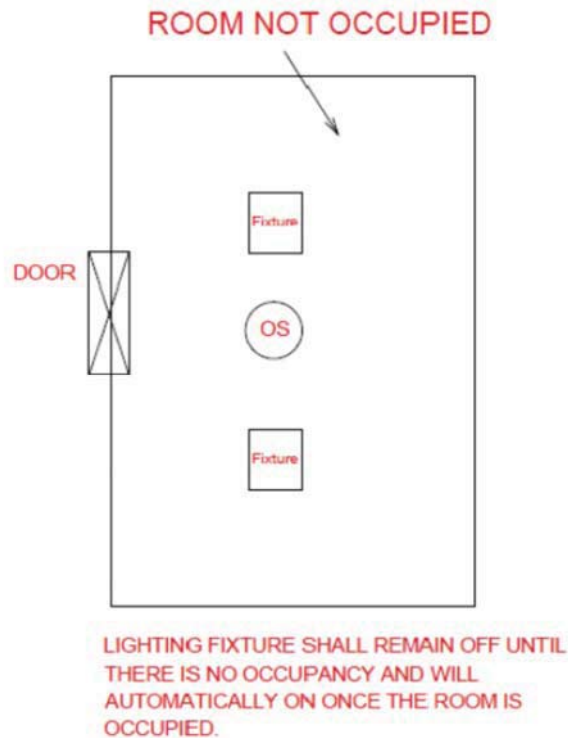
- a. Day Light Harvesting (Mainly in Rooms/areas where either side exposed to day light through window/s) 
- b. Occupancy based switching ON/OFF the lights.
- c. Based on time during 24 hours cycle in a day, creating scene (or back pre-set scenario) centrally for an individual Building.

4. 1 Day Light Harvesting (Mainly in Rooms/areas where either side exposed to day light through window/s). To meet this requirement, Light Level sensors used in all Rooms with windows directly exposed to sun light. This Light level sensor senses the ambient light of the room during the day and automatically control the light output of the Light fittings based on quantum of ambient light coming to the room through window/s. Please refer Fig-4(a) & Fig-4(b) below for a typical office room:



4.2 Occupancy based switching ON/OFF the lights:

Occupancy sensor will be installed in each office Rooms & Toilets which will switch ON/OFF based on the occupancy of the individual room. Refer Fig-5 below for a typical room with occupancy sensor & its function:



4.3 Based on time, during 24 hours cycle in a day, creating scene (or can say calling back pre-set scenario) centrally for an individual Building:

Scenes as required shall be set through key pad which can be recalled by press of a button of the touch pad. The same can be understood by considering the cases as given here under:

For example:

Case-1: All the lighting fixtures of the building shall be "ON".

Case-2: 50% of the corridor lighting fixtures "ON". Rest of the lighting fixtures are 100% ON.

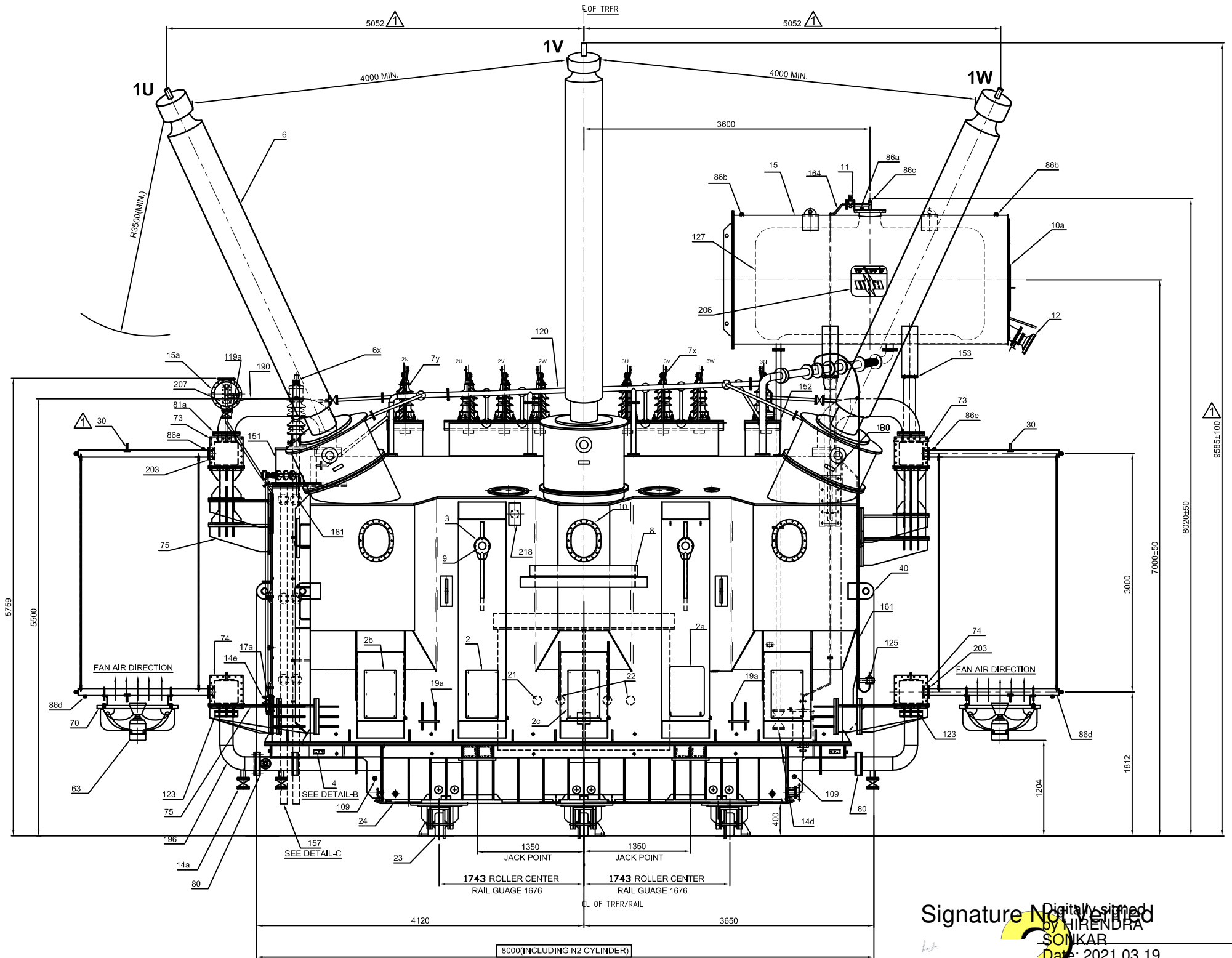
Case-3: The lighting fixtures of the rooms/offices shall be OFF for a particular time period e.g. lunch time (1.00 PM to 2.00PM), however the lighting fixtures of corridor remain ON.

The above cases are given as an example; however the exact programme shall be done at site as required.

Following components shall be used to meet the control system:

A. Occupancy Sensors	Required for Green Buildings BOQ SI No 2.1
B. Light Level Sensors	(Part of Lighting Sensor System BOQ SI No 2.2 required for Green Buildings)
C. DALI Controller	(Part of Lighting Dimming System for creating scenes BOQ SI No 2.3 required for Green Buildings)
D. Relay Controller	(Part of Control System BOQ SI no 2.4 required for Green Buildings)
E. Button Panels/Key Pad	(Part of Control System BOQ SI. No 2.4 & Lighting Dimming System BOQ SI No 2.3 required for Green Buildings)

DRG. NO. 3 4600 01263



Signature Digitally signed by HIRENDRA SONKAR

Date: 2021.03.19 16:34:36 IST

Reason: CAT I Location: NTPC/CEOC

THDC INDIA LIMITED
(A JV of GOVT. OF INDIA & GOVT. OF UP)



NTPC Limited
(A GOVT. OF INDIA ENTERPRISE)
CONSULTANCY WING

PROJECT KHURJA SUPER THERMAL POWER PROJECT
(2X660 MW PRESENT PROPOSAL + 1 X 660 MW FUTURE PROVISION)

REV	DATE	ALT	RAKESH		NTPC DRG. NO.	9915-371-110-BP-PVE-B-189	ADDITIONAL INFORMATION		NAME	SGN	DATE
01	03.03.21	CKD	GK/JS		NAME OF CUSTOMER	M/S THDC LTD.	W.O.-69140-A-512-01		DRN.	SG	12.11.20
		APPD	LK/GL		NO. OF TRANSFORMERS	2	STATUS OF DRAWING	DEPT	CODE	WEIGHT(kg)	SCALE
					PROJECT	2 X 660 MW THDC KHURJA TG PKG	DISTRIBUTION OF PRINTS	TRE	406		COMP.SCALE-1:1
					PO NO.	THDC/RKSH/CC-9915-371-FC-NOA-3115 DT. 13.10.2019	TITLE	ST-OUTLINE GENERAL ARRANGEMENT ELEVATION VIEW			
					TYPE OF PRODUCT	120 MVA, 400/11.5-11.5 KV, 3 PHASE STATION TRANSFORMER		DRG. NO. 3 46000 01263			
								SHEET 01 OF 05			

ZONE	CUSTOMER COMMENTS INCORPORATED ON SHEET NO. 1, 2 & 3. 3D DRAWING ADDED AT SHEET NO 4 & 5.
------	---

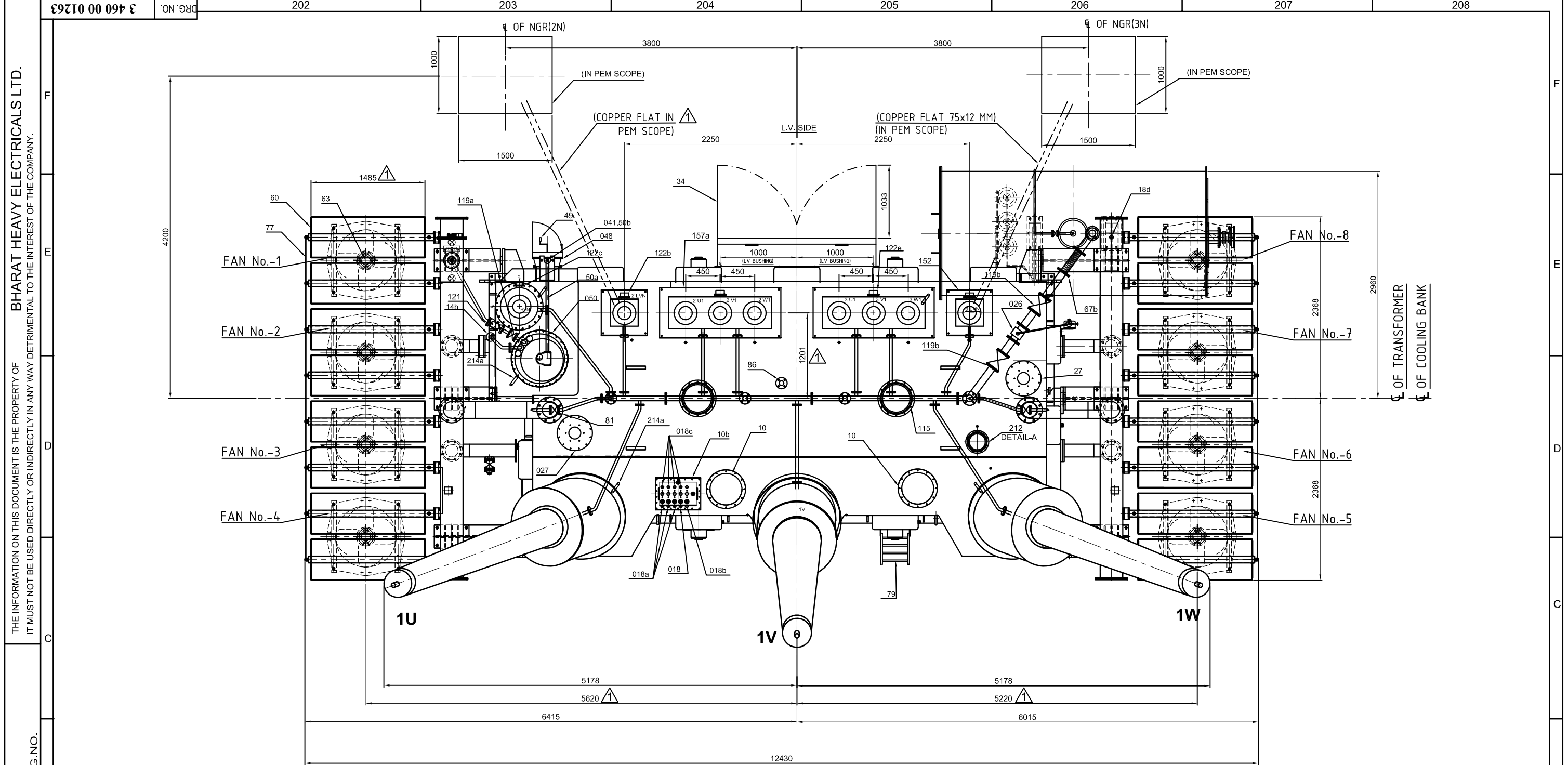
DRN.	SG	SGN	DATE
CHD.	GK/JS	SGN	12.11.20
APPD.	LK/GL	SGN	12.11.20
DRG. NO.	3 46000 01263	REV	01

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REF.DRG.NO.

SIGN.DATE

INVENTORY NO.



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SIGN. DATE REF. DRG. NO.

DIRECTION OF TRANSFORMER WITHDRAWL

OWNER 	THDC INDIA LIMITED (A JV of GOVT. OF INDIA & GOVT. OF UP)
CONSULTANT 	NTPC Limited (A GOVT. OF INDIA ENTERPRISE) CONSULTANCY WING
PROJECT	KHURJA SUPER THERMAL POWER PROJECT (2X660 MW PRESENT PROPOSAL + 1 X 660 MW FUTURE PROVISION)

REV	DATE	ALT	RAKESH	NTPC DRG. NO.	9915-371-110-BP-PVE-B-189	ADDITIONAL INFORMATION	भारत हेवी इलेक्ट्रिकल्स लिमिटेड भोपाल	NAME	SIGN	DATE
01	03.03.21	CKD	GK/JS	NAME OF CUSTOMER	M/S THDC LTD.	W.O.-69140-A-512-01	BHARAT HEAVY ELECTRICALS LTD. BHOPAL	DRN.	SG	12.11.20
ZONE CUSTOMER COMMENTS INCORPORATED ON SHEET NO. 1, 2 & 3. 3D DRAWING ADDED AT SHEET NO 4 & 5.				NO. OF TRANSFORMERS	2	STATUS OF DRAWING	DEPT CODE	WEIGHT(kg)	SCALE	12.11.20
				PROJECT	2 X 660 MW THDC KHURJA TG PKG	DISTRIBUTION OF PRINTS	TRE	406	COMP.SCALE-1:1	12.11.20
				PO NO.	THDC/RKSH/CC-9915-371-FC-NOA-315 DT. 03.10.2019	TRE-1,TRX,TRM-3	TITLE	ST- OUTLINE GENERAL ARRANGEMENT PLAN VIEW		
				TYPE OF PRODUCT	120 MVA, 400/11.5-11.5 KV, 3 PHASE STATION TRANSFORMER		DRG. NO.	3 46000 01263		REV
							SHEET 02 OF 05		01	

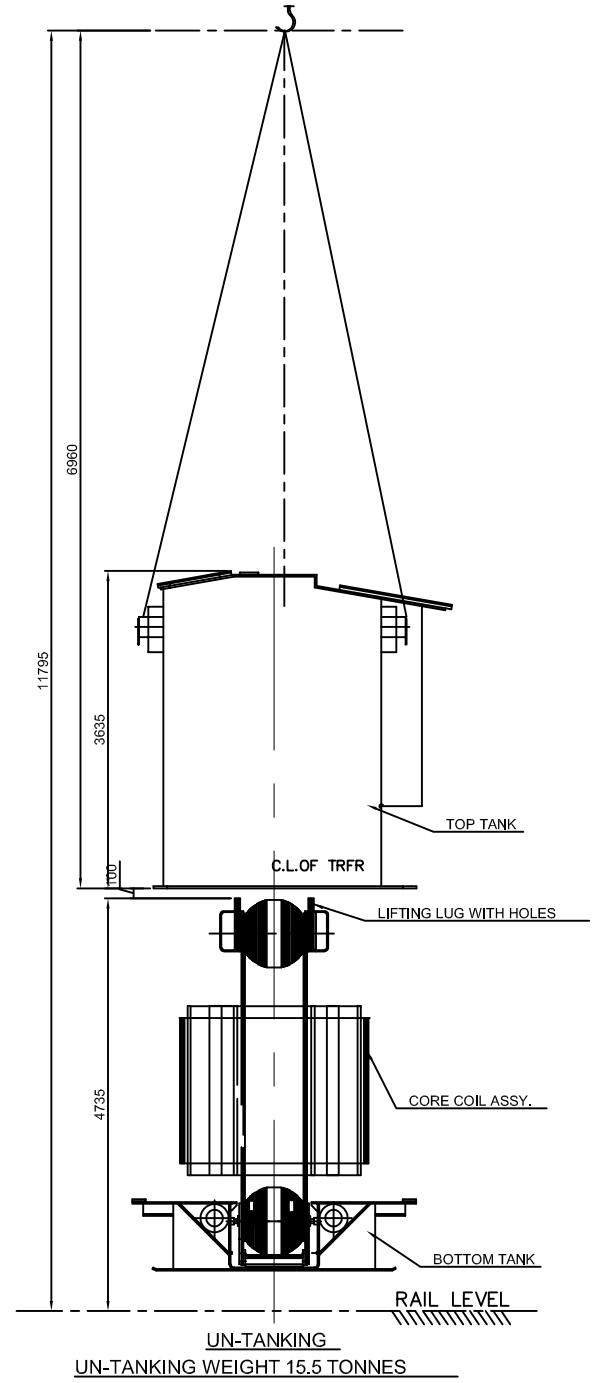
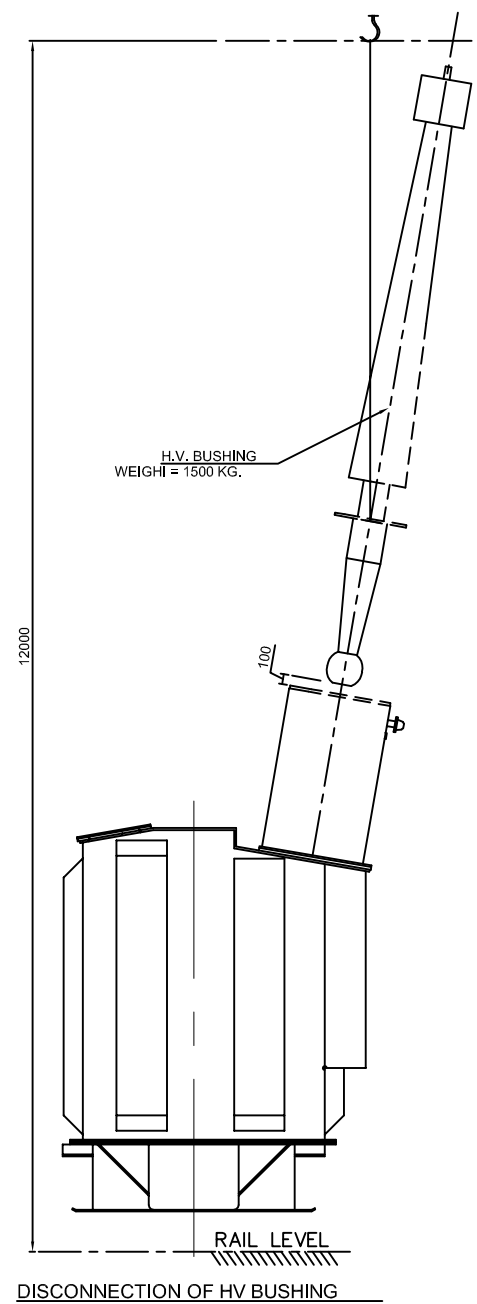
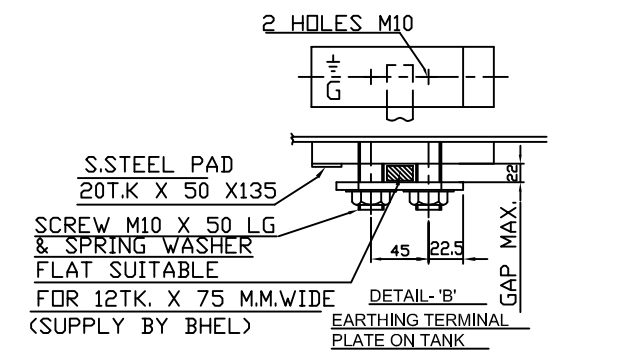
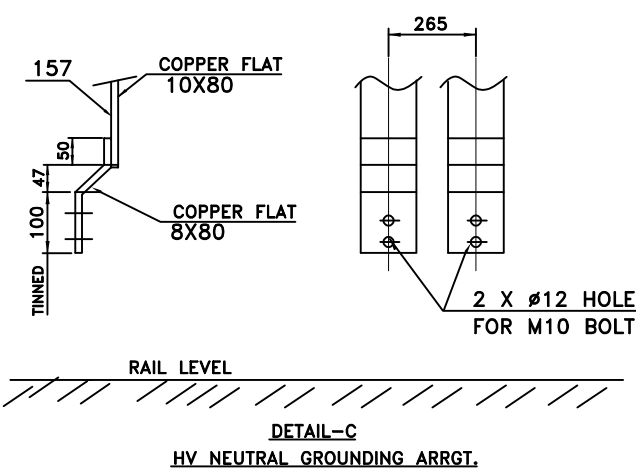
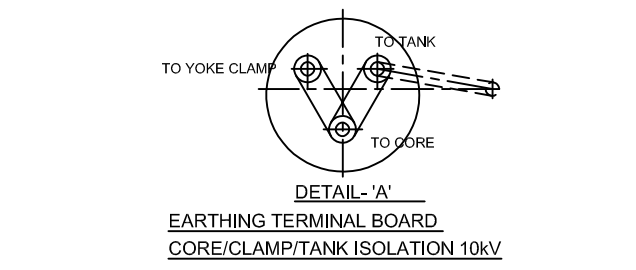
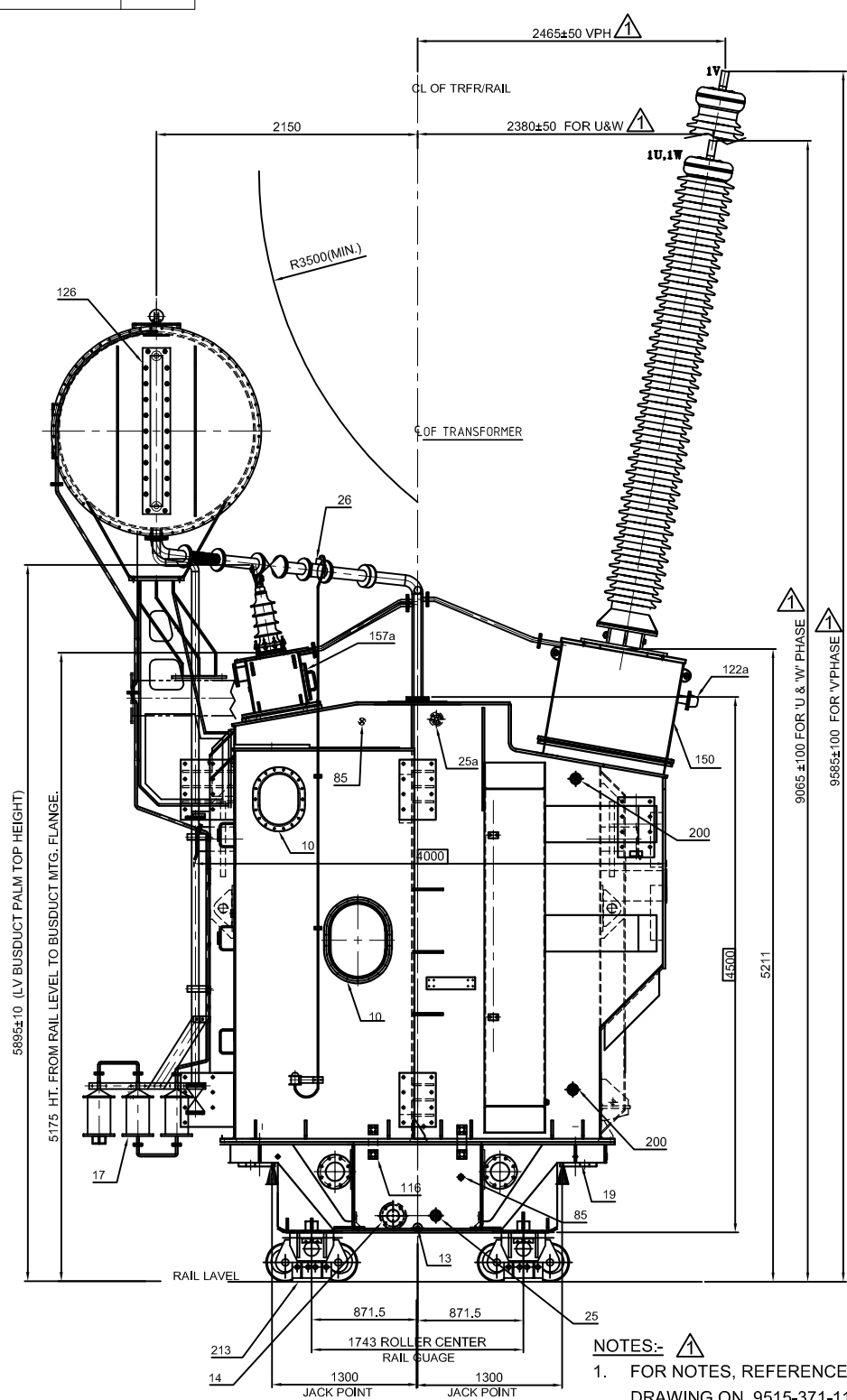
BHARAT HEAVY ELECTRICALS LTD.

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REF. DRG. NO.

SIGN. DATE

INVENTORY NO.



- NOTES:-**
- FOR NOTES, REFERENCE DRAWINGS, DETAIL OF WEIGHT & OIL QUANTITIES AND PART LIST, REFER NTPC DRAWING ON. 9515-371-110-BP-PVE-B-190.
 - FOR ALL THE DIMENSIONS, EXCEPT BUSDUCT & FOUNDATION RELATED TOLERANCE SHALL BE ±3% EXCEPT WHERE OTHER TOL. MENTIONED.
 - JACKING PADS (IT.19a) ARE SUITABLE FOR LIFTING TOP TANK ONLY.
 - REMOVE ALL BUSHINGS, AUX. CONSERVATOR, ALL PIPES, RADIATOR BANK, MOTOR DRIVE UNIT OF OLTC BEFORE LIFTING OF THE TOP TANK.
 - JACK POINTS MARKED THUS ↑ ARE UNLOADING FROM TRAILER/CHANGING ROLLERS DIRECTION.
 - DIMENSIONS SHOWN THUS □ ARE OVER ALL SHIPPING DIMENSIONS.
 - WIRING FROM INSTRUMENTS CTs ETC. NOT SHOWN FOR CLARITY

AIR CLEARANCES (min)		
	LINE TO LINE(MM)	LINE TO EARTH(MM)
H.V.	4000	3500
LV1	280	140
LV2	280	140
HVN	N.A.	320
LV1N/ LV2N	N.A.	140

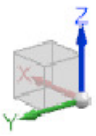
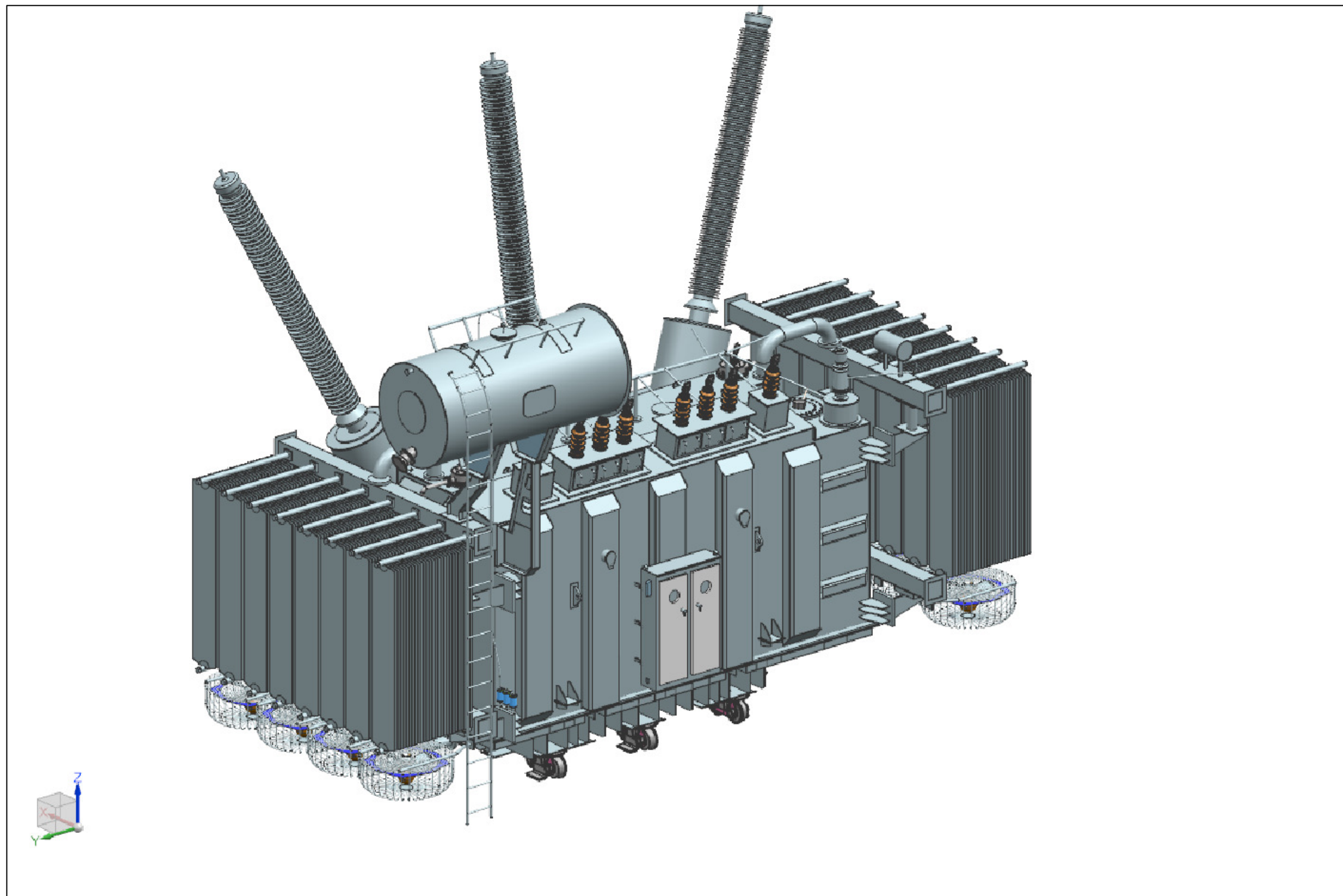
REV	DATE	ALT	RAKESH	REV	DATE	ALT	RAKESH
		CKD	GK/JS	01	03.03.21	CKD	GK/JS
		APPD	LK/GL			APPD	LK/GL

CUSTOMER COMMENTS INCORPORATED ON SHEET NO. 1,2 & 3. 3D DRAWING ADDED AT SHEET NO 4 & 5.

NTPC DRG. NO.	9915-371-110-BP-PVE-B-189
NAME OF CUSTOMER	M/S THDC LTD.
NO. OF TRANSFORMERS	2
PROJECT	THDC KHURJA TG PKG (2X660 MW)
LOA NO.	THDC/RKSH/CC-9915-371-FC-NOA-3115 DT. 13.10.2019
TYPE OF PRODUCT	120 MVA, 400/11.5-11.5 KV, 3 PHASE STATION TRANSFORMER

OWNER THDC INDIA LIMITED (A JV of GOVT. OF INDIA & GOVT. OF UP)				
CONSULTANT NTPC Limited (A GOVT. OF INDIA ENTERPRISE) CONSULTANCY WING				
PROJECT KHURJA SUPER THERMAL POWER PROJECT (2X660 MW PRESENT PROPOSAL + 1 X 660 MW FUTURE PROVISION)				
ADDITIONAL INFORMATION W.O.-69140-A-512-01	भारत हेवी इलेक्ट्रिकल्स लिमिटेड भोपाल BHARAT HEAVY ELECTRICALS LTD. BHOPAL	NAME DRN. SG	SIGN [Signature]	DATE 12.11.20
STATUS OF DRAWING "PR"	DEPT TRE	CODE 406	WEIGHT(kg) —	SCALE COMP.SCALE-1:1
DISTRIBUTION OF PRINTS TRE-1,TRX,TRM-3	TITLE ST-OUTLINE GENERAL ARRANGEMENT (END VIEW)	DRG. NO. 3 46000 01263	APPD. LK/GL [Signature]	DATE 12.11.20
		SHEET 03 OF 05		REV. 01

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LV VIEW

REF.DRG.NO.

SIGN. DATE

INVENTORY NO.

REV	DATE	ALT		REV	DATE	ALT	RAKESH		NTPC DRG. NO.	9915-371-110-BP-PVE-B-189
		CKD				CKD	GK/JS		NAME OF CUSTOMER	M/S THDC LTD.
		APPD		01	03.03.21	APPD	LK/GL		NO. OF TRANSFORMERS	2
ZONE				ZONE		CUSTOMER COMMENTS INCORPORATED ON SHEET NO. 1,2 & 3. 3D DRAWING ADDED AT SHEET NO 4 & 5.			PROJECT	THDC KHURJA TG PKG (2X660 MW)
									LOA NO.	THDC/RKSH/CC-9915-371-FC-NOA-3115 DT. 13.10.2019
									TYPE OF PRODUCT	120 MVA, 400/11.5-11.5 KV, 3 PHASE STATION TRANSFORMER

OWNER		THDC INDIA LIMITED (A JV of GOVT. OF INDIA & GOVT. OF UP)									
CONSULTANT		NTPC Limited (A GOVT. OF INDIA ENTERPRISE) CONSULTANCY WING									
PROJECT		KHURJA SUPER THERMAL POWER PROJECT (2X660 MW PRESENT PROPOSAL + 1 X 660 MW FUTURE PROVISION)									
ADDITIONAL INFORMATION		भारत हे वी इलेक्ट्रिकल्स लिमिटेड भोपाल W.O.-69140-A-512-01		NAME	SG						
STATUS OF DRAWING		"PR"	DEPT	CODE	WEIGHT(kg)	SCALE	DRN.	GK/JS		DATE	12.11.20
DISTRIBUTION OF PRINTS		TRE	406	--	COMP.SCALE:1:1	CHD.	LK/GL		DATE	12.11.20	
TRE-1,TRX,TRM-3		TITLE		ST-OUTLINE GENERAL ARRANGEMENT (3D - LV VIEW)		DRG. NO.	3 46000 01263		REV.	01	
						SHEET 04 OF 05					

DRG. NO. 3 460 00 01263

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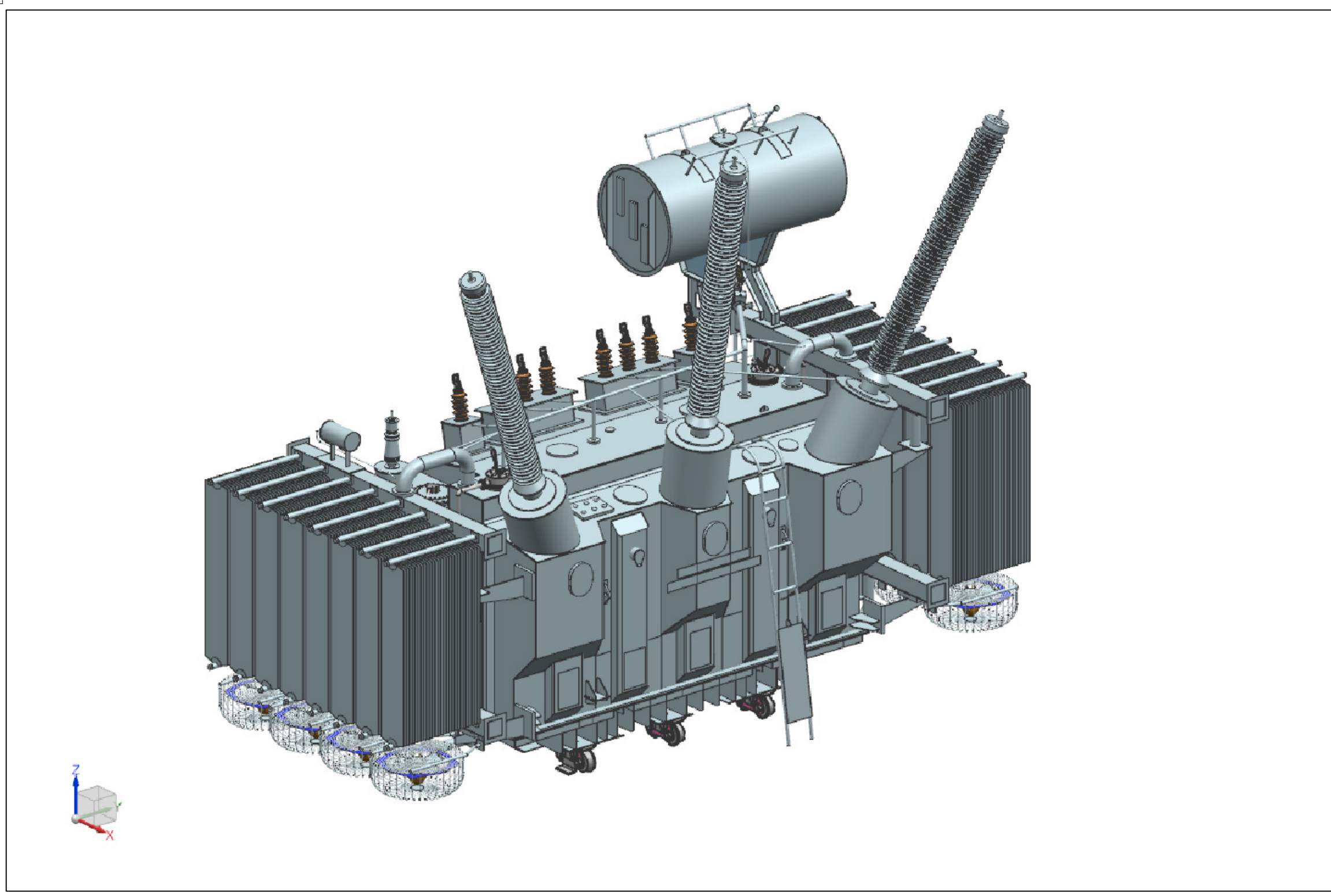
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HV VIEW

REF.DRG.NO.

SIGN. DATE

INVENTORY NO.

REV	DATE	ALT	REV	DATE	ALT	RAKESH	APPD
		CKD	01	03.03.21	APPD	GK/JS	LK/GL
		APPD					

NTPC DRG. NO.	9915-371-110-BP-PVE-B-189
NAME OF CUSTOMER	M/S THDC LTD.
NO. OF TRANSFORMERS	2
PROJECT	THDC KHURJA TG PKG (2X660 MW)
LOA NO.	THDC/RKSH/CC-9915-371-FC-NOA-3115 DT. 13.10.2019
TYPE OF PRODUCT	120 MVA, 400/11.5-11.5 KV, 3 PHASE STATION TRANSFORMER

OWNER	THDC INDIA LIMITED (A JV of GOVT. OF INDIA & GOVT. OF UP)			
CONSULTANT	NTPC Limited (A GOVT. OF INDIA ENTERPRISE) CONSULTANCY WING			
PROJECT	KHURJA SUPER THERMAL POWER PROJECT (2X660 MW PRESENT PROPOSAL + 1 X 660 MW FUTURE PROVISION)			
ADDITIONAL INFORMATION	W.O.-69140-A-512-01	भारत हेवी इलेक्ट्रिकल्स लिमिटेड भोपाल	DRN.	SG
STATUS OF DRAWING	"PR"	BHARAT HEAVY ELECTRICALS LTD. BHOPAL	CHD.	GK/JS
DISTRIBUTION OF PRINTS	TRE 406	SCALE	APPD.	LK/GL
TRE-1, TRX, TRM-3	TITLE	ST-OUTLINE GENERAL ARRANGEMENT (3D - HV VIEW)	DRG. NO.	3 46000 01263
			SHEET	05 OF 05
			REV.	01

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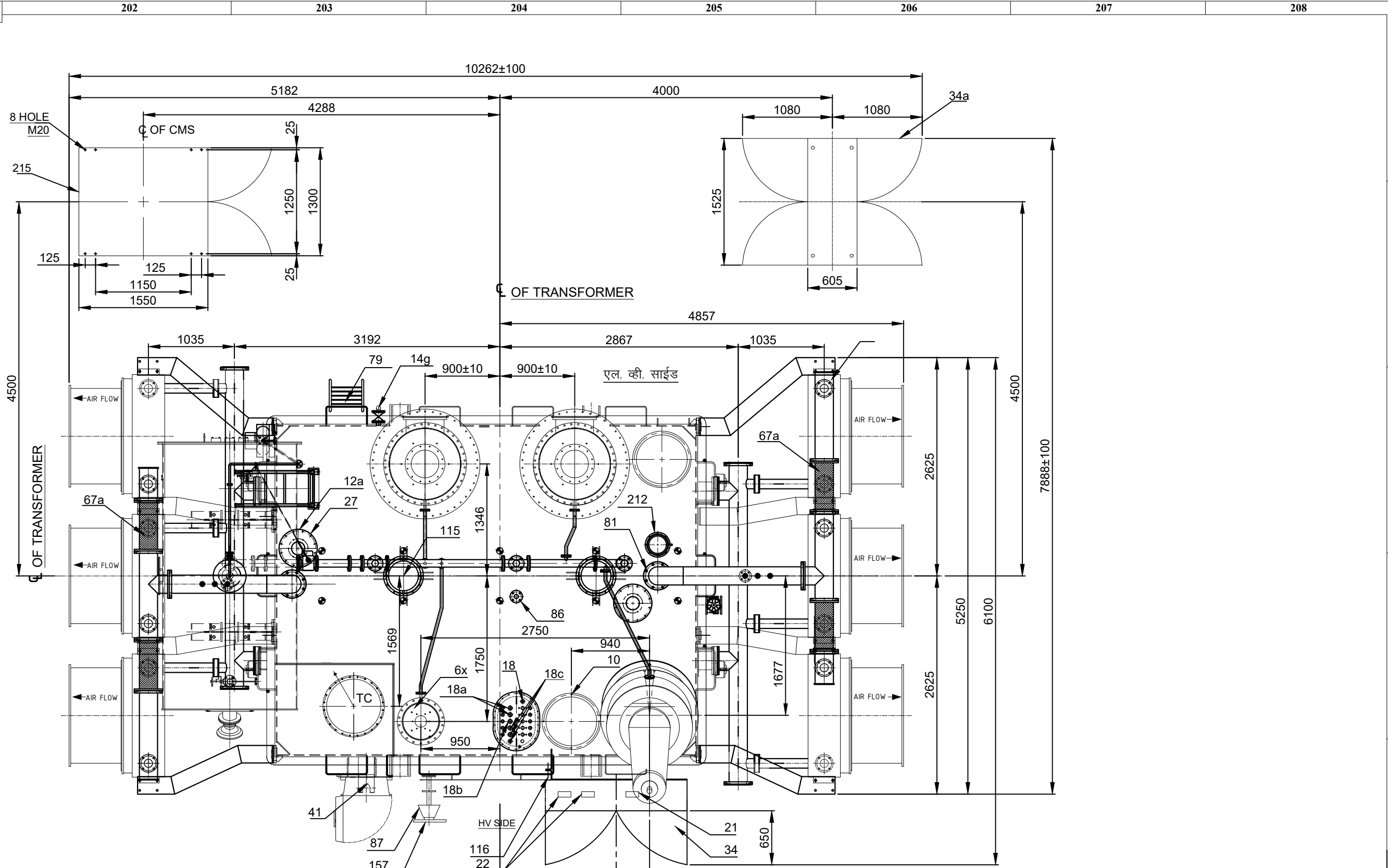


Reply to comments on drawing no. 9915-371-110-BP-PVE-B-189 Rev 00

Outline General Arrangement:

- Marked dimension are indicated in Rev-01.
- 3D drawing is placed at sheet no. 4 & 5.
- Centerlines are marked at respective sheets.
- Direction of rollers are checked and found in order inline with foundation drawing.
- Notes are added at sheet no. 3.
- All the changes are marked by revision cloud.

DRG. NO. 3 452 00 01209



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REF. DRG. NO.

SIGN DATE

INVENTORY NO.

REV.	DATE	ALT	RAKESH	REV.	DATE	ALT	RAKESH	PEM DRG. NO.	BP-DG-XXX-301-E001	ADDITIONAL INFORMATION	भारत हेवी इलेक्ट्रिकल्स लिमिटेड भोपाल BHARAT HEAVY ELECTRICALS LTD. BHOPAL				NAME	SIGN	DATE	
		APPD	CKD LK				CKD LK	NTPC DRG. NO.	9915-371-110-BP-PVE-B-152	W.O.-69139-A-512-01	DEPT	CODE	WEIGHT(kg)	SCALE	ALT	RAKESH	05.11.20	
		CKD	APPD LK/KA		02	24.05.21	APPD LK/KA	NAME OF CUSTOMER	M/S THDC LTD.	DISTRIBUTION OF DRAWING	"PR"	TRE	406	COMP.SCALE-1:1	APPD	LK/KA	05.11.20	
ZONE			NO CHANGE.	ZONE			NTPC COMMENT DATED 05.12.2020 INCORPORATED	NO. OF TRANSFORMERS	7	DISTRIBUTION OF PRINTS	TRE-1,TRX,TRM-3	TITLE	OUTLINE GENERAL ARRANGEMENT-GT (PLAN VIEW)				DRG. NO. 3 452 00 01209	REV 02
								PROJECT	2 X 660 MW THDC KHURJA TG PKG								SHEET 02 OF 05	
								PO NO.	THDC/RKSH/CC-9915-371-FC-NOA-3115 DT. 03.10.2019									
								TYPE OF PRODUCT	260 MVA, 21/420 KV, 1 PHASE GT									

OWNER		THDC INDIA LIMITED (A JV of GOVT. OF INDIA & GOVT. OF UP)
CONSULTANT		NTPC Limited (A GOVT. OF INDIA ENTERPRISE) CONSULTANCY WING
PROJECT	KHURJA SUPER THERMAL POWER PROJECT (2X660 MW PRESENT PROPOSAL + 1 X 660 MW FUTURE PROVISION)	

Rakesh

DRG. NO. 3 452 00 01209

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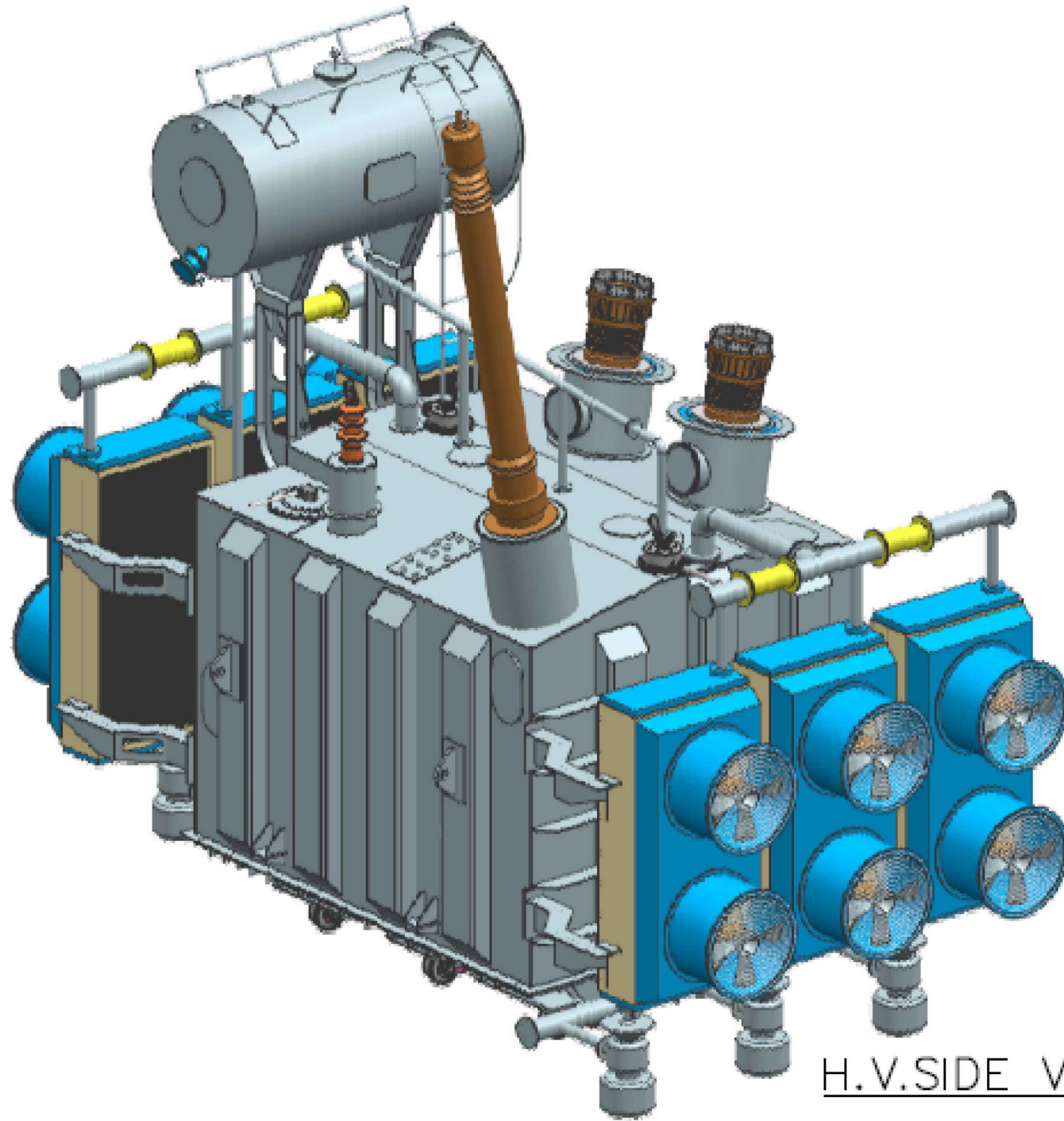
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H.V.SIDE VIEW

NOTES:-

1. MATERIALS, FITTINGS, ITEMS SHOWN OR NOT SHOWN TO BE AS PER CONTRACT & NTPC QA APPROVED.
2. DRAWING IS INLINE WITH ALL RELATED DRAWINGS & DOCUMENTS.

<p>THDC INDIA LIMITED (A JV of GOVT. OF INDIA & GOVT. OF UP)</p>	
<p>NTPC Limited (A GOVT. OF INDIA ENTERPRISE) CONSULTANCY WING</p>	
<p>PROJECT KHURJA SUPER THERMAL POWER PROJECT (2X660 MW PRESENT PROPOSAL + 1 X 660 MW FUTURE PROVISION)</p>	
<p>OWNER</p>	<p>NAME SIGN DATE</p>
<p>CONSULTANT</p>	<p>ALT RAKESH 05.11.20</p>
<p>PROJECT</p>	<p>CKD LK 05.11.20</p>
<p>DEPT</p>	<p>APPD LK/KA 05.11.20</p>
<p>CODE</p>	<p>DRG. NO. 3 452 00 01209</p>
<p>WEIGHT(kg)</p>	<p>SHEET 04 OF 05</p>
<p>SCALE</p>	<p>REV 02</p>
<p>COMP.SCALE-1:1</p>	
<p>TITLE</p>	
<p>OUTLINE GENERAL ARRANGEMENT-GT (3D VIEW)</p>	

REV.	DATE	ALT	RAKESH	REV.	DATE	ALT	RAKESH	PEM DRG. NO.	BP-DG-XXX-301-E001	ADDITIONAL INFORMATION	W.O.-69139-A-512-01
APPD				01	16.02.21	CKD	LK	NTPC DRG. NO.	9915-371-110-BP-PVE-B-152	STATUS OF DRAWING "PR"	DEPT
CKD				APPD		APPD	LK/KA	NAME OF CUSTOMER	M/S THDC LTD.	DISTRIBUTION OF PRINTS	TRE
								NO. OF TRANSFORMERS	7		406
								PROJECT	2 X 660 MW THDC KHURJA TG PKG		
								PO NO.	THDC/RKSH/CC-9915-371-FC-NOA-3115 DT. 03.10.2019		
								TYPE OF PRODUCT	260 MVA, 21/420 KV, 1 PHASE GT		

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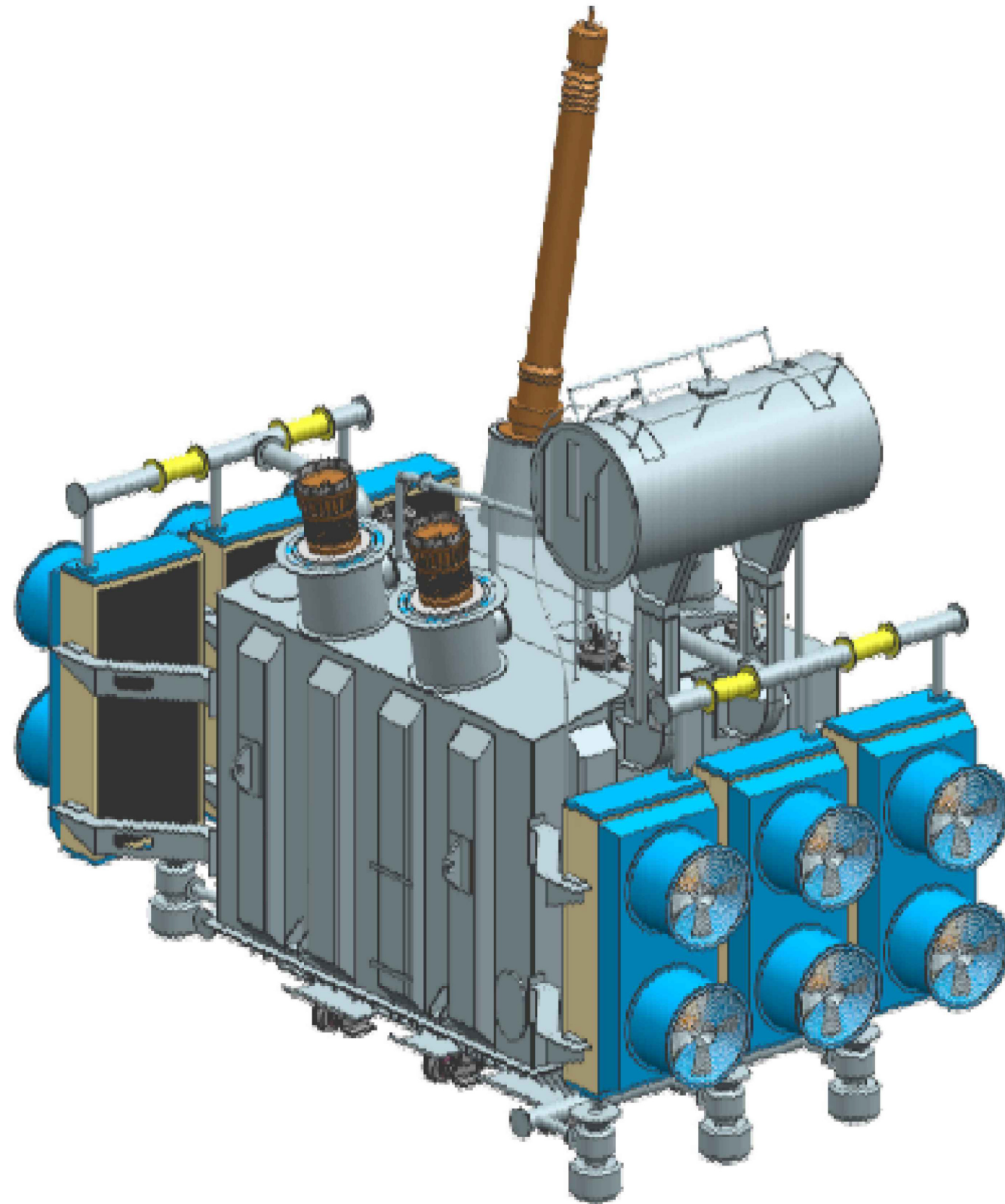
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Rakesh

6020001209 DRG. NO. 502 503 504 505 506 507 508

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L.V. SIDE VIEW

OWNER 	THDC INDIA LIMITED (A JV of GOVT. OF INDIA & GOVT. OF UP)																				
CONSULTANT 	NTPC Limited (A GOVT. OF INDIA ENTERPRISE) CONSULTANCY WING																				
PROJECT	KHURJA SUPER THERMAL POWER PROJECT (2X660 MW PRESENT PROPOSAL + 1 X 660 MW FUTURE PROVISION)																				
ADDITIONAL INFORMATION	<table border="1"> <tr> <td>DEPT</td> <td>CODE</td> <td>WEIGHT(kg)</td> <td>SCALE</td> </tr> <tr> <td>TRE</td> <td>406</td> <td>---</td> <td>COMP.SCALE-1:1</td> </tr> </table>	DEPT	CODE	WEIGHT(kg)	SCALE	TRE	406	---	COMP.SCALE-1:1												
DEPT	CODE	WEIGHT(kg)	SCALE																		
TRE	406	---	COMP.SCALE-1:1																		
<table border="1"> <tr> <td>NAME</td> <td>SIGN</td> <td>DATE</td> </tr> <tr> <td>ALT RAKESH</td> <td></td> <td>05.11.20</td> </tr> <tr> <td>CKD LK</td> <td></td> <td>05.11.20</td> </tr> <tr> <td>APPD LK/KA</td> <td></td> <td>05.11.20</td> </tr> </table>	NAME	SIGN	DATE	ALT RAKESH		05.11.20	CKD LK		05.11.20	APPD LK/KA		05.11.20	<table border="1"> <tr> <td>DRG. NO.</td> <td>REV</td> </tr> <tr> <td>3 452 00 01209</td> <td>02</td> </tr> <tr> <td>SHEET</td> <td>OF</td> </tr> <tr> <td>05</td> <td>05</td> </tr> </table>	DRG. NO.	REV	3 452 00 01209	02	SHEET	OF	05	05
NAME	SIGN	DATE																			
ALT RAKESH		05.11.20																			
CKD LK		05.11.20																			
APPD LK/KA		05.11.20																			
DRG. NO.	REV																				
3 452 00 01209	02																				
SHEET	OF																				
05	05																				

REV.	DATE	ALT	RAKESH	REV.	DATE	ALT	RAKESH	PEM DRG. NO.	BP-DG-XXX-301-E001	ADDITIONAL INFORMATION	भारत हेवी इलेक्ट्रिकल्स लिमिटेड भोपाल	NAME	SIGN	DATE
		APPD						NTPC DRG. NO.	9915-371-110-BP-PVE-B-152	W.O.-69139-A-512-01	भारत हेवी इलेक्ट्रिकल्स लिमिटेड भोपाल	ALT	RAKESH	05.11.20
	02	24.05.21	CKD LK	01	16.02.21	CKD LK		NAME OF CUSTOMER	M/S THDC LTD.	STATUS OF DRAWING "PR"	DEPT	CODE	WEIGHT(kg)	SCALE
			APPD LK/KA			APPD LK/KA		NO. OF TRANSFORMERS	7	DISTRIBUTION OF PRINTS	TRE	406	---	COMP.SCALE-1:1
								PROJECT	2 X 660 MW THDC KHURJA TG PKG	TITLE	OUTLINE GENERAL ARRANGEMEN-GT (3D VIEW)			
								PO NO.	THDC/RKSH/CC-9915-371-FC-NOA-3115 DT. 03.10.2019					
								TYPE OF PRODUCT	260 MVA, 21/420 KV, 1 PHASE GT					

501 502 503 504 505 506 507 508

Rakesh



BHARAT HEAVY ELECTRICALS LIMITED, BHOPAL
TRANSFORMER ENGINEERING DEPARTMENT

Reply to NTPC comments on drawing no. 9915-371-110-BP-PVE-B-152 Rev 00

Outline General Arrangement (OGA):

NTPC Comment: HV phase to earth clearance to be 4200 mm.

BHEL Reply: As per cl. no. 1.05.01 c) i), of THDC Technical specification; page 6 of 36, phase to earth clearance (400 kV) is 3500mm. hence, clearance of 4200 mm is not applicable for THDC GT.

NTPC Comment: 3D view and internal section view to be provided.

BHEL Reply: 3D view added in this OGA drawing. Separated drawing has been submitted for internal section view.

NTPC Comment: cooler pipe has been extended as compared to previous project.

BHEL Reply: cooler pipe design is same as compare to previous project, kindly refer latest OGA drg no. 9962-001-BP-501-PVE-B-001-04 of previous project.

NTPC Comment: few marked dimension to be provided.

BHEL Reply: required dimensions have been indicated in revised OGA drawing.

NTPC Comment: note for changing roller direction.

BHEL Reply: required note has been added in revised OGA drawing.

Reply to NTPC comments on drawing no. 9915-371-110-BP-PVE-B-152 Rev 01

NTPC Comment: Previous revision comments not incorporated. Kindly attach compliance sheet.

BHEL Reply: Previous revision comments either incorporated or clarified, kindly refer attached compliance sheet.

6120 00 697 3 ON GRD 102 103 104 105 106 107 108

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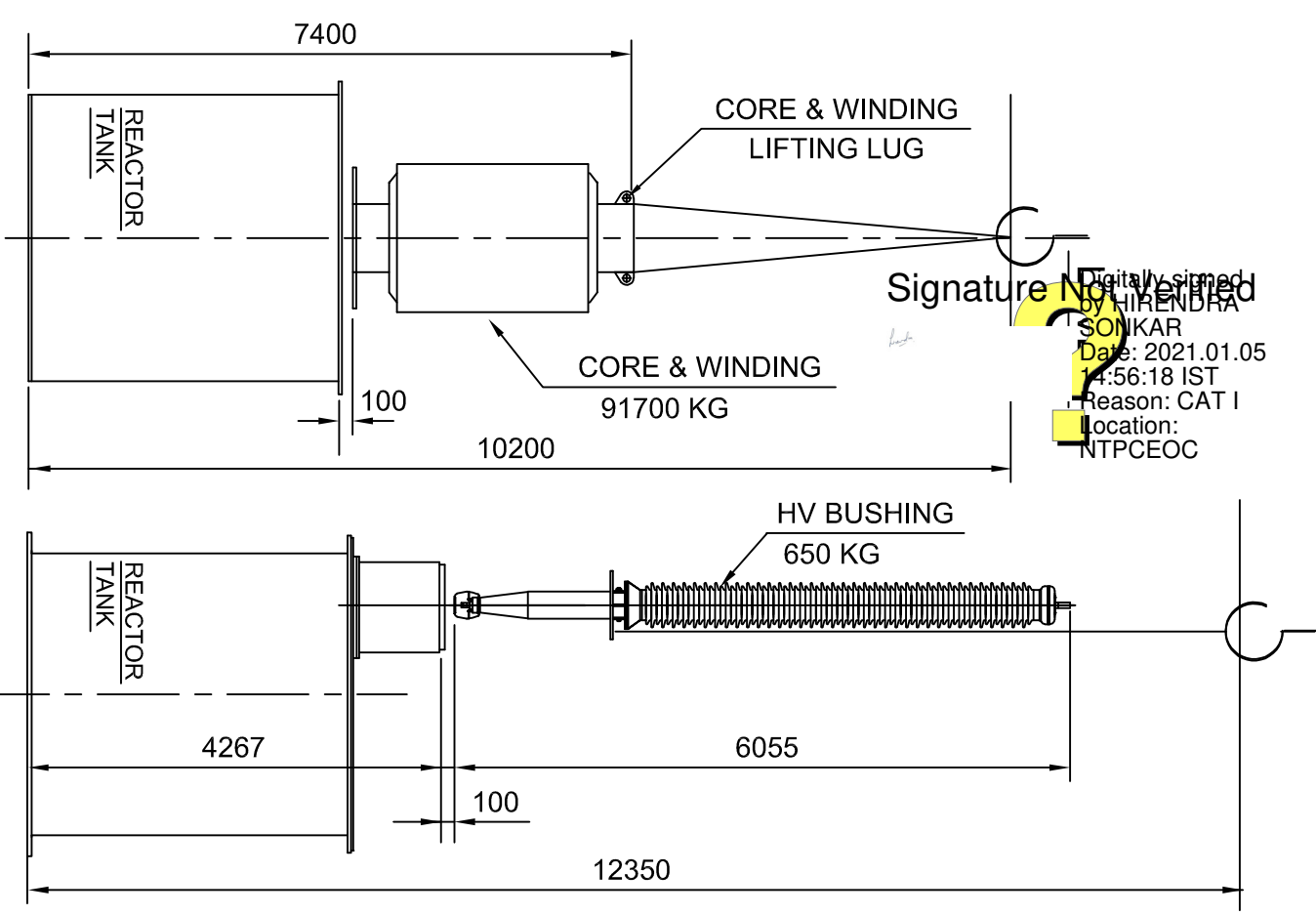
NOTES :-

1. WHEN REFERRING THIS DRAWING PLEASE QUOTE MVAR & W.O. NO.
2. 320 DIA. TWIN BI-DIRECTIONAL ROLLERS MOUNTED AT 1676 mm RAIL GAUGE IN BOTH DIRECTION ARE PROVIDED FOR MOVEMENT OF REACTOR AT SITE AND ROLLERS ARE TO BE REMOVED BEFORE ERECTION
3. OUT SIDE FINISHING PAINT TO SHADE RAL 5012(BLUE).
4. WIRING FROM INSTRUMENT CTS. ETC. ARE NOT SHOWN FOR CLARITY.
5. FOUNDATION BOLTS ARE IN THE SCOPE OF BHEL SUPPLY.
6. FOR PART LIST OF OGA REFER DRAWING NO. 3 469 00 02180
7. DIMNS. SHOWN THUS ARE OVERALL SHIPPING DIMENSIONS EXCLUSIVE OF PACKING.
8. DIMENSIONS SHOWN ARE WITH REF.TO PLINTH LEVEL.
9. FOR TANK COVER BOLTING REFER DETAIL 'B' SHT. NO. 02 OF 04.
10. ALL GASKETS USED FOR TRANSFORMERS & ACCESSORIES (IN CONTACT WITH OIL) WILL BE O-RING NITRILE RUBBER.
11. GLAND PACKING/GASKET MATERIAL SHALL BE OF "O" RING OF NITRILE RUBBER FOR ALL THE VALVE'S FLANGES. ALL THE FLANGES SHALL BE MACHINED.
12. PAINTING & OIL SHALL BE AS PER NTPC TECHNICAL SPECIFICATION.
13. ALL BOLTS & NUTS SHALL BE HOT DIP GALVANIZED/SS.
14. ALL FITTINGS, ACCESSORIES, ARRANGEMENT (SHOWN OR NOT SHOWN) SHALL BE PROVIDED INLINE WITH TECHNICAL SPECIFICATION.
15. REACTOR CAN BE WITHDRAWN WITH BUSHINGS WITHOUT FOULING.
16. ALL CABLES ON TRANSFORMER SHALL BE PROVIDED IN TRAYS.
17. TOLERANCE IN DIMENSIONS ±3% WHERE TOLERANCE NOT SPECIFIED.
18. HV, HVN BUSHINGS ARE BOUGHT OUT ITEMS SO DIMENSION/WEIGHT RELATED TO THESE BUSHING ARE TENTATIVE.

IMPORTANT NOTE:-

1. THE DESIGN FEATURES SHOWN ON THIS DRAWING (INLINE WITH IEC : 60076-6 APPLICABLE STANDARD & CUSTOMER SPECIFICATION) MEETS THE STATUTORY, REGULATORY & SAFETY REQUIREMENTS WITH RESPECT TO EARTHING ARRANGEMENT, DANGER & OTHER LABELS, CLEARANCES IN AIR, PROVISION FOR PRESSURE RELIEF DEVICE, GAS ACTUATED RELAY AND ANTI-EARTHQUAKE CLAMPING ARRANGEMENT.

MIN. AIR CLEARANCES (IN MM)		
PHASE TO PHASE	420 KV	145 KV
PHASE TO EARTH	4000	NA
	3500	1050



Signature Not Verified
 Digitally signed by SHREENDRA SONIKAR
 Date: 2021.01.05 14:56:18 IST
 Reason: CAT 1
 Location: NTPCEOC

UN-TANKING

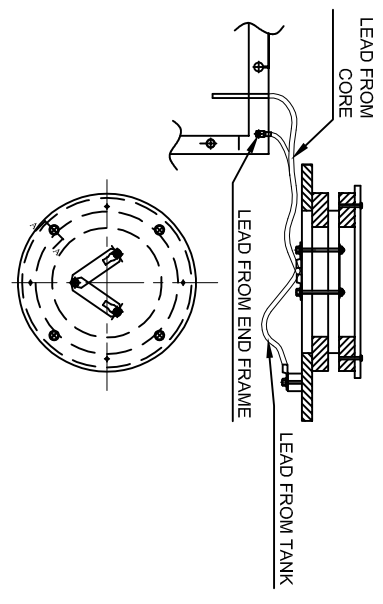
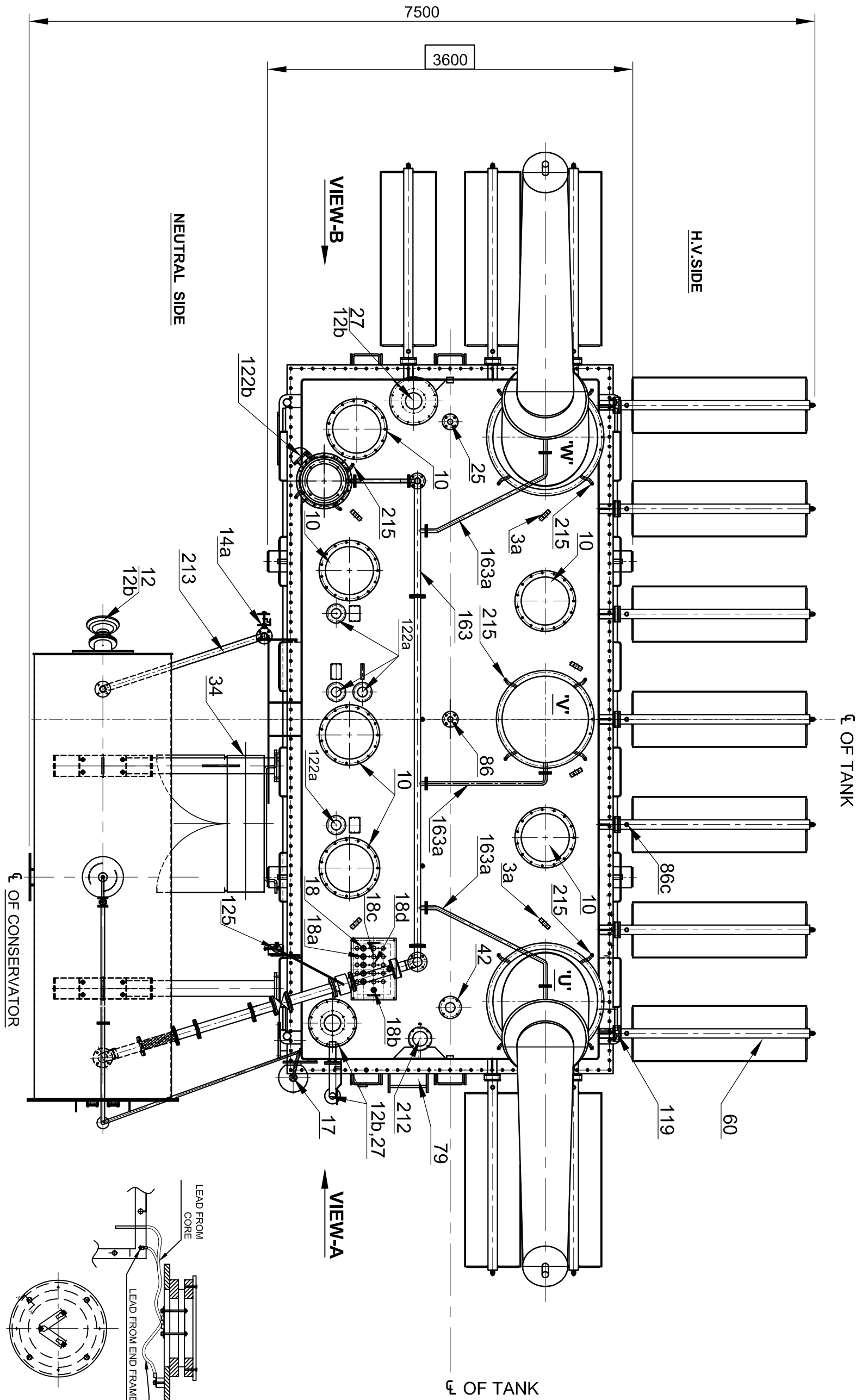
UN-TANKING OF H.V. BUSHING

REV	DATE	ALT.	REV	DATE	ALT.	REV	DATE	ALT.	MKP	PKM DRAWING NO.	PEM DRAWING NO.	W.O. - 69141-A-517-01	STATUS OF DRAWING	DISTRIBUION OF PRINTS	TRE-1, TRM-3	DRN	NAME	SIGN	DATE
CKD.			01	22.12.2020	CKD.					9915-371-1-10-BP-PVE-B-206	BP-DG-XXX-301-E054		PREPARED						11.11.2020
APPD.					APPD.					125MVAR, 420KV BUS REACTOR	THDC/RKSH/IC-9915-371-F-CANOA-3115 DATED 03/10/2019		FOR PRINT						11.11.2020
										PO NO.	THDC/RKSH/IC-9915-371-F-CANOA-3115 DATED 03/10/2019								11.11.2020
										PROJECT	2X660 MW THDC KHURJA TG PKG								3 469 00 02179
										NAME OF CUSTOMER	M/S TEHRI HYDRO DEV. CORP. LTD.								01

INVENTORY NO. SIGN.DATE REF.DRG.NO. 101 102 103 104 105 106 107 108

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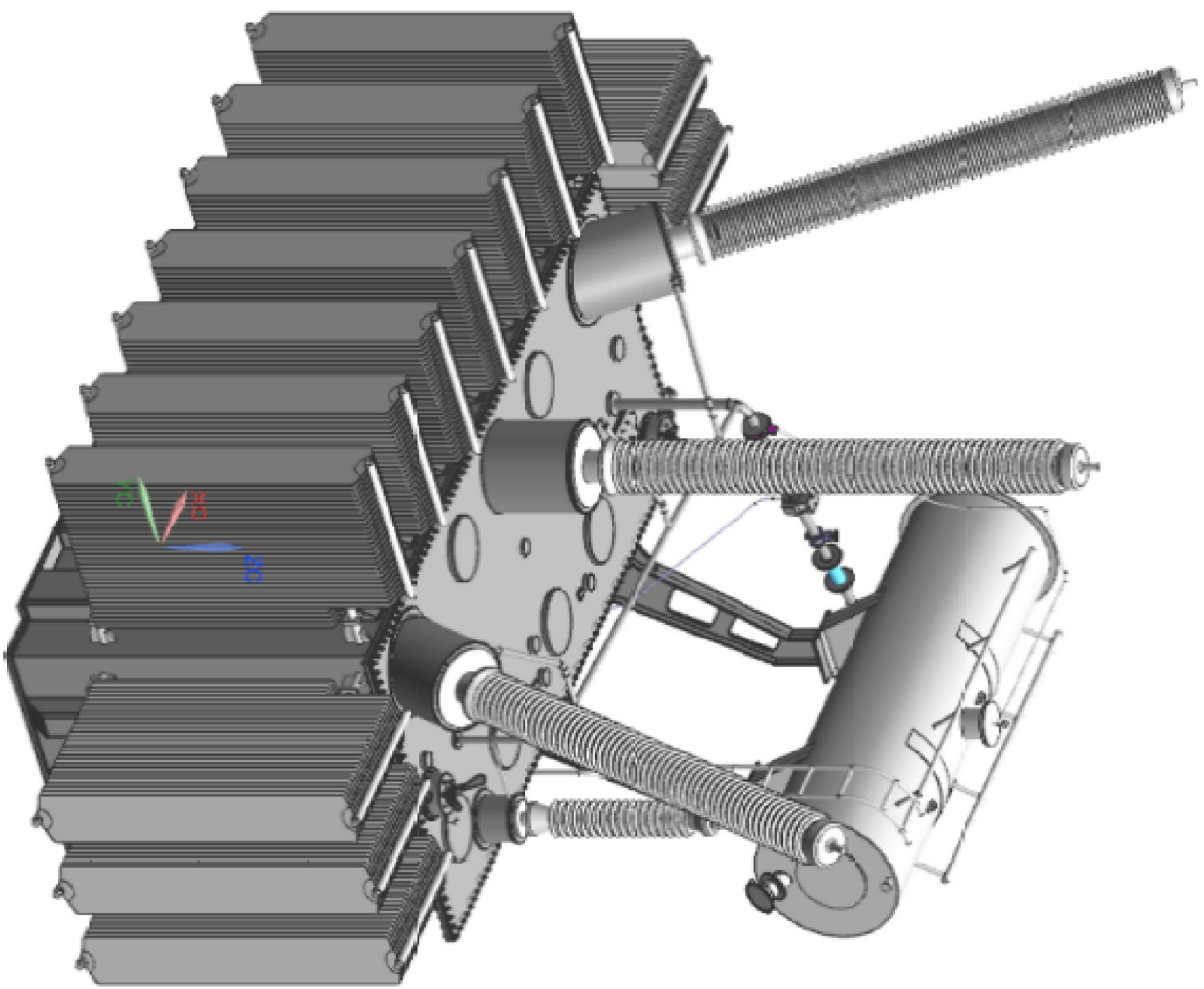
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EARTHING DETAILS OF CORE, END FRAME & TANK

REV	DATE	ALT.	REV	DATE	ALT.	REV	DATE	ALT.	MKP	PKM DRAWING NO.	ADDITIONAL INFORMATION	NAME	SIGN	DATE
CKD.			CKD.			CKD.				9915-371-110-BP-PV-E-B-206	W.O. - 69141-A-517-01	D.R.N.		11.11.2020
APPD.			APPD.			APPD.				125MVAR, 420KV BUS REACTOR	STATUS OF DRAWING [PR] DEPT	M.K.P.		11.11.2020
										THDC/RKSH/CC-9915-371-FC/ND-A-3115 DATED 03/10/2019	DISTRIBUTION OF PRINTS	K.D.		11.11.2020
										2X660 MW THDC KHURJA TG PKG	TRE-1, TRM-3	APPD.		
										M/S TEHRI HYDRO DEV. CORP. LTD.	TITLE			
											OUTLINE GENERAL ARRANGEMENT (PLAN VIEW) (125MVAR BUS REACTOR)	DRG. NO		
												SHEET	03	OF 06
														01

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



- NOTES:-
1. MATERIALS, FITTINGS, ITEMS SHOWN OR NOT SHOWN TO BE AS PER CONTRACT & CUSTOMER QA APPROVED.
 2. DRAWING IS INLINE WITH ALL RELATED DRAWINGS & DOCUMENTS.

REV	DATE	ALT.	CKD.	APPD.	REV	DATE	ALT.	CKD.	APPD.	REV	DATE	ALT.	CKD.	APPD.	ZONE	ZONE
										01	22.12.2020				ZONE	3D VIEW ADDED IN SHEET 05 & 06

INVENTORY NO.	SIGN.DATE	REF.DRG.NO.
501	502	503
504	505	506
507	508	

PEM DRAWING NO.	BP-DG-XXX-301-E084
NTFC DRAWING NO.	9915-371-110-BP-PVE-B-206
TYPE OF PRODUCT	125MVAR, 420KV BUS REACTOR
PO NO.	THDC/CRSH/CC-9915-371-FC/NOA-3115 DATED 03/10/2019
PROJECT	2X660 MW THDC KHURJA TG PKG
NAME OF CUSTOMER	M/S TEHRI HYDRO DEV. CORP. LTD.

W.O. - 69141-A-517-01	STATUS OF DRAWING [PR]	DISTRIBUION OF PRINTS	TRE-1, TRM-3
भारत हेवी इलेक्ट्रिकल्स लिमिटेड भोपाल	BHARAT HEAVY ELECTRICALS LTD. BHOPAL	OUTLINE GENERAL ARRANGEMENT	(3D VIEW FROM HV SIDE)
DEPT	CODE	WEIGHT(KG)	SCALE
TRE	406	COMP.SCALE-1:1

DRN	NAME	SIGN	DATE
CKD.	MKP	[Signature]	11.11.2020
APPD.	KD	[Signature]	11.11.2020
	KD/KA	[Signature]	11.11.2020
DRG. NO	3 469 00 02179	REV.	01
SHEET	05	OF	06



BHARAT HEAVY ELECTRICALS LIMITED, BHOPAL
TRANSFORMER ENGINEERING DEPARTMENT

Reply to NTPC comments on drawing no. 9915-371-110-BP-PVE-B-206 Rev 00

Outline General Arrangement (OGA) Drawing:

NTPC Comment: Kindly provide 3D view and internal view.

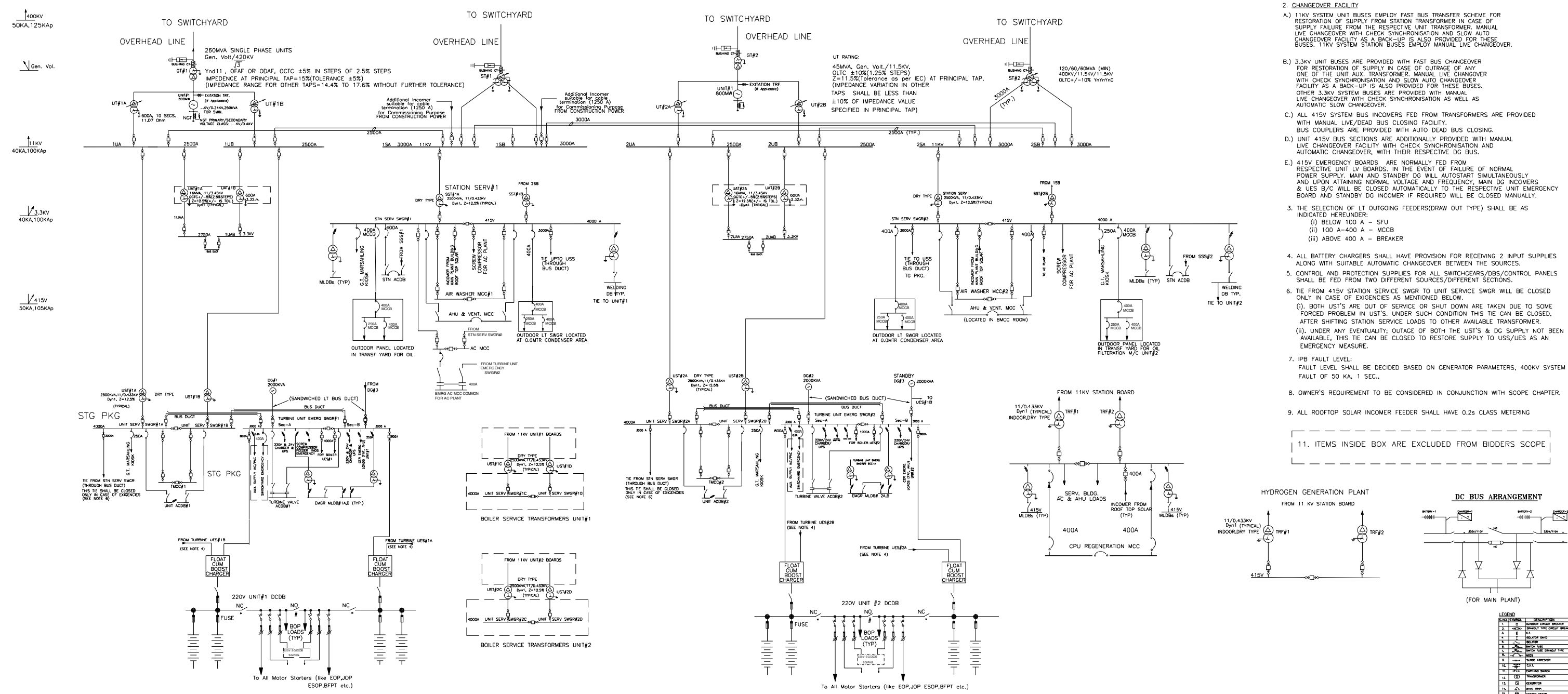
BHEL Reply: 3D view OGA included in the revised drawing. Refer separate drawing submitted for internal view.

NOTES:

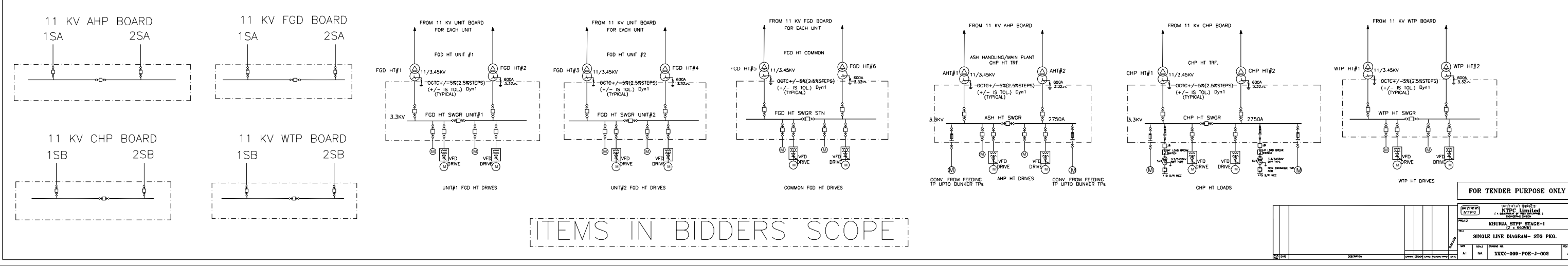
- ONE DIESEL GENERATOR PROVIDED BY OWNER PER UNIT IS CONNECTED TO THE RESPECTIVE TURBINE UNIT EMERGENCY BOARD, ONE STANDBY DG SET, COMMON FOR TWO UNITS IS PROVIDED TO CATER THE EMERGENCY REQUIREMENT OF ONE UNIT AT A TIME.
- CHANGEOVER FACILITY**
 - 11KV SYSTEM UNIT BUSES EMPLOY FAST BUS TRANSFER SCHEME FOR RESTORATION OF SUPPLY FROM STATION TRANSFORMER IN CASE OF SUPPLY FAILURE FROM THE RESPECTIVE UNIT TRANSFORMER. MANUAL LIVE CHANGEOVER WITH CHECK SYNCHRONISATION AND SLOW AUTO CHANGEOVER FACILITY AS A BACK-UP IS ALSO PROVIDED FOR THESE BUSES. 11KV SYSTEM STATION BUSES EMPLOY MANUAL LIVE CHANGEOVER.
 - 3.3KV SYSTEM BUSES ARE PROVIDED WITH FAST BUS CHANGEOVER FOR RESTORATION OF SUPPLY IN CASE OF OUTAGE OF ANY ONE OF THE UNIT AUX. TRANSFORMER. MANUAL LIVE CHANGEOVER WITH CHECK SYNCHRONISATION AND SLOW AUTO CHANGEOVER FACILITY AS A BACK-UP IS ALSO PROVIDED FOR THESE BUSES. OTHER 3.3KV SYSTEM BUSES ARE PROVIDED WITH MANUAL LIVE CHANGEOVER WITH CHECK SYNCHRONISATION AS WELL AS AUTOMATIC SLOW CHANGEOVER.
 - ALL 415V SYSTEM BUS INCOMERS FED FROM TRANSFORMERS ARE PROVIDED WITH MANUAL LIVE/DEAD BUS CLOSING FACILITY. BUS COUPLERS ARE PROVIDED WITH AUTO DEAD BUS CLOSING.
 - UNIT 415V BUS SECTIONS ARE ADDITIONALLY PROVIDED WITH MANUAL LIVE CHANGEOVER FACILITY WITH CHECK SYNCHRONISATION AND AUTOMATIC CHANGEOVER, WITH THEIR RESPECTIVE DG BUS.
 - 415V EMERGENCY BOARDS ARE NORMALLY FED FROM RESPECTIVE UNIT LV BOARDS. IN THE EVENT OF FAILURE OF NORMAL POWER SUPPLY, MAIN AND STANDBY DG WILL AUTOSTART SIMULTANEOUSLY AND UPON ATTAINING NORMAL VOLTAGE AND FREQUENCY, MAIN DG INCOMERS & US/BY WILL BE CLOSED AUTOMATICALLY TO THE RESPECTIVE UNIT EMERGENCY BOARD AND STANDBY DG INCOMER IF REQUIRED WILL BE CLOSED MANUALLY.
- THE SELECTION OF LT OUTGOING FEEDERS(DRAW OUT TYPE) SHALL BE AS INDICATED HEREUNDER:
 - BELOW 100 A - SFU
 - 100 A-400 A - MCCB
 - ABOVE 400 A - BREAKER
- ALL BATTERY CHARGERS SHALL HAVE PROVISION FOR RECEIVING 2 INPUT SUPPLIES ALONG WITH SUITABLE AUTOMATIC CHANGEOVER BETWEEN THE SOURCES.
- CONTROL AND PROTECTION SUPPLIES FOR ALL SWITCHGEARS/DBS/CONTROL PANELS SHALL BE FED FROM TWO DIFFERENT SOURCES/DIFFERENT SECTIONS.
- TIE FROM 415V STATION SERVICE SWGR TO UNIT SERVICE SWGR WILL BE CLOSED ONLY IN CASE OF EXIGENCIES AS MENTIONED BELOW.
 - BOTH US'T'S ARE OUT OF SERVICE OR SHUT DOWN ARE TAKEN DUE TO SOME FORCED PROBLEM IN US'T'S. UNDER SUCH CONDITION THIS TIE CAN BE CLOSED. AFTER SHIFTING STATION SERVICE LOADS TO OTHER AVAILABLE TRANSFORMER.
 - UNDER ANY EVENTUALITY; OUTAGE OF BOTH THE US'T'S & DG SUPPLY NOT BE AVAILABLE, THIS TIE CAN BE CLOSED TO RESTORE SUPPLY TO USS/UES AS AN EMERGENCY MEASURE.
- IPB FAULT LEVEL:

FAULT LEVEL SHALL BE DECIDED BASED ON GENERATOR PARAMETERS, 400KV SYSTEM FAULT OF 50 KA, 1 SEC.,
- OWNER'S REQUIREMENT TO BE CONSIDERED IN CONJUNCTION WITH SCOPE CHAPTER.
- ALL ROOFTOP SOLAR INCOMER FEEDER SHALL HAVE 0.2s CLASS METERING

11. ITEMS INSIDE BOX ARE EXCLUDED FROM BIDDERS SCOPE



OUTDOOR TRANSFORMERS, HT CABLES FOR TIE/TRANSFORMER INCOMERS & OUTGOING FEEDERS, CIVIL WORKS OF THE SWITCHGEAR ROOMS FOR THE BELOW SUBSYSTEMS ARE EXCLUDED FROM BIDDERS SCOPE. SUPPLY ERECTION TESTING COMMISSIONING OF HT SWITCHGEAR/HT BUSDUCT AS REQUIRED FOR OWNERS SUBSYSTEM INDICATED BELOW IS IN BIDDERS SCOPE. FOR FEEDER DETAILS OF HT SWITCHGEAR REQUIRED FOR OWNERS USE REFER ANNEX-XX TO SUBSECTION-II B



ITEMS IN BIDDERS SCOPE

BROAD LIST OF ERECTION & CONSUMABLES

S. NO.	DESCRIPTION
1	Spacer GI
2	Spacer epoxy
3	Saddle GI
4	Saddle epoxy
5	Checknut GI
6	Checknut epoxy
7	Inspection bend GI
8	Inspection bend epoxy
9	Solid bend GI
10	Solid bend epoxy
11	Circular boxes GI (with gasket as applicable)
12	Circular boxes epoxy (with gasket as applicable)
13	Ball and Socket
14	Nylon grips
15	wooden screws, machine Screw
16	Reducer
17	PVC bush, PVC Sleeves
18	Cu Lugs, Earth Clip, Anchor fastener
19	Ferrules
20	Flexible Coupler
21	MS rod for pole earthing
22	GS flat 'U' clamps for pole JB fixing
23	GI bolts for 'U' clamps fixing
24	GI conduit sleeve
25	Accessories required for handrail mounted fixture (GMS plate, GI 'U' bolt with nut & washer, bolt with washer, reducer, conduits)
26	GI bolts & nuts for fixture and CG box fixing
27	GI bolts & nuts with washer for panel/receptacle mounting
28	Primer and oxide paint for pole & MS structure painting
29	Aluminium paint for pole & MS structure painting
30	Double compression glands
31	Fan boxes

NTPC SAFETY RULES

FOR CONSTRUCTION AND ERECTION OF POWER PLANTS

INTRODUCTION:

NTPC Limited is a Maharatna organization taking lead in realizing the power dreams of the Nation with a vision “To be one of the World’s largest and best power utilities, Powering India’s growth”. Safety is one of the prime concerns of NTPC and it always strives towards accident free construction, erection, commissioning, operation and maintenance of its power projects. In this process, NTPC has already formulated Safety policy and guidelines for smooth execution of all its project activities.

In order to strengthen the existing Safety Rules for Construction and Erection and thereby curbing the chances of accidents in Construction & Erection works at various projects of NTPC, the existing safety rules have been revised for strict implementation. These Safety Rules lay down the safety requirements for safe execution of project activities, responsibilities of the contracting agencies, and all concerned involved in Construction and Erection.

A. RESPONSIBILITIES OF CONTRACTORS FOR IMPLEMENTATION OF SAFETY RULES:

The Safety Rules for Construction & Erection as outlined hereunder, while setting out a broad parameter of safety norms, are not exhaustive. The contractor and his agencies are advised to refer to the following statutory provisions as amended from time to time for details and strict compliance therewith.

FOR GREENFIELD PROJECTS:

- (a) Building and Other Construction Workers (regulation of employment and conditions of service) Act, 1996 (briefly referred to as BOCW Act),
- (b) Building and other construction workers (regulation of employment and conditions of service) Central Rules, 1998 (briefly referred to as BOCW Rules) as adopted by the various State Governments,

FOR EXPANSION, MODIFICATION, ALTERATION AND, OR CONSTRUCTION ACTIVITY WITHIN AN EXISTING PLANT OPERATING AS PER APPROVED SITE PLAN UNDER THE FACTORIES ACT;

- (a) Factories Act, 1948,
- (b) Factories Rules, as adopted by the various State Governments
- (c) BOCW Act
- (d) BOCW Rules

The contractor is also required to ensure compliance with all the relevant Acts/Rules in addition to above.

It shall be incumbent on the contractor to ensure that the requirements of safety, statutory or otherwise specified, are fully met. Thus the onus of implementation of the norms so prescribed shall squarely rest with the contractor concerned or, on his behalf, his sub-contractor or any other agency deployed by him, indemnifying NTPC from all the liabilities that may arise out of any failure to comply with the above mentioned Acts/Rules or any contravention thereof by the contractor or any other sub-agency on his behalf.

Safety cannot be ensured solely through Rules and Regulations or Codes. It is the responsibility of the Contracting Agency to ensure that basic safety principles are incorporated in the planning stage of their mobilization, execution, installation of machines, equipment, storage, etc., and initiate and maintain *safety programs*. It is desirable to have a planned programme and secure adequate cooperation of senior management, EICs, sub-contracting agencies, supervisory personnel and workers involved to ensure the implementation of the provisions of these Rules in true spirit so as to achieve the ultimate goal of *accident prevention*.

It shall also be the responsibility of the contracting agency to provide amenities and safety requirements on each construction job in order to reduce or to eliminate hazards of construction activities and also to provided necessary *first aid* facilities as well as Ambulance van (in case of major agencies) for prompt transportation of injured persons to a physician or hospital.

It is also mandated that the authorized representative of NTPC, namely, the Engineer-in-charge, may, at his convenience, exercise such superintendence, supervision and, or control as may be deemed necessary, but this shall not absolve the contractor of his basic responsibility for strict compliance with the norms, standards and, or legal provisions as applicable under the Factories Act/Rules and the Building and other construction (regulation of employment and conditions of service) Act/Rules.

Section wise checklist of provisions of BOCW Act/Rules is given hereunder for ready reference of the contractor. (This list has been prepared in chronological order with primary importance to Section of Act and secondary importance to Rules)

S - Refers relevant Sections in BOCWA

R - Refers relevant Rules in BOCWR

Sl. No.	ITEMS	RELEVANT SECTIONS / RULES IN BOCWA AND BOCWR AND RBOCWR
1	Registration of establishment	S – 7, R – 23 to 27
2.	Display of registration certification at workplace	R – 26 (5)
3.	Hours of work	S – 28 R – 234 to 237
4.	Register of overtime	S – 28; S – 29 R – 241(1) Form XXII
5.	Weekly rest and payment at rest	R – 235
6.	Night shift	R – 236
7.	Maintenance of workers registers and records	S – 30 R – 238
8.	Notice of commencement and completion	S – 46 R – 239
9.	Register of persons employed as building workers	R – 240
10.	Muster roll and wages register	R – 241(1) (a); Form XVI and XVII
11.	Payment of wages	R – 248
12.	Display of notice of wages regarding	R – 249
13.	Register of damage or loss	R – 241(1)(a); Form XIX, XX, XXI
14.	Issue of wages book	R – 241(2)(a); Form XXIII
15.	Service certificate for each workers	R – 241(2)(b); Form XXIV
16.	Display an abstract of BOCWA and BOCWR	R – 241(5)
17.	Annual return	R – 242; Form XXV
18.	Drinking water	S – 32
19.	Latrines and Urinals	S – 33 R - 243
20.	Accommodation	S – 34
21.	Creches	S – 35
22.	First-aid boxes	S – 36 R – 231 and Schedule III
23.	Canteens	S – 37 R – 244
24.	Food stuff and other items served in the canteens	R – 245
25.	Supply of tea and snacks in work place	R – 246
26.	Food charges on no loss no profit basis	R - 247
27.	Delhi BOCW welfare Board Rules	R – 250 to 296
28.	Safety committee	S – 38 R – 208

29.	Safety officer	S – 38 R – 209 and Schedule VII
30.	Reporting of accidents and dangerous occurrences	S – 39,R – 210
31.	Procedure for inquiry in to the causes of accidents	R – 211
32.	Responsibility of employer	S - 44 R – 5
33.	Responsibility of Architects, Project engineer and Designers	R – 6
34.	Responsibility of workmen	R – 8
35.	Responsibility for payment of wages and compensation	S – 45
36.	Penalties and Procedures	S – 47; S – 55
37.	Excessive noise, vibration etc.	R – 34
38.	Fire Protection	R – 35
39.	Emergency action plan	R – 36
40.	Fencing of motors	R – 37
41.	Lifting of carrying of excessive weight	R – 38
42.	Health, Safety and Environmental Policy	R – 39
43.	Dangerous and Harmful Environment	R – 40
44.	Overhead protection	R – 41
45.	Slipping, Tripping, Cutting, Drowning and Falling Hazards	R – 42
46.	Dust, Gases, Fumes, etc.	R – 43
47.	Corrosive substance	R – 49
48.	Eye Protection	R – 45
49.	Head Protection and other protection apparel	R – 46; R – 54
50.	Electrical Hazards	R – 47
51.	Vehicular traffic	R – 48
52.	Stability of structure	R – 49
53.	Illumination	R – 50; R – 124
54.	Stacking of materials	R – 51
55.	Disposal of debris	R – 52
56.	Numbering and marking of floors	R – 53
57.	Lifting appliances and gears	R – 55 to 81
58.	Runways and Ramps	R – 82 to 85
59.	Working on or adjacent to water	R – 86 & 87

60.	Transport and earthmoving equipment's	R – 88 to 95
61.	Concrete work	R – 96 to 107
62.	Demolition	R – 108 to 118
63.	Excavation and Tunneling works	R – 119 to 168
64.	Ventilation	R – 153
65.	Construction, repair and maintenance of step roof	R – 169 to 171
66.	Ladders and Step ladders	R – 172 to 174
67.	Catch platform and hoardings, chutes, safety belts and nets	R – 175 to 180
68.	Structural frame and formworks	R – 181 to 185
69.	Stacking and unstacking	R – 186 & 187
70.	Scaffold	R – 188 to 205
71.	Cofferdams and Caissons	R – 206 to 211
72.	Explosives	R – 212 & 213
73.	Piling	R – 214 to 222
74.	Medical Examination for building and other construction worker, Crane operator an Transport vehicle drivers	R – 81; R – 223(a)(iii) and Schedule
75.	Medical examination for occupational health hazards	R – 233(a)(iv)
76.	Charging of workers for Medical Examination	R – 223(b)
77.	Occupational health centres and Medical officers	R – 225 and Schedule X & XI
78.	Ambulance van & room	R – 226 & 227 and Schedule IV & V
79.	Stretchers	R – 228
80.	Occupational health service for building workers	R – 229
81.	Medical examination for occupational health hazards	R – 223(a)(iv)
82.	Emergency care services and emergency treatment	R – 232
83.	Panel of experts and agencies	Central Rule 250
84.	Power of inspectors	Central rule 251

B. RESPONSIBILITIES AND DUTIES OF WORKERS

- (a) It shall be the responsibility of the worker to comply with the requirements of safety as laid down for him and the group of workers to which he belongs and fully cooperate in the discharge of the responsibility that has been assigned to the contractor.
- (b) If he discovers any defects in the lifting appliance, lifting gear, lifting device or those concerning any transport equipment or other construction equipment or tools as well as the physical work conditions, he will report such defects promptly to his employer or NTPC Engineer or other person in authority;
- (c) No building worker shall, unless duly authorized or in case of absolute necessity, remove or interfere with any fencing, guards, gangways, gear, ladder, hatch covering, life saving appliances, lighting or other things whatsoever required and provided for safety and health. If any of the aforesaid things is removed, the persons engaged in the work shall restore such thing at the end of the period during which its removal was necessary;
- (d) Every worker shall use only means of access provided in accordance with the approved norms and no person shall authorize or order another to use such means of access or method other than those approved;
- (e) Workers shall use such means of access and egress for going to and exiting from the workplace as provided.

SECTION - I

SAFETY MANAGEMENT

1.0 SAFETY MANUAL AND SAFETY POLICY:

- 1.1** The Safety policy of the contracting agency should reflect the commitment of the concerned agency towards safety and health of the workers specified for the particular site.
- 1.2** The Contractor shall have Safety Plan detailing the safety norms evolved through Safety Policy and Job Safety Analysis (JSA) or Hazard Identification & Risk Assessment (HIRA) of all package activities and constitute a Safety management program. Contracts shall also ensure POWRA (point of work risk assessment) before start of any activity.
- 1.3** The safety management programme in the form of Safety Manual shall give details of provisions proposed by the agency w.r.t. Job Safety Analysis (JSA) or Hazard Identification and Risk Assessment (HIRA) to ensure safety of the employees and elimination of health hazards. The Safety Manual including safety policy duly signed by the head/senior executive of the agency shall be submitted to the concerned Engineer-Incharge(EIC), NTPC before start of their project activities at site.
- 1.4** Each contracting agency shall have facilities for conducting the above safety management programme, commensurate with magnitude of the work under contract.

2.0 APPOINTMENT OF SAFETY OFFICER/SAFETY SUPERVISOR:

- 2.1** Each contracting Agency shall provide a sufficient number of qualified, suitable and experienced persons to manage all safety related matter on Site relating to the works. Irrespective of manpower employed by the agency whether temporary, casual, probationer, regular or permanent or on contract, Agency shall deploy a qualified Safety Officer/executive, responsible for carrying out the safety management programme before start of the work.
- 2.2** The safety officer shall create an organization, commensurate with the project activities, consisting of other staff as required for suitable deployment.
- 2.3** The schedule of requirement of safety personnel is given below.

No. of Workers	No. of Safety Supervisors	No. of Safety Officers
Up to 100	1	1
101 to 250	2	1
251 to 500	4	1
501 to 1000	6	2
1000 to 2000	6+ One additional supervisor up to every additional 250 workers	3
2000-3000	10+ One additional supervisor up to every additional 250 workers	4
3000-4000	14+ One additional supervisor up to every additional 250 workers	5
Above 4000	18 + One additional supervisor up to every additional 250 workers	5 + one safety officer up to addition 1000 workers

2.4 The qualification and experience of the safety personnel should meet the following criteria.

- a) Safety Supervisor: (i) Possesses recognized degree in any branch of Engineering. OR
(ii) Diploma in any branch of Engineering with at least one year construction experience.
- b) Safety Officer/Safety Executive: Qualification as given under BOCW Act/rules and minimum experience of three years.

2.5 In case contractor fails to employ the required safety professionals, the department may at the cost and risk of the contractor deploy additional/required safety professionals. The cost incurred towards this shall be deducted from contractor's bill at following the rates or actual whichever is higher.

- 1. Safety Engineer Rs. 1500/day.
- 2. Safety Supervisor Rs. 1000/day.

3.0 MEETING FOR SAFETY AFTER AWARD OF THE CONTRACT:

Representatives of contracting agency along with safety Officer/executive shall meet the concerned EIC of the particular activity prior to start of construction activities for the purpose of discussing safety standards and requirements applicable to the work under contract. The person representing the agency should be a responsible person for all their site activities.

4.0 PERSONAL PROTECTIVE EQUIPMENT:

4.1 The contracting agency should ensure sufficient inventory of personal protective equipment (PPEs) prior to initial mobilization as specified in the Bidding Documents. After identifying the need of the required PPEs for various activities performed at the site, an additional inventory of approx. 20% of required PPEs should be maintain during the execution of the work. A PPE plan shall be prepared which gives fair idea regarding issue of PPEs to various personnel as per the following 'PPE Selection Matrix'.

4.2 Mandatory PPEs: Wearing of Safety Helmet, Safety Shoes and reflective jacket is mandatory for all work at site and it should be ensured that all employees and project visiting personnel shall invariably wear safety helmet, safety shoes & reflective jacket.

PPE Matrix (apart from mandatory PPEs, i.e., Safety Helmet & Safety Shoes)

Activity	Type of Protection						Remarks, if any
	Hand	Eye	Ear	Body	Respiratory	Others	
Gas Welding & Cutting	LG	WG	-	LA	*SCBA/ OLBA	-	* for confined space
Electric Arc Welding	LG	HMWS	-	LA	*SCBA/ OLBA	-	* for confined space

Rigging	CG	SG	-				--
Working at Height	-	SG	-	DLFBH	-	*FAS	* for vertical columns
Grinding & Chipping	CG	FS / SG	-	LA	-	-	--
Working in High Noise	-	-	EP / EM	-	-	-	--
Handling of Cement Concrete	RG	SG	-	-	DM	-	
Blasting	CG	SG	EP*	-	-	-	* at noise area
Excavation	CG	SG	-	-	DM	-	*Gum boot in place of Safety shoe for foot
Chemical Handling	PVCG	CSG	-	PVCA	-	-	*Full body rubber suit with hood
Electrical and C&I	ERG*	SG	-	-	-	-	*For high voltages
Sand/shot blasting	CG	-	EP / EM	CA	SAMH	-	

ABBREVIATIONS: FS: Face Shield, CSG: Chemical splash goggles, HMWS: Helmet mounted welder's shield, GB: gum boot, DLFBH: Double lanyard full body harness, SG: Safety goggles, DM: Dust mask, SAMH L Supplied air mask/hood, EP/EM: Ear plug/Ear Muff, CG: Cotton hand gloves, LG: Leather hand gloves, LA: Leather apron, RG: Rubber gloves, PVCG: PVC Gloves, PVCA: PVC Apron, SCBA: Self-contained breathing apparatus, WG: Welding goggles, ERG: Electrical Rubber Gloves. OLBA : Online breathing apparatus

4.3 The above-mentioned PPEs should be made available with contractor at site and issued to the concerned workers on the day of employment. All PPEs shall comply with ISI standards with valid test certificates.

4.4 At least two breathing apparatus sets (complying requirement as per IS: 10245) shall be provided at each site where excavation/tunneling works and Welding/ Cutting operations in confined areas are being carried out, to rescue the victims under exposure to harmful gases/vapors, if any.

5.0 SAFETY COMMITTEE:

- 5.1** *Safety committee* shall be formed within each contracting agency comprising of worker representatives with equal no. of management representatives as per the provisions of BOCW Act/rules. This committee in each agency shall meet at least once in every month. The safety officer of the concerned agency shall coordinate these meetings. NTPC Safety officer shall be special invitee for Safety Committee meetings. The safety committee functioning shall be in line with the provisions of BOCW Act/Rules.
- 5.2** Apart from the above, each agency shall organize safety meetings every day before start of day's work to educate & motivate the workers about the necessity of safety. Case study of accident/ incident can be shared in these meetings.
- 5.3** The contractor shall also regularly organize safety meetings for all job supervisors/foremen.
- 5.4** Weekly meeting with agencies' Safety Officers to be organized by safety department of NTPC and minutes to be recorded, circulated and compliance status to be checked on regular basis.

6.0 SAFETY MESSAGE PROPAGATION:

- 6.1** Contracting agencies shall arrange for display of safety hoardings depicting suitable safety cartoons/messages/ cautionary notices at appropriate places of project site to remind the workers to perform their duties safely. Minimum one safety message board/hoarding of appropriate size for every 10 workers to be provided and maintained by the concerned agency.
- 6.2** Apart from safety hoardings, each agency should maintain a safety bulletin board at all their work locations. Such safety bulletin boards should depict the activities being planned for the day, good practices, permit details etc.
- 6.3** Safety suggestion boxes shall be kept at each contractor's office at site for obtaining safety suggestions from the workers. Best suggestions should be implemented and may be rewarded suitably to encourage the workers for safety.

7. COMPETENCY OF EMPLOYEES:

- 7.1** Throughout the course of the contract, persons employed by agency shall be physically fit, qualified/experienced to perform their assigned duties/ jobs.
- 7.2** Employees shall not, knowingly be permitted to work in a manner that their ability or alertness is so impaired because of fatigue, illness or any other reason, that it may expose them and or others to injury.
- 7.3** No worker, vehicle operator shall be less than 18 years of age. And the vehicle operator shall have a valid license as per requirements of Motor Vehicle Act.
- 7.4** Contractor shall comply with all applicable state/central laws and codes related to employment of operators for Hoist, Shovel, Crane, Tractor, Bull-dozer, any other howling heavy equipment/vehicle.

8.0 SAFETY INDUCTION AND TRAINING :

8.1 Each worker deployed by the agency shall be given 2-days induction training which shall include the medical examination and instructions related to particular job, fire fighting, first-aid and reporting of accidents. All employees shall be given safety training as per BOCW Act/Rules.

8.2 The contracting agency shall also impart job specific skill based safety training to all its employees (Minimum one day) on various related safety topics using internal/external safety professionals/consultants as per the matrix given below. Record of such trainings and attendance particulars shall be maintained in a register for ready reference to statutory authorities/engineer-in charge.

TRAINING MATRIX:

Name of topic	Executives	Super visors	Skilled Workmen	Other Workers
Safety Induction	Y	Y	Y	Y
Accident_ Causes, factors, cost	Y	Y	Y	-
Industrial hazards & Accident Prevention	Y	Y	Y	-
Investigating, reporting, records	Y	Y	-	-
Personal Protective Equipment	-	Y	Y	Y
Construction Safety & Role of Supervisory personnel	-	Y	-	-
Permit to Work (PTW)	-	Y	Y	y
Statutory Provisions (BOCW Act/Rules, Factories Act 1948 etc.)	Y	Y	y	y
Material handling	-	y	Y	Y
Emergency Management	Y	Y	Y	-
Electrical Safety	-	Y	Y	-
Fire safety	Y	Y	Y	Y
First Aid & CPR (cardio pulmonary resuscitation)	-	Y	Y	Y (Selected)
Safety in Welding & Cutting	-	-	Y	-
Safety Audit	Y	Y	-	-
Safety in Lifting Tools & Tackles	-	Y	Y	y
Safety in Working at height	-	Y	Y	Y
Safety in Confined space work	-	Y	Y	Y
Defensive Driving	-	Y*	Y*	Y*

*for construction vehicle operators, helpers & crane operators

Y=Yes

9.0 ID PASS

- 9.1** CLIMS (Contract Labor Information Management System) will be the criterion for entering or gate pass system if implemented at site.
- 9.2** The contractor shall ensure that all personnel working at site having a photo Identity card before they are engaged for any work and properly mentioned details like validity, Category/designation and work area etc. This ID card should be issued only after ensuring their screening test, medical fitness and safety induction training. Id card gate pass shall be indicated with 3 nos. of offence marks. With each offence the gate pass of concerned workmen/ supervisor will be punched giving on the spot indication of persons indulging in unsafe actions.
- 9.3** Drinking of Alcoholic beverages is strictly prohibited. Employees under the influence of any intoxicants, even to the slightest degree, shall not be permitted to remain at work. Each contractor should maintain 'breath analyzer' to determine the intoxicated workers at site.

10 SAFETY AUDIT

- 10.1** Internal Safety Audit once in every six months by the contracting agency and external safety audit as once in a year by third party shall be conducted, with prior intimation to EIC and NTPC Safety Deptt. The external auditing agency should be reputed safety institution or a certified Safety Auditor under any statutory legislation. The audit report along with time bound action plan should be submitted to Engineer-in-charge and NTPC Safety Dept.
- 10.2** Apart from above, Electrical Safety Audit shall be conducted quarterly by a team comprising of Electrical engineer, Safety representative of contractor and NTPC Electrical Erection representative covering the following and submit the report to EIC.
- i) Electrical incidents investigation findings and remedial measures implemented.
 - ii) Adequacy of power supply requirements
 - iii) Power distribution system in place
 - iv) Updated electrical single line diagram including the IP44 DBs arrangement.
 - v) Electrical protection devices – ELCBs, O/L protections etc.
 - vi) Earth or ground connection and earth pit maintenance details
 - vii) Education and training of electrical personnel undertaken
 - viii) Any other point appropriate to the site conditions.

11. SAFETY BUDGET

Every contracting agency should clearly estimate and allocate a separate budget head for safety requirements every year and make the safety activity plan for the year and submit to NTPC EIC & Head of Safety. Budget allocations should be practically adequate to the site safety requirements and the details shall be intimated to the concerned EIC and safety deptt. before start of the work under the contract and subsequently, every year by 15th of April. Engineer-in Charge in consultation with Head of Safety shall review and monitor the effective utilization of allocated budget for safety related activities by the Contractor.

12. REPORTING AND INVESTIGATION OF ACCIDENTS AND DANGEROUS OCCURRENCES:

12.1 Reporting of accidents: Notice of any accident (the prescribed format is annexed to the manual) to a worker at the building or construction site that

- (a) Causes loss of life; or
- (b) Disables a worker from working for a period of **48 hours** or more immediately following the accident;

Shall forthwith be sent by Telegram, Telephone, Fax, Email or similar other means including special Messenger within **four hours** in case of **fatal accidents** and **72 hours** in case of **other accidents**, besides the Engineer-in-charge, to:

- I. The Regional Labour Commissioner (Central);
- II. The Board with which the worker involved was registered as a beneficiary;
- III. Director General of Building and other construction (regulation of employment and conditions of service) Act/Rules; and
- IV. The next of kin or other relative of the worker involved in the accident;

12.2 Further, notice of accident shall be sent in respect of an accident which

- (a) Causes loss of life; or
- (b) Disables the injured worker from work for more than 10 days to
 - (1) The Officer-in-charge of the nearest Police Station;
 - (2) The District Magistrate or, if the District Magistrate by order so desires, to
 - (3) The Sub-Divisional Magistrate;

12.3 Where any accident causing **disablement that subsequently results in death**, notice thereof in writing of such death, shall be sent the Authorities mentioned above within **72 hours** of such death.

12.4 In case of an accident causing minor injury, first-aid shall be administered and that resulting in disability of **48 hours or more**, the injured worker shall be given first-aid and immediately transferred to a Hospital or other place for medical treatment.

12.5 All near-miss accidents shall be reported to NTPC Engineer In-charge and Safety Officer as per prescribed format.

12.6 Reporting of dangerous occurrences: The following classes of dangerous occurrences shall be reported to the Inspector having jurisdiction, whether or not any disablement or death caused to the worker, namely:

- (a) Collapse or failure of lifting appliances, or hoist, or conveyors, or similar equipment for handling of building or construction material or breakage or failure of rope, chain or loose gears; or overturning of cranes used in construction work;
- (b) Falling of objects from height;
- (c) Collapse or subsidence of soil, any wall, floor, gallery, roof or any other part of any structure, platform, staging, scaffolding or means of access including formwork;
- (d) Contract work, excavation, collapse of transmission;
- (e) Explosion of receiver or vessel used for storage at a pressure than atmospheric pressure, of any gases or any liquid or solid used as building material;

- (f) Fire and explosion causing damage to any place on construction site where building workers are employed;
- (g) Spillage or leakage of any hazardous substance and damage to their container;
- (h) Collapse, capsizing, toppling or collision of transport equipment;
- (i) Leakage or release of harmful toxic gases at the construction site;
- (j) In case of failure of a lifting appliance, loose gear, hoist or building and other construction work, machinery and transport equipment at a construction site, such appliances, gear, hoist, machinery or equipment and the site of such occurrence shall, as far as practicable, be kept undisturbed until inspected by the Authorities;

12.7 Every notice given for fatal accidents shall be followed by a written report to the concerned Statutory Authorities and the Engineer In-charge in the specified Form annexed as Schedule, under acknowledgement.

12.8 Incident / injury statistics shall be maintained by all agencies cause wise.

12.9 Investigation of accidents and dangerous occurrences

Besides reporting, it shall be the responsibility of the contractor to constitute a team (members as per the gravity of the incident) of responsible person to thoroughly investigate all incidents involving near-miss accidents, lost-time and reportable accidents and dangerous occurrences with a view to finding out the causative factor, taking remedial measures and fixing responsibility, and make a copy of the investigation report along with action-plan, specifying a definite time-frame for implementation of the findings, available to the Engineer in-charge forthwith.

13. MEDICAL AND FIRST AID AMENITIES:

13.1 It is the responsibility of each contracting agency to ensure the availability of suitable arrangements at their work site for rendering prompt and efficient First aid to injured persons.

13.2 Arrange one trained and certified first aid for every twenty workers in each shift.

13.3 Ambulance with proper equipment for prompt transportation of the injured persons to a physician or a hospital shall be provided before start of the work in cases where 500 or more than 500 workers are employed. For smaller contracts, where less than 500 workers are employed, Contractor shall have a tie-up with suitable Agency for providing Ambulance with proper equipment for prompt transportation of the injured persons to a physician or a hospital in case of an Accident / Emergency. Further, Contractor shall submit a proof of the same to EIC/Safety Officer of NTPC.

13.4 Deploy one full time construction medical officer (qualification as per Schedule XI of BOCW Central Rules -1998) for cases where 500 or more workers are employed (upto one thousand workers) and one additional construction medical officer for additional one thousand workers or part thereof. For smaller contracts, where less than 500 workers are employed, Contractor shall have a tie-up with suitable Hospital / Nursing home in the vicinity of the

Project/Site where work is being executed, for providing adequate medical treatment by qualified medical officers and nursing staff, as and when required. Further, Contractor shall submit a proof of the same to EIC/Safety Officer of NTPC.

Notwithstanding anything stated above, Contractor/Agency shall strictly comply with the requirements of relevant BOCW Act/ BOCW Rules/ Factory Act/Factory Rules/ any other statutory Act/Rules/Law with regards to providing suitable medical facilities to the workers.

In case contractor fails to employ the required construction medical officer alongwith Additional staff, corresponding payment for the same shall not be made and/or necessary action as per provisions of the Bidding documents shall be taken by NTPC.

- 13.5** Additional staff including one nurse, one dresser-cum compounder, one sweeper-cum-ward boy with each construction medical officer for full working hours
- 13.6** The Telephone nos. of Medical officer, Hospital(s) or ambulance shall also be conspicuously displayed at each work site.
- 13.7** First-aid kits as approved by medical officer shall be provided at accessible points in the ratio of at least one kit for every 50 employees.
- 13.8 Health Management:** The site manager shall implement health examinations for the working personnel on a regular basis.

Types of health examination	Target	Frequency
General health examination	All workers	Annual
Occupational health examination (Audiometric, PFT, Vision etc.)	Worker engaging in noise, dust, vibration, harmful light generating work	Annual
Occupational health examination (Vision)	Personnel involved in operation of Cranes, heavy vehicles	Annual
Occupational health examination (Vertigo/Height pass)	Workers engaged at Height Works	At the time of induction training and every year

14. TESTING & EXAMINATION OF LIFTING, TOOLS, TACKLES, PRESSURE VESSELS AND OTHER EQUIPMENT:

- 14.1** All the lifting equipment, tools, tackles, pressure vessels etc. shall be tested & examined as per BOCW or Factories Act and rules made there under.

- 14.2** The records & certificates of such testing & examination shall be maintained and readily available for reference to statutory authorities/engineer-in-charge.
- 14.3** Proper color coding system should be maintained and marking should be done accordingly on all lifting tackles.
- 14.4** Regular testing of ELCBs and RCCBs by competent electrician must be ensured by agencies and record should be maintained.

15. EMERGENCY MANAGEMENT PLAN

- 15.1** The contractor shall ensure that an Emergency Management Plan is prepared to deal with emergencies arising out of:
 - a. Fire and explosion;
 - b. Collapse of lifting appliances and transport equipment;
 - c. Collapse of building, sheds or structure etc.;
 - d. Gas leakage or spillage of dangerous goods or chemicals;
 - e. Drowning of workers, sinking vessels, and
 - f. Landslides getting workers buried; floods, storms and other natural calamities.
- 15.2** While arrangements shall be made for emergency medical treatment and evacuation of the victim in the event of an accident or dangerous incident occurring, the chain of command and the responsible persons of the contractor with their telephone numbers and addresses for quick communication shall be adequately publicized and conspicuously displayed in the workplace.
- 15.3** It is also required that there is a tie-up with the hospitals and fire stations located in the neighborhood for attending to the casualties promptly and emergency vehicle kept on standby duty during the working hours for the purpose.
- 15.4** It shall be the responsibility of the contractor to keep the Local Law & Order Authorities informed and seek urgent help, as the case may be, so as to mitigate the consequences of an emergency. Prompt communication to NTPC, telephonically initially and followed by a written report, shall be made by the contractor.

16. ENFORCEMENT OF SAFETY CODE, SAFETY RULES & REGULATIONS:

The Engineer-In charge shall ensure that the contractor is exercising at all times, reasonable and proper precautions for the safety of people at works and complying with the provisions of current safety rules and laws according to safety code and relevant statutes of state/central governments. In case of negligence or default, the agency shall be penalized suitably as per penal provisions of NTPC Safety Rules.

17. WORK PERMIT SYSTEM

- 17.1** The Contractor shall implement Work Permit system, which is a formal written system used to control certain types of work that are potentially hazardous. A work permit is a document, which specifies the work to be done, and the precautions to be taken. Work Permits form an essential part of safe systems of work for many construction activities. They start the work

only after safe procedures have been defined and clearance taken from respective NTPC EICs. Permits to Work are usually required in high-risk areas as identified by the Risk Assessments.

17.2 Examples of high-risk activities include but are not limited to:

- i) Entry into confined spaces
- ii) Cutting & welding
- iii) Working at Height along with checklist
- iv) Working on electrical equipment
- v) Heavy lifting operations
- vi) Removal of grating/ Handrail / floor opening
- vii) Material Shifting

The copies of recommended formats for reference is given in annexure-IV.

17.3 The permit-to-work system should be fully documented, laying down:

- i) How the system works
- ii) The jobs it is to be used for;
- iii) The responsibilities and training of those involved; and
- iv) How to check its operation;

17.4 A Work Permit authorization form shall be completed with the maximum duration period not exceeding 12 hours.

17.5 A copy of each Permit to Work (PTW) shall be displayed near to work are (on PTW Display board) in close proximity to the actual works location to which it applies.

18. ACCESS TO AND FROM THE WORKPLACE

18.1 Safe, clean, well lit, unencumbered access and egress to and from work areas shall be maintained at all times in normal operating conditions.

18.2 The number and location of accesses and egresses from and to the workplace shall be adapted to the number of people likely to be present at any time, and therefore to evacuate from the workplace in case of emergency.

18.3 If access and egress to work areas are restricted due to operational conditions (e.g. access restricted due to pressure testing, etc.), alternative access and egress ways must be implemented, so far as is reasonably practicable. If this is not reasonably practicable, all concerned organizations and persons must be informed of the access restrictions, and work scheduling must be adapted in consequence.

18.4 Temporary access to height or into ground openings shall be of purpose made material such as scaffolds, stair cases/towers and ramps, which incorporate guardrails .

19. INTERFERENCE WITH MOVING VEHICLES AND PEDESTRIANS

- 19.1** The circulation of vehicles and pedestrians must be segregated by establishing restricted areas, one way routes where possible, pedestrian crossing zones and designated parking areas.
- 19.2** The appropriate measures must be implemented in order to prevent collision between pedestrians and vehicles at pedestrian crossings. This may include, but shall not be limited to:
 - Mirrors;
 - Lighting;
 - Speed bumps before the crossing point.
- 19.3** Vehicle and pedestrian ways shall be physically separated with Hard-barriers, so far as is reasonably practicable, and be indicated with signs.



- 19.4** When it is not reasonably practical to implement a physical segregation, pedestrians must maintain safety distance of at least 2 meters from moving/operating vehicles at all times.
- 19.5** Traffic rules must be made visible through signage and traffic stops, consistent with those used on public
- 19.6** Roads as per road safety requirement.
- 19.7** All pedestrians on Project sites must wear high-visibility garments.
- 19.8** Pedestrians (including banksmen) must wear high-visibility garments in all areas where trucks and other vehicles (forklifts, cranes, etc.) maneuver. These areas must be clearly signaled / marked (floor painting, Hard-barriers, signs, etc.).Additional points:
- 19.9** Competent banksmen must be used for operations involving reversing or maneuvering where space or view is restricted.
- 19.10** Drivers must only operate vehicles they are competent to drive and must follow the established traffic routes and comply with all site rules.
- 19.11** The maximum driving speed on site is 15 km per hour.
- 19.12** Drivers and passengers must not get on or off moving vehicles.
- 19.13** When driving a forklift, forks must be lowered, the mast tilted back.
- 19.14** Smoking, eating, drinking, using a mobile phone or using earbuds or headphones when driving a vehicle is strictly prohibited.
- 19.15** When the vehicle is not in use, it must be ensured that:
 - The engine is stopped and prevented from unauthorized use (e.g.: starter key removed), brake applied (and with wheels chocked for heavy vehicles);
 - All raised parts are lowered to the ground or put in a safe position (cranes);
 - It does not obstruct emergency exits, other routes, fire equipment or electricity panels.

20. HOUSEKEEPING

The contractor shall ensure that their work area is kept clean, tidy and free from debris generated by their activities. All debris/scrap should be stored in separate bins. The work areas must be cleaned on a daily basis and a full cleaning session of each area shall be conducted on a weekly basis. All equipment, materials and vehicles shall be stored in an orderly manner. Access to emergency equipment, exits, telephones, safety showers, eye wash stations, fire extinguishers, pull boxes, fire hoses, etc. shall not be blocked or otherwise disturbed, restricted or delayed.

21. STACKING AND STORAGE PRACTICE

Contractor Agency shall ensure stacked material is bonded on a stable and level footing capable of carrying the mass of the stack. Adequate clearances shall be provided between the sides of the stack and top to facilitate unimpeded access to service equipment like overhead wiring, cranes, forklifts and firefighting equipment, and hoses. Circular items shall be sufficiently choked with wedges not with odd bits of materials. Free-standing stacks of gunny bags and sacks such as Cement bags shall be stacked to prescribe safe stacking heights with layers formed for stable bonding, preventing slippage causing accidents. Stacking against walls shall not be permissible.

Contractor shall maintain the premises and surrounding areas in clean and clear manner with safe access and egress. There shall be sufficient and adequate storage racks, shelving, bins and pallets and material handling equipment to stack his construction materials such as Pipes, Structural and his construction enabling materials. Unwanted materials shall be promptly moved away for efficient material movement.

Any temporary store shed will be built in conformity with fire safety requirements. The stores must be provided with adequate lighting arrangement (Flame proof / intrinsically safe depending upon the Zone category) and must be equipped with sufficient fire extinguishing arrangement. "No Smoking" and other relevant signage must be displayed conspicuously at strategic locations and safety precautions must be strictly enforced.

All material should be kept at least 150mm above from the ground by providing wooden packing below. Maximum height of material stacking should not be greater than 3 meter. All loose material must be kept in wooden box or in sharp edge protected drum and material identification details to be displayed. Materials inside store room should be kept on scaffold rack.

Gas cylinder storage area must be 30m away from the hot work zone and separate storage facility must be available for empty and full cylinder with proper shed. Storage area must be design in a way that 6 meter distance between LPG/DA and oxygen maintained

22. CONFINED SPACES

All Confined Spaces belonging to Subcontractor shall be identified and clearly signed posted as a confined space forbidden to unauthorized Personnel at every entrance. A method for preventing entry must be established and maintained for all Confined Spaces. Physical prevention system (such as locks) is preferred.

Before commencing work in a Confined Space, the Subcontractor must obtain a Permit to Work from the relevant authority.

The following requirements shall be met at any time:

- Only competent and trained workers can participate to work in confined spaces (as a minimum as per local Law). A Confined Space Entry Log (or equivalent) must be used to identify the person inside the Confined Space at any time;
- Air Analysis tests must be carried out to determine if the Confined Space is oxygen deficient and/or contains flammable substances, toxic agents, carbon monoxide and/or harmful physical agents. The air shall be analyzed before starting work, during work and after work. Adequate ventilation must be provided;
- Working in the confined space without a watcher is strictly forbidden. An adequate means of communication is required and shall enable easy and clear communication:
 - Between those inside the space,
 - Between those inside the space and those outside,
 - To summon help in case of emergency;
 - Adequate emergency provisions must be in place. In particular, necessary rescue equipment must be ready, pre inspected and available. The arrangements need to be suitable and sufficient for the rescue of persons in the event of an emergency.

23. FIRE PROTECTION AND PREVENTION

Routine hot works should be described in the contractor Risk Control Plan .Non-routine hot works are submitted to daily hot works permits given by the relevant authority.

Full and unrestricted access to emergency exits, fire-fighting equipment, fire control and emergency vehicles shall be maintained at all times. The Subcontractor shall provide, install and maintain their own temporary fire protection against hazards they introduce to the Site (work areas, storage areas, and temporary facilities under their responsibilities).

Fire extinguishers shall be inspected at least annually by a certified person and visually inspected monthly and documented by the Contractor.

24. ELECTRICAL SAFETY

Personal authorization must be issued by Contractor Management (or formally designed delegates) likely to perform or supervise electrical works.

Without such an authorization validated by EIC, no Contractor's employee shall undertake electrical works.

No live work on high voltage or medium voltage is allowed. All high voltage and medium voltage electrical works must be performed on isolated equipment and only after verification of absence of voltage with suitable equipment. Low voltage and very low voltage live work is only allowed for measurement tests and checks of equipment. The below measures will be taken:

- Work practices must protect against direct or indirect body contact by means of tools or materials and be suitable for work conditions and the exposed voltage level
- A Lockout and Tagout procedure must be applied prior to commencing any electrical work. Prior to commencing works on isolated equipment, a verification of absence of voltage with suitable safety test equipment must be performed.
- Energized panels will remain locked with a specific key or tool whenever they are unattended and tagged with the signs and warnings indicating the presence of danger. If not reasonably practicable, a restricted area delimited with physical barriers and supported by warning signs must be implemented around the opened equipment.
- Only qualified electrical Contractor Personnel may enter substations and/or transformer vaults and only after being specifically authorized by NTPC EIC.
- All joints (Both terminal and intermediate) in cable should be made using lugs and joint area should be crimped using crimping tools.
- All temporary connection should be provided through 30mA ELCB/RCCB using 3 core double insulated cable and only 3 pin industrial plug top will be used for connection.
- Zero energy verification needs to be ensured before any electrical operation using only VAV before working on a live circuit which has been isolated
- Only industrial type DB to be used for connection and weather protection shed needs to be provided for every DB and shed height should not be less than man height.
- Double earthing protection must be provided for every electrical equipment and earthing value should be less than 1 Ohm
- Deployment of trained, experienced & licensed electrician as well as licensed electrical supervisor must be ensured at site as per Rule-45 of the Indian Electricity Rules, 1956 ;
- EIC May perform screening/ competency test for all contractor electrical professions i.e. electrical engineers and helpers. Selection/ rejection of the personnel who appear for the screening is sole discretion of EIC
- Electrical helper who will be engaged in helping the electrician/ engineer must have minimum ITI certificate to be eligible for working with him
- All PPE' s used while being involved in electrical work must be as per IS Standards available for electrical work

25. COMPRESSED GAS CYLINDERS

Gas cylinders shall be securely stored and transported, and identified and used in line with the safety Requirements as per Gas Cylinder Rules -2106.

Hose lines shall be adequately protected, inspected and tested for leaks in line with the safety Requirements. Flash back arrestor /NRV must be used at both ends of the hoses and all hose should be free from damage and fixed properly preferably using crimping clamps. Leakage test must be done before every use by soap solution and physical inspection of hose must be carried out regularly. Only trolley attached with wheel will be used for cylinder transportation in which cylinders must be kept secured with chain. Only Industrial type regulator fitted with two stage double dial pressure gauge is allowed to be used.

26. LIFTING OPERATIONS

The Contractor shall prepare a lifting plan, checked and submit for authorization by contractor's competent authorized persons prior to any lifting operation and formally communicated to all persons undertaking the work.

All persons preparing, issuing lifting plans and all persons involved in lifting operations must be subject to formal competence checks by the contractor to ensure necessary training, experience and qualification prior to commencing work. The Subcontractor must ensure that their nominated Lifting Leader has appropriate qualifications.

Contractor lifting plans include:

The lifting methodology, step by step

The risk analysis of the operation including consideration for weather conditions and work environments (e.g.: proximity of hazards and obstructions to the load, consideration for overturning, load integrity) where appropriate and consideration for simultaneous operations and the measures taken to avoid conflicting tasks in the lifting area

The identification of the designated lifting area, the fall zone and the control measures to prevent access such as barriers, signs, etc.

The description of the type, weight, size, shape and center of gravity of the load and the method used for slinging, attaching and detaching the load with the availability of approved lifting points on load when necessary

The list of the certified and inspected equipment and lifting accessories to be used

The composition of the team required to perform the task (crane driver, rigger, etc.) with the needed qualifications and description of their roles and responsibilities including the intended communication method

Any Heavy equipment (crane, winch machine, etc.) manufactured less than 15 years from the current year shall be only allowed to be used at our project Site's. Pre-safety Inspection of the equipment by safety deptt. shall be done before mobilizing the equipment at our project site.

The contractor must ensure that a competent operational leader is formally appointed to supervise each lifting operation. All lifting plans must clearly define the specific roles and responsibilities for each person involved (e.g.: crane drivers, lifting coordinators and riggers) and must be checked and issued prior to lifting operation. Clear communication channels must be formally established and maintained between everyone involved in a lift with only authorized person giving instruction to the operator.

Special permission needs to be taken from NTPC EIC for tandem lifting and for any non-routine lifting operations must strictly adhere to the guidelines described in corresponding Standard / Procedures / Directive.

No employee of the contractor shall be positioned under a suspended load or between a suspended load and fixed objects.

All lifting equipment and accessories must have valid manufacturers certificates or thorough examination records and be uniquely identified, marked with the safe working load, listed in a register and subject to formal regular inspection as per EHS requirements and shall have valid certificates from a competent authority. Inspection before use by the operator is mandatory. All lifting hooks must have latch. All cranes shall be fitted with Automatic Safe Load Indicator (ASLI) and Anemo Meter.

The contractor shall operate and maintain cranes and hoisting equipment in accordance with manufacturers' specifications and limitations and the safety Requirements. All defective, non-inspected or unidentified (safe working load / identification number) lifting equipment or accessories must be either removed from site or physically prevented from use.

27. LOCKOUT TAGOUT (“LOTO”)

Prior to performing work on Machines or Equipment, the Subcontractor shall ensure that all energy sources are isolated and verify the absence of residual energy (e.g.: by using specific voltage detecting device for electricity).

At any time, the contractor shall follow the Site-specific LOTO and Permit to Work rules. The contractor must ensure that all of their affected Subcontractor Personnel receive the necessary training. Lockout/ Tagout must be implemented before servicing and maintenance is performed on Machines and Equipment, which could unexpectedly start-up, become energized, or release stored energy exposing persons to a risk of injury, unless the works undertaken are performed using alternative measures that provide effective protection.

Absence of residual energy must be verified using the suitable equipment or process adapted to the machine and the kind of energy to be checked before start of work. *The contractor must procure suitable VAV instrument for verification of absence of voltage before implementing LOTO all by themselves.*

When the contractor is in charge of LOTO, each authorized person must be issued with an individual lock with a unique key. The contractor shall secure areas where energy sources have been de energized, so as to prevent the access of unauthorized personnel and erect suitable signs. All affected Personnel shall be notified.

Once an item of electrical equipment has been energized, an item of mechanical plant and/or System has been erected and released for Commissioning, no work will be allowed on such item of Equipment or System unless a valid Permit to Work (PTW) has been obtained from the relevant authority.

28. MONTHLY SAFETY REPORT

Agency has to submit the monthly safety activity report in the form of Lead-Lag indicator to NTPC Safety Deptt. Sample format attached as annexure –IV.

- 29.** In case the Contractor doesn't adhere to any of the provisions of the NTPC Safety Rules for Construction and Erection of Power Plants, corresponding payment for the provisions not adhered, shall not be made and/or necessary action as per provisions of the Bidding documents shall be taken by NTPC.

SECTION-II

1. Safety at workplace and equipment

1.0 GENERAL PROVISIONS:

1.1. Housekeeping:

- a. The contractor shall be primarily responsible for maintaining Good housekeeping and safety standards in the workplace;
- b. Loose materials that are not required for use shall not be placed or left behind so dangerously as to obstruct workplaces or passageways;
- c. All projecting nails shall be removed or bent to prevent injury;
- d. Equipment, tools and small objects shall not be left lying unattended or unsecured from where they could fall or cause a person to trip;
- e. Scrap, waste or rubbish shall not be allowed to accumulate in the site as these combustibles can create serious fire hazards and affect safe working;
- f. Workplaces and passageways that become slippery owing to spillage of oil or other causes shall be cleaned up or strewn with sand, ash or the like;
- g. Portable equipment shall be returned after use to their designated storage place.

1.2. Means of access and egress shall consist of

- a. Adequate and safe means of access and egress shall be provided in all workplaces;
- b. The means of access and egress shall be maintained in a safe condition;

1.3 Lighting and ventilation

- a. All practical measures shall be taken to prevent smoke, fumes etc. from obscuring any workplace or equipment at which any worker is engaged;
- b. Adequate and suitable artificial lighting shall be provided where natural lighting is not sufficient as per IS 3646 (Part II). The artificial lighting so provided shall not cause any incidental any danger, including that of producing glare or disturbing shadows;
- c. To prevent danger to health from air contamination by dust generated during grinding, cleaning, spraying or manipulation of materials as also to provide protection against dangerous gases, fumes, vapours, mist, etc. effective arrangements shall be made for ventilation;
- d. Workers shall be provided with suitable respiratory protective equipment, if it is not technically possible to have uncontaminated air. To this end, a study by a competent person shall be made to decide on the due protection. Sufficient illumination at all times for maintaining safe working conditions shall be provided where building workers are required to work or pass, and for passageways, stairways and landings such illuminations shall not be less a than 0.5 foot candles at the floor level;
- e. Where natural lighting is not adequate to prevent danger, adequate and suitable lighting shall be provided as per IS: 3646 – Part II;
- f. Artificial lighting shall not cause any danger due to a brightness greater than 10 foot candles per square inch, except where the angle of inclination from the eye to the source or the part pf the fitting as the case may be exceeds 20⁰, including that of producing glare or disturbing shadows;
- g. Where necessary to prevent danger to health from air contamination by dust from the grinding, cleaning, spraying, or manipulating of materials or objects, arrangements shall be made to limit the concentration of the pollutants by thorough ventilation, and dust generated due to movement of earthmoving machinery and other construction equipment, by spray of water in the area from time to time;
- h. Adequate ventilation by the circulation of fresh air shall be maintained in such places where the concentration of pollutants is likely to affect the health of the workers;

- i. Special care shall be taken to ventilate the workplace where gas cutting, welding or other operations involving generation of dangerous fumes, vapours, mists, gases etc is likely;
- j. Where it is technically not possible to eliminate dust or noxious or harmful fumes or gases sufficiently to prevent injury to the health of the workers, the contractor shall provide suitable respiratory equipment like dust mask or gas/fume mask or breathing apparatus or other suitable respiratory equipment.

1.4. Dangerous and harmful environment:

- a. When an internal combustion engine exhausts into confined space or excavation or tunnel or any other workplace where neither natural ventilation nor artificial ventilation system is adequate to keep the carbon monoxide content of the atmosphere below fifty parts per million, adequate and suitable measures shall be taken at such workplace in order to avoid exposure of building workers to health hazards;
- b. No building worker shall be allowed to enter any confined space or tank or trench or excavation wherein there is given off any dust fumes or other impurities of such nature and to such extent as is likely to be injurious or offensive to the building worker or in which explosives, poisonous, noxious or gaseous material or other harmful articles have been carried or stored or in which dry ice has been used as a refrigerant, or which has been fumigated or in which there is a possibility of oxygen deficiency, unless all practical steps have been taken to remove such dust, fumes or other impurities and dangers which may be present and to prevent any further ingress thereof, from such workplace or tank or trench or excavation;
- c. No worker shall be allowed to enter any such space unless a responsible person has certified it safe and fit for the entry of such building workers.

1.5. Fumes/gases due to Welding and gas-cutting operations: When welding or cutting operations are carried out in a confined space:

- a. Adequate ventilation, by means of exhaust fans or forced draught, as the condition may require, shall be constantly provided; otherwise enough quantity of air shall be circulated by means of air compressors to dilute the contaminant within permissible limits;
- b. Workers shall take necessary precautions to prevent unburned combustible gas or oxygen from escaping inside a tank or vessel or other confined space;
- c. Welding or cutting operations on any container that has held explosives or where inflammable gases may have been generated, shall be undertaken after the container has been thoroughly cleaned by steam or other effective means; and
- d. Gas-test shall be carried out ensure that the confined space is completely free from combustible gases and vapours.

1.6. Dust, gases, fumes

- a. Concentration of dust, gases or fumes shall be prevented by providing suitable means to control their concentration within the permissible limit so that they may not cause injury or create health hazard to a building worker;

- b. For protection against such hazardous substances, besides efficient and effective means of control, personal protective equipment like dust masks, breathing apparatus, other respiratory appliances, goggles, as the case may be, shall be provided.

1.7. Excessive noise:

- a. Adequate measures shall be taken against the harmful effects of an excessive noise;
- b. Use of earplugs/muffs and anti-vibration gloves shall be ensured to protect the workers from the impact of exposure to such dangers;
- c. The noise level in no case shall exceed as prescribed in the concerned Rules and exposure in excess of 115 dBA over the period of a quarter of an hour cannot be permitted:

1.8. Corrosive substances:

- a. All corrosive substances, including alkalis and acids, shall be stored and used by a person dealing with such substances at a building or other construction work in such a manner that it does not endanger the building worker and suitable protective equipment shall be provided by the employer to a building worker during handling or use of such substances at a building or other construction work and in case of spillage of such substances on the building worker, immediate remedial measures shall be taken;
- b. While protection of the body could be ensured by use of corrosion resistant apparel/overalls, suitable goggles, gloves, apron, gum boots etc. shall be made available to all concerned personnel;
- c. To deal with an accidental spillage of a corrosive substance on the body of a worker, the facility of eyewash fountain or water shower, as the case may be, shall be installed, within the easy reach of the workplace.

1.9. Eye protection:

- a. Suitable personal protective equipment for the protection of eyes shall be provided and used by the building worker engaged in operations like welding, cutting, chipping, grinding or similar operations which may cause hazard to his eyes;
- b. Goggles or face shield or welding screen with suitable shade of glass/filters etc shall be provided for the protection of the eyes.

1.10. Overhead protection:

- a. It shall be ensured that at the building or other construction site, overhead protection is erected along the periphery of every building under construction that shall be of fifteen meters or more in height when completed;
- b. Overhead protection shall not be less than two meters wide and shall be erected at a height not more than five meters above the base of the building and the outer edge of such overhead protection shall be one hundred fifty millimeters higher than the inner edge thereof or shall be erected at an angle of not more than twenty degrees to its horizontal sloping into the building;

- c. It shall be also ensured that at the building and other construction work that any area exposed to risk of falling material, articles or objects is roped or cordoned off or otherwise suitably guarded from inadvertent entry of persons other than building workers at work in such area.

1.11. Lifting and carrying of excessive weight:

- a. No building worker lifts by hand or carries overhead or over his back or shoulders any materials, articles, tools or appliances exceeding in weight the maximum limits as set out in the following table unless aided by any other building worker or a mechanical device;
- b. No worker aided by other workers, lift by hand or carry overhead or over their back or shoulders any materials, articles, tools or other appliances exceeding in weight the sum total of the maximum limits as prescribed in the concerned Rules, unless aided by a mechanical devices:

1.12. Protections against fall of persons –

- a. All scaffolds/working platforms at height of two metres or more shall be fenced;
- b. All guard-rails for the fencing of floor openings, gangways, elevated workplaces shall be made of sound material, good construction and possess adequate strength and be between 1 m and 1.5 m above platform level, consist of two rails (two ropes or chains may be used if they are sufficiently taut) and supporting stanchions;
- c. Intermediate rails, ropes or chains shall be midway between the top and lower of edges of the top rail;
- d. Sufficient number of stanchions or standard poles or uprights shall be maintained to ensure the required stability and resistance;
- e. Guard-rails shall be free from sharp edges and be maintained in good repair;
- f. Floor openings through which persons could fall, shall be guarded by covering or fencing;
- g. If the means of protection is removed to allow the passage of persons or goods or other purpose, the same shall be replaced as soon as possible, while making temporary arrangements for reasonable degree of safety in the meanwhile;
- h. Covers for floor opening shall be safe to walk on and if vehicles operate thereon it shall be safe for the same. This will require the contractor to have prior assessment of expected loads;
- i. Cover for floor opening shall be secured by hinges, grooves, stops or other effective means against sliding, falling down or lifting out or any other inadvertent displacement;
- j. Covers for any openings shall not constitute any hindrance to traffic and, as far as practicable, be flush with the floor;
- k. If covers constitute as grids, the bars shall be spread not more than 5 cm apart;
- l. Elevated workplaces at more than 2 m above the floor or ground shall be protected on all open sides by guardrails. It is commonly observed that fragile barricade tapes are used as a substitute of a strong and dependable fencing. This practice is prohibited. The barricade tapes can be used as markers/route guide only;
- m. Elevated workplaces shall be provided with safe means of access and egress such as stairs, ramps or ladders according to suitability;
- n. Persons employed at elevated workplaces or other situations at more than 2m from which they may fall, shall be protected by means of adequate safety nets, or platforms, or be secured by

safety belts with the lanyard properly anchored above the head level of the user. All possible effort shall be made to have strong and dependable mechanical arrangement.

1.13. Protection against fall of objects and materials:

- a. Materials and objects such as scaffolding materials, waste materials or tools shall not be thrown up or down from heights, as they are liable to cause injury;
- b. If materials and other objects cannot be safely lowered from heights, adequate precautions such as the provision of fencing, lookout men or barriers shall be provided to protect any person from injury.

1.14. Protection against entry of unauthorized persons:

- a. Construction zones in the site and built up areas alongside main traffic routes shall be barricaded;
- b. Unauthorized persons shall not be allowed access to construction sites and visitors shall be provided with the required protective equipment and it be ensured that they use them effectively.

1.15. Head protection and other protection apparel:

Every building worker who is required to –

- a. Pass through or working within the areas where there is hazard of his being struck by falling objects or materials, shall be provided with safety helmets of the type approved and tested in accordance with the national standards;
- b. Work in water or in wet concrete or in other similar work, shall be provided with suitable waterproof;
- c. Work in rain or in similar wet condition, shall be provided with waterproof coat with hat;
- d. Workers using or handling of alkalis, acid or other similar corrosive substances shall be provided with appropriate protective equipment in accordance with the approved standards;
- e. Every building worker engaged in handling sharp objects or materials at a building or other construction work, which may cause hand injury, shall be provided with suitable hand gloves in accordance with the approved standards.

1.16. Stability of structures:

- a. No wall, chimney or other structure or part of a structure shall be left unsupported in such condition that it may fall, collapse or weaken due to wind pressure, vibration or due to any other reason. Entry of persons into such locations where tall structures are being built shall be regulated without a let up.

1.17. Safety of Structures and equipment and other safety concerns

- a. Safety of structures like scaffoldings, platforms, gangways/walkways, towers, stairs, ladders, ramps, safety in excavation, formwork, falsework, demolition work, storage, handling and use of explosives, inflammable substances and hazardous materials, gas cutting and welding, use of electricity etc.; and equipment viz. construction machinery, crushers and batching plant, boiler and other pressure vessels, transport and material handling equipment, lifting appliances, vehicles etc., shall be operated and maintained as per approved norms and –
 - i. They shall be made of sound material and of good construction, free from patent defects, provided with adequate safe guards, properly maintained, periodically inspected and strong enough to withstand safely the loads and stresses to which they may be subjected;
 - ii. They shall carry enough factor of safety bearing in mind that the possibility of their abuse, which otherwise shall be prevented by constant and adequate supervision, cannot be ruled out altogether;
 - iii. It is incumbent on the contractor to ensure that only competent and authorized persons operate the equipment or attend to electrical and mechanical systems and repair of faults or breakdowns etc.
- b. Working in the confined space may involve certain serious hazards. Strict adherence to the conditions of Permit-to-work issued for the purpose is required;
- c. Control of energy sources shall be ensured through Log-out/Tag-out practices.

1.18. Slipping, tripping, cutting, drowning and falling hazards:

- a. The contractor shall keep all passageways, platforms and other places free from accumulations of dust, debris or similar material and from other obstructions that may cause tripping;
- b. Any sharp projections or protruding nails or similar projections which may cause any cutting hazard to a building workers shall be removed or otherwise made safe by taking suitable measures;
- c. No contractor shall allow any building worker at construction work to use the passageway, or a scaffold, platform or any other elevated working surface which is in slippery and dangerous condition and shall ensure that water, grease, oil or other similar substances which may cause the surface slippery, be removed or sanded/saw-dusted or covered with suitable material to make it safe from slipping hazard;
- d. Wherever building workers are exposed to the hazarded of falling into water, they shall be provided with rescuing arrangement from such hazard and if it is considered necessary, well equipped boat or launch manned with trained personnel shall be provided by the contractor at the site of such work;
- e. Every open side or opening into or through which a building worker, vehicle or lifting appliance or other equipments may fall at a building or other construction work shall be covered or guarded suitably to prevent such fall except where free access is necessary by reasons of their nature of the work;
- f. Wherever building workers are exposed to the hazards of falling from height while employed on such work they shall be provided by the employer with adequate equipment or means for

saving them from such hazards, Such equipments or means shall be in accordance with the standards as laid down;

- g. Whenever there is a possibility of falling of any martial, equipment or building worker at a construction site relating to a building or other construction work, adequate and suitable safety net shall be provided in accordance with the above stipulation;

2.0 SAFETY IN MATERIAL HANDLING AND WASTE DISPOSAL

2.1. GENERAL PROVISIONS:

- a. All building materials stored in tiers shall be stacked, racked, blocked, interlocked or otherwise secured safely to prevent sliding, falling or collapse and in an orderly manner to avoid obstruction of any passageway at the place of work. Piles of materials shall be stored or stacked in such a manner as to ensure their stability;
- b. Maximum safe load limits of floors within buildings and structures in kg/cm² shall be conspicuously posted in all storage areas, except for floor or slab on gradient. Maximum safe load shall not be exceeded. Material or equipment shall not be stored upon any floor or platform in such quantity as to exceed its safe carrying capacity;
- c. Ailes and passageways shall be kept clear to provide for the free and safe movement of material handling equipment or persons. Such areas shall be kept in good repair;
- d. When a difference in road or working levels exist, means such as ramps, blocking or grading shall be used to ensure the safe movement of vehicles between two levels;
- e. Material stored inside buildings under construction shall not be placed within 2 m of any hoist way or inside floor openings nor within 3.2 m of exterior wall which does not extend above the top of material stored;
- f. Persons employed required to work on stored material in silos, hoppers and similar storage areas shall be equipped with lifelines and safety belts;
- g. Non-compatible materials shall be segregated in storage;
- h. Bagged materials shall be stacked by stepping back the layers and cross-keeping the bags at least every 10 bags high;
- i. Materials shall not be stored on scaffolds or runways in excess of supplies needed for immediate operations;
- j. Bricks stacks shall not be more than 2.2 m in height. When a loose brick stack reaches a height of 1.3 m it shall be tapered back 5 cm in every foot of height above the 1.25 m level;
- k. When masonry blocks are stacked higher than 2 m, the stack shall be tapered back on half block per tier above the 2 m level;
- l. Material or equipment shall not be stored or placed so close to any edge of a floor or platform as to endanger the safety of persons below or working in the vicinity. Where stacking, unshackling, stowing or unstarving of construction material or article, or handling in connection therewith cannot be safely carried out unaided, reasonable measures to guard against accident or dangerous occurrences shall be taken by shoring or otherwise to prevent any danger likely to be caused by such handling;
- m. Stacking of material or article shall be made on firm foundation not liable to settle and such material or article and shall not overload the floor on which such stacking is made;

- n. The material or articles shall not be stacked against partition or walls of a warehouse or stores unless it is known that such partition or the wall is of sufficient strength to withstand the pressure of such materials or articles;
- o. The materials or articles shall not be stacked to such a height and in such a manner as would render the pile of such stack unstable and cause hazards to the building workers or the public in general;
- p. Where the building workers are on stack exceeding one point five meters in height, safe means of access to the stack shall be provided;
- q. All stacking or unstacking operations shall be performed under the supervision of a responsible person for such stacking or unstacking;
- r. The stacking of construction materials or articles shall not be made near the site of excavation, shaft, pit or any other such opening;
- s. Stacks that may lean heavily or become unstable or collapse are barricaded shall be avoided;
- t. Structural steel, poles, pipe, bar stock and other cylindrical materials, unless racked, shall be stacked and blocked so as to prevent sliding, spreading or tilting.

2.2. LUMBER:

- a. Used lumber shall have all nails withdrawn before stacking;
- b. Lumber shall be stacked on level and solidly supported sills;
- c. Lumber piles shall not exceed 6 m in height provided that lumber is handled manually, shall not be stacked more than 5 m height;
- d. Lumber shall be so stacked as to be stable and self-supporting.

2.3. STACKING OF CEMENT AND BAGS CONTAINING OTHER MATERIALS:

- a. The cement or other material in bags shall be stacked in a header and stature-wise in rows alternately in not more than 10 numbers and there will be circulation of space of at least 600 mm in between two such rows;
- b. While removing bags from the stack pile the stability of such stack pile shall be ensured;
- c. Bags containing cement or lime shall be stored on a firm ground;
- d. The materials like bricks, tiles or blocks shall also be stored on a firm ground;
- e. Reinforcing steel shall be stored according to its shape, size and length and stack of reinforcing steel kept as low as possible;
- f. No pipe shall be stored on rack or in stack where such pipe is likely to fall by rolling;
- g. The angle of repose shall be maintained where loose materials are stacked;
- h. When dust laden material is to be stored or handled, measures shall be taken to suppress the dust produced by such storing or handling and suitable personal protective equipment supplied to and used by the building workers working for such storing or handling.

2.4. DISPOSAL OF DEBRIS AND WASTE MATERIAL:

- a. It shall be ensured that debris is
 - i. Handled and disposed of by a method, which does not cause danger to the safety of a person and not allowed to accumulate so as to constitute a hazard;
 - ii. Kept sufficiently moist to bring down the dust under control;
 - iii. Not thrown inside or outside from any height of such building or other construction work;
- b. Brought down by suitable means/chutes provided for the purpose and on completion of work, leftover building material, article or other substance or debris shall be disposed off as soon as possible to avoid any hazard to any traffic or person;
- c. Whenever materials are dropped more than 6 m to any point lying outside the exterior walls of the building an enclosed chute of wood, or equivalent material shall be used;
- d. When debris is dropped through holes in the floor without the use of chutes, the area where the material is dropped shall be completely enclosed with barricades not less than 1.1 m high and not less than 1.9 m back from the edge of the opening above. Signs warning of the hazard of falling material shall be posted at each level;
- e. All scrap lumber, waste material and rubbish shall be removed from the immediate work area as the work progresses;
- f. Disposal of waste material or debris as per the guideline issued by CPCB in compliance of Rule 10 sub-rule 1(a) of C & D Waste Management Rules, 2016).
- g. All bio-degradable material shall be disposed off in the pit for making compost. Pellets can also be made from bio-degradable material
- h. All solvent wastes, oil rags and flammable liquids shall be kept in fire resistant covered containers until removed from the work site.

2.5. HANDLING GAS CYLINDERS:

- a. Gas cylinders shall not be lifted on bare slings. For lifting the cylinders, cage of suitable size shall be used and all cylinders shall be horizontally positioned in it. Such cage shall have fencing in such a way that there is no possibility of fall of cylinders from this cage.

2.6. RIGGING EQUIPMENT FOR MATERIAL HANDLING:

- a. Rigging equipment for material handling shall be inspected prior to use in each shift as necessary during its use to ensure that it is safe. Defective rigging equipment shall be removed from service;
- b. Rigging equipment shall not be loaded in excess of its recommended safe working load, as prescribed in the Indian standards;
- c. Rigging equipment, when not in use, shall be removed from the immediate work area so as not to present a hazard to persons engaged in the area;

- d. Special custom designed grabs, hooks, clamps, or other lifting accessories, for such units as modular panels, prefabricated structures and similar materials, shall be marked to indicate the safe working loads shall be proof tested prior to use 125% of their rated load;
- e. Welded alloy steel chain slings shall have permanently affixed-durable identification standing size, grade, rated capacity and manufacturer.

2.7. FENCING OF MOTORS ETC

- a. All motors, cogwheels, chains and friction gearings, flywheels, shafting and the other dangerous and moving parts of machinery (whether or not driven by mechanical power) and steam pipes shall be securely fenced and the fencing of dangerous parts of machinery not removed while such machinery is in motion or in use;
- b. No part of any machinery which is in motion and which is not securely fenced, shall be examined, lubricated, adjusted or repaired except by a person skilled and trained for such examination, lubrication, adjustment or repairs and machine parts cleaned only when such machine is stopped;
- c. When a machine is stopped for servicing or repairs, adequate measures shall be taken to ensure that such machine does not restart inadvertently and not only tag-out sign is required; it is also essential that an active system of isolating the power be applied.

2.8. PROTECTION AGAINST LIGHTNING

- a. Where necessary, installations shall be protected against lightning, provided further that;
- b. No bare conductors or bare current-carrying parts of equipment be permitted to be installed unless adequate precautions are taken to prevent direct or indirect contact;
- c. Only flame-proof equipment and conductors shall be installed at places where explosives or inflammable substances are stored, handled or used or where explosive atmosphere exists;
- d. Persons competent and authorized only shall attend to electrical breakdowns and other operational faults and give or restore power to an equipment and such persons shall be easily identifiable by their dress or special helmet worn;
- e. It will constitute a standard practice to switch off portable tools while shifting from one place to another or while leaving them behind unattended;
- f. The contractor shall ensure that a system is in place to always keep tools well maintained.

2.9. VEHICULAR TRAFFIC

- a. Whenever any building or other construction work is being carried on, or is located in close proximity to a road or any other place where any vehicular traffic may cause danger to building workers, it shall be ensured that such building or other construction work is barricaded and suitable warning signs and lights displayed or erected to prevent such danger and if necessary, a request in writing made to the concerned authorities to control such traffic;

- b. All vehicles used at construction site shall comply with the requirements of the Motor Vehicles Act, 1988 (59 of 1988) and the Rules made hereunder;
- c. The driver of a vehicle of any class or description operating at a construction site shall hold a valid driving license under the Motor Vehicles Act. 1988 (59 of 1988).

2.10. USE OF SAFETY BELT OR OTHER FALL ARREST SYSTEMS:

Wherever any work at a height of 3 m or more is carried out, use of a suitable fall arrest system is mandatory if the workplace has already not been provided with an otherwise reliable means of protection for preventing the fall of persons from that height, provided further that:

- a. Safety belt, lanyard, life lines and devices for the attachment of such life lines shall conform to the approved standards;
- b. Every building worker shall be supplied with safety belt and safety life lines for his protection and such building worker shall use such belts and life lines during the performance of his work;
- c. All building workers using safety belt and safety life lines shall have the knowledge of safe use and maintenance of such belts and life lines and shall be supplied with necessary instructions for its use;
- d. The responsible person for supervising the use of safety belts and safety lifelines shall inspect and ensure that such safety belts and lifelines are fit for use before taking them into use.

2.11. SAFETY NET AND ITS USE

- a. Every safety net shall be of adequate strength, made of sound material and suitable for use and conform to the approved standards;
- b. The responsible person for maintenance of safety nets and their use shall ensure safe fixing of such safety nets and provide such safety nets with suitable and sufficient anchorage so that the purposes for which such safety net is intended for use is served;
- c. Use of multi-layer safety net to be ensured to avoid fall of material/objects.

2.12. STORAGE OF SAFETY BELTS AND NETS, ETC:

- a. Proper arrangement shall be made for the safe storage of safety belts, safety lifelines and safety nets when they are not in use and are protected against mechanical damage, damages from chemicals and damages from biological agents.

2.13. SAFETY HELMETS AND SAFETY FOOTWEAR

- a. The Engineer in-charge may declare whole or part of a site as the hardhat area and in such an eventuality it shall be the responsibility of the contractor to provide safety helmet of the approved quality to all personnel engaged in construction and erection work, including the visitors to the site;
- b. Accordingly, wherever safety footwear is required for the safety of the personnel, the contractor shall provide the same of the approved type free of charge.

3.0 WELDING AND GAS CUTTING OPERATIONS

3.1 GAS WELDING:

3.1.1 GENERAL PROVISIONS:

- a. All welders shall be provided with fire resistant protective clothing and equipment, such as fire resistant gauntlets and aprons, helmets and goggles with suitable filter lenses and its usage shall be ensured;
- b. The welders shall not be allowed to wear clothing that is not free from grease, oil and other flammable material;
- c. Adequate precautions shall be taken to protect persons working or passing near welding operations from dangerous sparks and radiation;
- d. When welding or cutting is being done on materials containing toxic or harmful substances or liable to produce toxic or harmful fumes, adequate precautions shall be taken to protect workers from the fumes, either by
 - i) Exhaust ventilation, or
 - ii) Respiratory protective equipment;
 - iii) Arrangement shall be made so that welding sparks do not fall down on the persons working below or material, which are combustible in nature and may be damaged with such sparks.
- e. The oxygen pressure for welding shall always be high enough to prevent acetylene flowing back into the oxygen cylinder;
- f. Acetylene shall not be used for welding at a pressure exceeding 1 atmosphere gauge;
- g. Adequate precautions shall be taken to prevent:
 - i) Fire being started by sparks,
 - ii) Slag or hot metal; and
 - iii) Damage to fibre ropes from heat, sparks, slag or hot metal;
- h. Precautions shall be taken to prevent flammable vapours and substances from entering the working area;

3.2. WELDING AT PLACES WITH FIRE RISKS:

- a. Unless adequate precautions are taken, no welding or cutting operations shall be allowed near the place where combustible materials are stored, or near materials or plant where explosive or flammable dusts, gases or vapours are likely to be present or given off. If hot work permit system exists at the site, the same shall be followed;
- b. Combustible materials and structures that cannot be removed from the vicinity of welding operations shall be shielded by asbestos or protected by other suitable means.

3.3. WELDING IN CONFINED SPACE:

When welding or cutting operations are being carried out in a confined space;

- a. Adequate ventilation, by means of exhaust fans or forced draught as the condition may require, shall be constantly provided; otherwise enough quantity of air shall be blown in by means of compressors to dilute the pollutants;

- b. No blow pipe shall be left unattended inside a tank or vessel or other confined space during meal break or other interruption of the work;
- c. The worker shall take all necessary precautions to prevent unburned combustible gas or oxygen from escaping inside a tank or vessel or other confined space; and
- d. When necessary to prevent danger, an attendant shall watch the welders from outside.

3.4. WELDING ON CONTAINERS FOR EXPLOSIVE OR FLAMMABLE SUBSTANCES:

Welding or cutting operations on containers in which they are explosives or flammable substances shall not be allowed;

- i) Welding or cutting operations on any container that has held explosive or where flammable gases may have been generated, shall only be undertaken,
- ii) After the container has been thoroughly cleansed by steam or other effective means; and
- iii) Found by air tests to be completely free from combustible gases and vapours; or
- iv) After the combustible gas in the container has been completely replaced by an inert gas or by water;
- v) If an inert gas is used as laid down in clause 4.2.3, after the vessel has been filled with gas, the gas shall continue to flow slowly into it thorough out the welding or cutting operations;
- vi) Before starting any welding operations on, or otherwise applying heat to, closed or jacketed containers or other hollow parts, such containers or parts shall be adequately vented in suitable manner.

3.5. GAS CYLINDERS

- a. Gas cylinders shall be inspected, stored, handled and transported in conformity with the requirements of Gas Cylinders Rules, 1981;
- b. When in use, cylinders shall be held in upright positions by straps, collars or chains;
- c. Devices referred to in clause 6.2 shall be such that the cylinders can be rapidly removed in an emergency;
- d. Welders shall not temper with or attempt to repair safety devices and valves on gas cylinders;
- e. When acetylene cylinders are coupled, flash back arrestor shall be inserted between the cylinder and the coupler block, or between the coupler block and the regulator;
- f. Only acetylene cylinders or approximately equal pressure shall be coupled;
- g. No gas shall be taken from a cylinder unless a pressure reducing regulator has been attached to the valve;
- h. Only the right pressure reducing regulator shall be used for the gas in the cylinder;
- i. Cylinder valves shall be kept free from gases, grease, oil, dusts and dirt;
- j. Leaky cylinders charged with acetylene or liquefied fuel gas shall be taken into the open air at a safe distance from any open flame or sparks.

3.6 HOSE

- a. Only hose especially designed for welding and cutting operations shall be used to connect an oxy-acetylene torch to gas outlet;
- b. Hose lines for oxygen and for oxy-acetylene shall be of different colours and preferably of different size;
- c. Hose connections shall be sufficiently light to withstand without leakage a pressure twice the maximum delivery pressure of the pressure regulators in the system;

- d. Care shall be taken that hose does not become kinked or tangled, stepped on or run-over or otherwise damaged;
- e. Any length of hose in which a flashback has burned, shall be discarded;
- f. No hose with more than one gas passage shall be used;
- g. Only soapy water shall be used for testing hose for leaks.

3.7. TROCHES

- a. When torches are being changed, the gases shall be shut off at the pressure reducing regulators and not by crimping hose;
- b. Torches shall be lit with friction lighters or other safe source but not with matches.
- c. Electric welding equipment:
- d. Welding machines shall be controlled by a switch mounted on or near the machine framework that, when opened, immediately cuts off the power from all conductors supplying the machine;
- e. Welding circuit shall be so designed as to prevent the transmission of high potential from the source of supply to the welding electrodes;
- f. The maximum open circuit voltage shall be in accordance with Indian Standards;
- g. Electrode conductors or cables shall not be excessive in length and shall not be longer than necessary to perform the work;
- h. Return conductors shall be taken directly to work and securely connected mechanically and electrically to it or to the work bench, floor etc. and to an adjacent metallic object;
- i. Cable shall be supported so as not to create dangerous obstruction;
- j. Motors, generators, rectifiers and transformers in arc welding or cutting machines, and all current carrying parts, shall be protected against accidental contact with uninsulated live parts;
- k. Ventilating slots in transformer enclosures shall be so designed that no live part is accessible through any slot;
- l. Frames of arc welding machines shall be effectively earthed;
- m. In hand-operated arc welding machines, cables and cable connectors used in arc welding circuits shall be effectively insulated on the supply side;
- n. The outer surface electrode holders of hand-operated arc welding machines, including the jaw so far as practicable, shall be effectively insulated;
- o. Electrode holders of hand-operated arc-welding machines shall, if practicable, be provided with discs or shields to protect the operator's hands from the heat of the arcs;
- p. Only heavy-duty cable with unbroken insulation shall be used;
- q. Circuit connections shall be waterproof;
- r. When lengths of cable have to be joined, only insulated connectors shall be used on the earth line and the electrode holder line;
- s. Connections to welding terminals shall be made at distribution boxes, socket outlets, etc. by bolted joints;
- t. Welding terminals shall be adequately protected against accidental contact by enclosures, covers or other effective means;
- u. Electrode holder shall
 - i. Have adequate current capacity;
 - ii. Be adequately insulated to prevent shock, short-circuiting or flashovers.

3.8. OPERATIONS

- a. Arc welding and cutting operations that are carried on at places where persons other than the welders are working or passing shall be enclosed by means of suitable stationary or mobile screens;
- b. Walls and screens of both permanent and temporary protective enclosures shall be provided to absorb harmful rays from the welding equipment and prevent reflection, and if necessary, be painted or otherwise treated for the purpose;
- c. When arc welding is done in damp confined spaces;
 - i) Electrode holders shall be completely insulated; and
 - ii) The welding machines shall be outside the confined space;
- d. Welders shall take adequate precautions
 - i) To prevent any part of their body from completing an electric circuit
 - ii) To prevent contact between any part of the body and the exposed part of the electrode, or electrode when in contact with metal; and
 - iii) To prevent wet or damaged clothing, gloves and boots from touching any live part;
- e. Welding circuits shall be switched off when not in use;
- f. Electrodes shall only be inserted in the holder with insulating means such as insulating gloves;
- g. Electrode and return leads shall be adequately protected against damage;
- h. Live parts of electrode holders shall be inaccessible when they are not in use;
- i. Electric arc-welding equipment shall not be left unattended with current switched on.

4.0 SAFETY IN THE USE OF ELECTRICITY

4.1. GENERAL PROVISIONS

- a. Before commencement of any building or other construction work, adequate measures shall be taken to prevent any worker from coming into physical contact with any electrical equipment or apparatus, machines or live electrical circuit which may cause electrical hazard during the course of his employment and suitable warning signs shall be displayed and maintained at conspicuous places in Hindi and in local language understood by the majority of the building workers;
- b. In workplaces where the exact location of underground electric power line is not known, the building workers using jack hammers, crow bars or other hand tools which may come in contact with a live electrical line shall be provided with approved insulated protective gloves and footwear;
- c. As far as practicable, no wiring or cable, which may come in contact with water or which may be mechanically damaged or which may result in electric shock shall be left on ground or;
- d. All electrical appliances and current carrying equipment used shall be made of sound material and adequately earthed;
- e. All temporary electrical installations shall be provided with earth leakage circuit breakers;
- f. It is required that all portable power-driven hand tools are provided with double insulation to secure a high degree of protection from electrical hazards;
- g. Electrical installations shall comply with the requirements of any law for the time being in force, especially the Indian Electricity Act/Rules in particular with specific reference to the following:
 - i) All parts of installations shall be of standard construction not lower, from the safety point of view, than the national standards, as applicable. All parts of electrical installations shall be so constructed, installed and maintained so as to prevent electrical fires, explosion and shock;
 - ii) Earthing of metal work of electrical equipment, other than the parts which carry current, shall be provided and will conform to Electricity Act and IS: 3042 – 1966 (code of practice for earthing);
- h. All parts of electrical installation shall be adequate size and characteristics for the work they may be called upon to do and in particular they shall:
 - i) Be of adequate mechanical strength to withstand working conditions in construction operations; and
 - ii) Be not liable to damage by water, dust or electrical, thermal or chemical action to which they are subjected to in construction operations;
- i. All parts of electrical installations shall be so constructed, installed and maintained as to prevent the danger of electric shock; fire and external explosion;
- j. It shall be made impossible for circuit breakers to be opened or closed inadvertently, by gravity or by mechanical impact;

- k. Before operation of OCBs, oil level must be checked and the event of short, extra quantity must be filled;
- l. Use of rubber gloves and rubber gum boots of tested quality where electric shock is likely to occur shall be provided, but these shall not be considered as providing adequate protection against the risk of electric shock in lieu of inbuilt safety arrangement in the system;
- m. First-aid boxes, instruction for restoration of persons affected by electric shock shall be made;
- n. Arrangement shall be made for sufficient number of CO₂/chemical powder type fire extinguishers/sand buckets etc.;
- o. No electrical circuits shall ever be overloaded to the dangerous extent or beyond the rated capacity;
- p. In confined areas, only 24 volt supply shall be used for every equipment, including hand-held portable tools and hand lamps;
- q. All electrical appliances and outlets shall be clearly marked to indicate their purpose and voltage.

4.2. FUSES

- a. Fuses shall bear markings indicating their rated current, whether they are of the fast or slow-breaking type and, as far as practicable, and their rated breaking capacity. Fuses as per need and of correct rating shall be used in the circuit;
- b. Effective measures shall be taken to ensure that persons removing or inserting fuses will not be endangered, in particular by any adjacent live parts;
- c. In case of blow of fuses only after finding out and correcting of the fault, new fuses shall be provided in the circuit.

4.3. SWITCHES

- a. All switches shall be of enclosed type and so installed and earthed as to prevent danger in their operation;
- b. Use of switches, which may connect or disconnect circuit through gravity, shall not be used.

4.4. MOTORS

- a. All motors shall be equipped with a switch;
- b. When a motor can be cut off from more than one place, where practicable, a stopping device shall be installed in the immediate vicinity of the motor;
- c. Motors shall be so installed as to ensure that they can be adequately cooled;
- d. Motors shall be effectively protected against over current;
- e. Whenever the motors installed are in the open area where there is the possibility of fall of liquid corrosives or otherwise, it shall be suitably protected with covering;
- f. Earthing shall be connected to all motors, generators etc. as prescribed in the Indian Electricity Rules, amended from time to time.

4.5. CONNECTIONS

- a. At points where conductors are joined, branched or led into apparatus, they shall be:
 - i. Mechanically protected, and
 - ii. Properly maintained;

- b. Conductors shall be joined, branched or led into an apparatus through junction boxes, bushings, glands or equivalent connecting devices;
- c. Junction boxes or plug-out-socket couplings shall be used for joining cables wherever practicable;
- d. When parts of conductors are joined together, or conductors are joined to one another or to an apparatus, the attachment shall be made by screwing, clamping, soldering, riveting, brazing, crimping, or equivalent means. Loose connections shall not be provided in any case;
- e. Cable joints, junction boxes and connectors shall be protected as far as practicable, against traffic, fall of ground, water and other sources of damage;
- f. Whenever armoured cables are joined, the junction boxes shall be bridged by a suitably conductive bond between the armouring of the cables.

4.6. TRANSPORTABLE AND PORTABLE ELECTRICAL EQUIPMENT:

- a. The supply of electricity to portable apparatus shall not exceed 250v;
- b. Hand-held and portable machines shall be equipped with a built-in switch to switch off power in case of emergency;
- c. Hand-held electrically operated tools shall be provided with built-in switch to disconnect the circuit when the tool is not being used;
- d. Portable electrical tools, unless flameproof, shall not be used in flammable or explosive atmosphere;
- e. Only three-core cable shall be used for single-phase operated tools with the third core connected to earth

4.7. HAND LAMPS

- a. Hand lamps shall be equipped with strong cover of glass or other transparent material;
- b. Portable lamp holders shall have:
 - i) All current –carrying parts enclosed;
 - ii) Insulated handle; and
 - iii) They shall operate at 24 v;

4.8. INSPECTION, MAINTENANCE

- a. All electrical equipment shall be inspected before it is taken into use to ensure that it is suitable for its purpose of use;
- b. At the beginning of every shift every person using electrical equipment shall make a careful external examination of the equipment and conductors for which he is responsible, especially flexible cables;

- c. Periodic inspections, testing, maintenance of all electrical equipment is to be made and record of test of transformer oil and pit earthing shall be maintained;
- d. Electrical conductors and equipment shall be repaired by the electrician only as far as practicable, no work shall be done live conductors or equipment;
- e. Before any work is begun on conductors or equipment that does not have to remain live;
 - i) The current shall be switched off;
 - ii) Adequate precautions shall be taken to prevent the current from being switched on again;
 - iii) The conductors or the equipment shall be tested to ascertain that they are dead;
 - iv) The conductor and equipment shall be earthed and short-circuited; and
 - v) Neighbouring live parts shall be adequately protected against accidental contact;
- f. After work on conductors and equipment, the current shall only be switched on again on the orders of a competent person;
- g. Electricians shall be provided with adequate tools, and person protective equipment, such as rubber gloves, mats etc.;
- h. All conductors and equipment shall be considered to live unless there is certain proof to the contrary.

4.9. WORK IN THE VICINITY OF ELECTRICAL INSTALLATION

- a. When work is to be done in the neighborhood of electrical conductors or installations, the contractor shall ascertain the voltage carried and the works shall not be allowed to reach to unsafe distance from them;
- b. When any excavation is to be made or any bore-holed sunk, the contractor shall ascertain whether there are any underground conductors, in or in dangerous proximity to, the zone of operations;
- c. No work shall be done in dangerous proximity to a conductor or an installation until it has been made dead;
- d. Before work begins, work permit shall be obtained from the Engineer in-charge if live electricity lines/circuit are passing in close vicinity;
- e. Before the current is restored, the contractor shall ensure that no work remain on the work site;
- f. If conductor or an installation in the neighbourhood of which work is to be done can not be made dead, special precautions shall be taken and special instructions given to the workers so as to prevent danger by adequately enclosing or fencing;
- g. If mobile equipment has to be employed in the neighbourhood of conductors or installations that cannot be made dead, its movement shall be so controlled as to keep it at a safe distance from them.

5.0 SAFETY IN THE USE OF HAND TOOLS AND POWER-OPERATED TOOLS

5.1 GENERAL PROVISIONS

- a. All hands and power tools and similar equipment, shall be maintained in safe condition.
- b. When power operated tools are designed to accommodate guards, they shall be equipped with such guards, when in use;
- c. Belts, gears, shafts, pulleys, sprockets, spindles, drums, fly wheels, chains and other reciprocating, rotating or moving parts of the equipment shall be similarly guarded;
- d. Personnel using hand and power tools and exposed to the hazard of falling, flying, abrasive, and splashing objects, or exposed to harmful dusts, fumes, mists, vapours, or gases shall be provided with the particular personal protective equipment necessary to protect them from the hazards;
- e. All hand-held powered platen sanders, grinders, grinders with wheels of 5 cm or less, routers, planers, laminate trimmers, nibblers, shears, scroll saws and jigsaws with blade shanks of 0.5 cm wide or less shall be equipped with only a positive **on-off control**.
- f. All hand-held powered drills, tappers, fastener drivers, horizontal, vertical or angle grinders with wheels greater than 5 cm in diameter, disc sanders, belt sanders, reciprocating saws, saber saws and other operating powered tools shall be equipped with a momentary contact on control provided that turnoff can be accomplished by a single motion of the same finger or fingers that turn it on.

5.2. HAND TOOLS

- a. The contractor shall not issue or permit the use of unsafe hand tools;
- b. Wrenches including adjustable pipe end and socket wrenches shall not be used when jaws are sprung to the point that slippage occurs;
- c. Impact tools such as drift pins, wedges and chisels shall be kept free of mushroomed heads;
- d. The wooden handles of tools shall be kept free of splinters or cracks and shall be kept tight on the tools.

5.3. POWER OPERATED TOOLS

- a. Electric power operated tools shall be either of the approved double-insulated type or shall be grounded;
- b. The use of electric cords for hoisting or lowering loads shall not be permitted;
- c. Pneumatic power tools shall be secured to the hose or whip by some positive means to prevent the tool from becoming accidentally disconnected;
- d. Safety clips or retainers shall be securely installed or maintained on pneumatic impact (percussion) tools to prevent attachments from being accidentally expelled;
- e. All pneumatically riveting machine staplers and other similar equipment provided with automatic fastener feed, which operate at more than 7 kg/cm² pressure at the tool a safety device on the

muzzle to prevent the tool from ejecting the fasteners unless the muzzle is in contact with the work surface;

- f. Compressed air shall not be used for cleaning purposes except when the pressure is reduced to less than 2 kg/cm² and that too with effective chip guarding. The 2 kg/cm² pressure requirement does not apply to concrete form, mill scale and similar cleaning purposes;
- g. The manufacturer's safe operating for hoses, pipes, valves, filters and other fittings shall not be exceeded;
- h. Only personnel who has been trained in the operation of the particular tool shall be allowed to operate power-actuated tools;
- i. The tool shall be tested each day before loading to see that the safety devices are in proper working condition. The method of testing shall be accordance with the manufacturer's recommended procedure;
- j. Any tool found not in proper working order, or that which develops a defect during use, shall be immediately removed from service and not used until properly repaired;
- k. Tools shall not be loaded until just prior to the intended firing time. Neither loaded nor empty tools are to be pointed at any other person. Hands shall be kept clear of the open barrel end;
- l. Loaded tools shall not be left unattended;
- m. Fasteners shall not be driven into very hard or brittle materials including, but not limited to, cast iron, glazed tiles, surface hardened steel, glass block, live rock, face brick or hollow tiles;
- n. Driving into materials that can be easily penetrated shall be avoided unless backed by a substance that will prevent the pin or fastener from passing completely through and creating a flying missile hazard on the other side;
- o. No fastener shall be driven into a palled area caused by an unsatisfactory fastening;
- p. Only non-sparking tools shall be used in an explosive or flammable atmosphere;
- q. All tools shall be used with the correct shield, guard or attachment as recommended by the manufacturer.

5.4. ABRASIVE WHEELS AND TOOLS

- a. All grinding machines shall be supplied with sufficient power to maintain the spindle speed at safe levels under all conditions of normal operation;
- b. Grinding machines shall be equipped with suitable safety guards;
- c. The maximum angular exposure of the grinding wheel periphery and sides shall not be more than 90^o, except that when the work requires contact with the wheel below the horizontal plane of the spindle, the angular exposure shall not exceed 120^o. In either case, the exposure shall begin not more than 65^o above the horizontal plane of the spindle. Safety guards shall be strong enough to withstand the bursting of the wheel;
- d. Floor and bench-mounted grinders shall be work-rests, which shall be rigidly supported and readily adjustable. Such work-rests shall be kept at a distance not to exceed 5 mm from the surface of the wheel;

- e. Cup type wheels used for external grinding shall be protected by either revolving cup guard or a band type guard;
- f. When safety guards are required, they shall be mounted as to maintain proper alignment with the wheel and the guard and the guard and its fastening shall be adequate strength to retain the fragments of the wheel in case of accidental breakage. The maximum angular exposure of the grinding wheel periphery and sides shall not exceed 180°;
- g. Portable abrasive wheel used for internal grinding shall be provided with suitable safety flanges;
- h. When safety flanges are required, they shall be used only with wheels designed to fit the flanges. Only safety flanges, of a type and design and properly assembled so as to ensure that the pieces of the wheel will be retained in case of accidental breakage, shall be used;
- i. All abrasive wheels shall be closely inspected and ring tested before mounting to ensure that they are free from cracks or defects;
- j. Grinding wheels shall fit freely on the spindle and shall not be forced on. The spindle nut shall be tightened only enough to hold the wheel in place;
- k. All employees using abrasive wheels shall be protected by suitable eye protection equipment.

5.5. WOODWORKING TOOLS

- a. All fixed power driven woodworking tools shall be provided with a disconnect switch that can either be locked or tagged in the **off-position**;
- b. The operating speed shall be attached or otherwise permanently marked on all circular saws over 0.5 m in diameter or operating at over 3000 peripheral rpm. Any saw so marked shall not be operated at a speed other than that marked on the blade. When a marked saw is retensioned for a different speed, the marking shall be corrected to show the new speed;
- c. Automatic feeding devices shall be installed on machines wherever the nature of the work will permit. Feeder attachments shall have the feed rolls or other moving parts covered or guarded so as to protect the operator from hazardous points;
- d. All portable power driven circular saws shall be equipped with guards above and below the base plate or shoe. The upper guard shall cover the saw to the depth of the teeth, except for the minimum arc required to permit the base to be tilted for bevel cuts. The lower guard shall cover the saw to the depth of the teeth, except for the minimum arc required to allow proper retraction and contact with the work. When the tool is withdrawn from the work, the lower guard shall automatically and instantly return to the covering position.

6.0 SAFETY IN THE USE OF LADDERS AND STAIRS

6.1. GENERAL ASPECTS OF SAFETY RELATED TO USE OF LADDERS

- a. Every ladder or step-ladder used in building or other construction work shall be of good construction, made of sound material and of adequate strength for the purpose for which such ladder or step-ladder is used;
- b. When a ladder is used as a means of communication, such ladder shall be lashed to a fixed structure so that while working on such ladder it does not slip;
- c. A ladder or step ladder shall not stand on loose bricks or other loose packing and have a level and firm footing;
- d. No ladder shall be used which has a missing or defective rungs or rungs, which depend for support solely on nails, spikes or other similar fixing.

6.2. MATERIALS FOR LADDERS

- a. Shall be constructed with upright of adequate strength and are made of straight-grained wood, free from defects and having the grain of such wood running length wise;
- b. Shall have rungs made of straight-grained wood free for defects and mortised or securely notched into the upright, reinforcing metal ties, if wedges shall not secure the tenors of such ladders;
- c. Where it is required, in case of use of fixed ladders, sufficient foot-hold and hand-hold shall be provided for use by the building worker;
- d. Every ladder shall be -
 - i. Secured so as to prevent undue swaying;
 - ii. Equally and properly supported on each of its upright;
 - iii. So used as not to cause undue sagging; and
 - iv. Placed as nearly as possible at an inclination of four in one;
- e. The use of all ladders and stepladders shall conform to the approved standards;
- f. Wooden ladders shall be constructed with uprights of adequate strength as well as rungs made of wood free from visible defects and having the grains of the wood in the ladders running lengthwise and rungs mortised or rebuted into the uprights;
- g. Uprights and rungs of metal ladders shall have a cross-section adequate to prevent dangerous deflection, shall be equal and not less than 25 cm or more than 35 cm;
- h. Rungs of metal ladders shall be kept clean so as to prevent them from becoming slippery;
- i. Portable ladders shall not exceed 9 m in length;
- j. Every ladder or run of ladders rising to a height exceeding 9 m shall be provided with an intermediate landing, providing further that the intervals between landings shall not exceed 9 m. The landings shall be of suitable size and protected by railings;
- k. Defective ladders that cannot be satisfactorily repaired shall be tagged Not Fit For Use and destroyed;
- l. Wooden ladders shall not be painted, but oiled or covered with clean varnish or other transparent preservatives;
- m. Metal ladders shall be protected against corrosion by being coated with rust-proof paint or by other means unless they are made of non-corrosive metals;

- n. Every ladder shall rise at least 1 m above the highest point to be reached and have one of the uprights continued to that height to serve as a hand-rail at the top;
- o. Ladders shall not stand on loose bricks or other loose packing but have a level and firm footing so that they are equally supported on each upright;
- p. Every ladder shall be securely fixed so that it cannot move from its top and bottom points of rest and if it cannot be secured at the top, it shall be securely fastened at the base and if fastening at the top is also impracticable, it shall have a man stationed at the foot holding the end to prevent it from slipping;
- q. Where a run of two or more ladders connects different floors, the ladders shall be staggered and a protective landing with the smallest practicable opening shall be provided at each floor;
- r. A ladder having only one upright or a missing or dangerously defective rung shall not be used;
- s. When a ladder is placed in position, the distance between the foot of a ladder and the base of the structure against which it rests shall be about one-quarter of its length;
- t. Workers using ladders shall leave at least one hand free for climbing up and down, face the ladder, avoid wearing slippery footwear and avoid carrying heavy or bulky loads;
- u. A ladder shall not be placed in front of a door that opens towards it unless the door is fastened or locked or guarded;
- v. A ladder shall not be placed against a window frame unless the ladder is fitted with a board at the top so that the applied load is safely distributed over the frame;
- w. Metal ladders shall not be used in the vicinity of live electrical equipment;
- x. Adequate means shall be provided to prevent displacement of the ladder set up in public thoroughfare or where persons, vehicles etc. may accidentally collide with it.

6.3. PORTABLE STEPLADDERS

- a. The length of portable stepladders shall not exceed 6 m and their back legs shall be adequately braced;
- b. Stepladders exceeding 1.5 m in length shall have two or more cross-ties;
- c. The spread between the front and back legs shall be restricted by means of hinged metal flat bars or high-grade fibre or other effective means;
- d. When in the open position, treads of stepladders shall be horizontal.

6.4. PORTABLE TRESTLE LADDERS

- a. The height of the trestle ladders shall not exceed 5.5 m;
- b. The spread between the front and back legs shall be restricted by means of hinged metal flat bars or high-grade fibre or other effective means;
- c. The front and back legs shall be joined at the top by bolted steel hinges of adequate dimensions or other effective means;
- d. Both legs of trestle ladders shall be equipped with sufficient number of steel crossties.

6.5. EXTENSION LADDERS

- a. The length of extension ladders shall not exceed 15 m;
- b. Extension ladders shall be equipped with an effective lock and guide brackets by which the ladder can be extended, retracted or locked in any position;

- c. The rungs of overlapping sections shall coincide so as to form double treads and shall be equipped with one or more extension ropes;
- d. Extension ropes shall be securely anchored and run over suitable pulleys.

6.6 MECHANICAL LADDERS

- a. Mechanical ladder is that ladder, which is a mechanically extendable ladder, mounted on a wheeled frame;
- b. Mechanical ladder shall be equipped with guard-rails and toe-boards and a cage of heavy-gauge steel mesh;
- c. If mechanical ladder has no railed platform or cage, workers using it shall be secured by suitable safety belt;
- d. Mechanical ladders shall not be moved, while a person is on them, unless they have specially designed to ensure that perfect stability is maintained during movement.

6.7. FIXED LADDERS

- a. Uprights of fixed ladders shall be at least 40 cm and shall be set an angle of 15⁰ to the vertical;
- b. Clearance at the back of the rungs shall be at least 15 cm and no obstruction within 75 cm of the face of the ladder;
- c. There shall be at least 7.5 cm clearance between the ladder and the nearest fixed object;
- d. When it is necessary for a ladder to pass closely through a hole in a platform or a floor, the edges of the hole shall be padded so as to prevent injury to the users;
- e. The length of the runs of fixed ladder shall not exceed 9 m;
- f. Landing platform shall be provided for each 9 m or fraction thereof;
- g. As far as practicable, runs shall be staggered;
- h. Runs from which a person could fall from more than 6 m shall be enclosed in a cage of heavy-gauge mesh or hoops;
- i. Fixed ladders shall be firmly bolted or welded in position.

6.8. STAIRS

- a. Stairs shall be of adequate strength to withstand safely the loads that they will have to carry;
- b. Stairs used for the purpose of construction work shall have a clear width of at least 60 cm;
- c. Stairs made of perforated material shall not have openings exceeding 1.2 cm in width;
- d. No step of a stairway shall depend for its support solely on nails, spikes, screws or other similar fixing;
- e. No stairway with missing or dangerously defective steps shall be used;
- f. Every stairway that is at an angle of less than 30⁰ from the vertical shall be provided with a secure handhold at the top landing place, either by extending one upright for at least 1 m or by other effective means;
- g. Movable and removable stairs shall be adequately secured in the position of use;
- h. In all building structures permanent stairs shall be constructed as soon as practicable;
- i. When work on a building has progressed to a height of more than 18 m above the ground and it has not been practical to construct the permanent stairs, sufficient number of stairs shall be provided to ensure safe access to the working levels.

7.0 SAFETY IN THE USE OF LIFTING APPLIANCES & GEARS

7.1. CONSTRUCTION AND MAINTENANCE OF LIFTING APPLIANCES:

All lifting appliances, including their parts and working gear, whether fixed or movable, and any plant or gear used in anchoring or fixing of such appliances -

- a. Shall be of sound construction, sound material, and of adequate strength to serve the purpose for which these are to be used and all such appliances shall be free from patent defects, and
- b. Maintained in good repair and working condition;
- c. Every drum or pulley around which the rope of any lifting appliance is carried, shall be of adequate diameter and sound construction in relation to such rope;
 - i. Any rope that terminates at the winding drum of lifting appliance shall be securely attached to such drum and at least three dead turns of such rope remain on such drum in every operating position of such lifting appliance;
 - ii. The flange of a drum projects twice the rope diameter beyond the last layer of such rope and if such rope and if such projection is not available, other measures like anti-slackness guards shall be provided to prevent such rope from coming off such drum;
- d. Every lifting appliance shall be provided with adequate and efficient brakes which shall be:
 - i) Capable of preventing fall of suspended load (including any test load),
 - ii) Effectively controlling such load while it is being lowered, acting without shock and shall be attached with shoes that can be easily removed for running and which shall be simple and have easily accessible means of adjustment;
- e. Provided that nothing contained above shall apply to **steam-winch** that can be operated as safely as with brakes.

7.2. CONTROLS OF EVERY LIFTING APPLIANCE SHALL BE SO;

- a. Situated that the driver of such appliance at his stand or seat has ample room for operating and has an unrestricted view of building or other construction work, as far as practicable, and that he remains clear of the load and the ropes, and that no load passes over him;
- b. Positioned with due regard to ergonomic considerations for proper operation of such appliance;
- c. Located that the driver of such appliance remains above the appliance and shall have upon them or adjacent to them clear markings to indicate their purpose and mode of operations;
- d. Provided, where necessary, with a suitable locking device to prevent accidental movement or displacement and shall move, as far as practicable, in the direction of the resultant load movement;
- e. Wherever automatic brakes are provided, they shall automatically come to the neutral position in case of power failure.

7.3. TEST AND PERIODICAL EXAMINATION

7.3.1 Test: all lifting appliances including all parts and gears thereof, whether fixed or movable, shall be tested and examined by a competent person before being taken into use for the first time or after it

has undergone any alteration or repairs liable to affect its strength or stability or after erection on a site and also once at least in every five years, in the manner as specified;

7.3.2. Examination: all lifting appliances shall be thoroughly examined by a competent person at least in every twelve months and where the competent person making such examination forms the opinion that the lifting appliance cannot continue to function safely, he shall forthwith give notice in writing of his opinion to the contractor.

7.4. AUTOMATIC LOAD INDICATOR

- a. Cut-out shall be provided which automatically arrests the movement of the lifting parts of every crane if the load exceeds the safe working load, wherever possible;
- b. Wherever the above provisions cannot be applied and if it is not possible to install an automatic safe load indicator, in that case, provision of a table showing the safe working loads at the corresponding inclinations or radii of the jib on the crane shall be considered sufficient.

7.5. INSTALLATION:

Fixed lifting appliances shall be installed by a competent person in a manner that

- a. Such appliances cannot be displaced by the load, vibration or other influences;
- b. The operator of such appliance is not exposed to danger from loads, ropes or drums;
- c. The operator can either see over the zone of operation or communicate with all loading and unloading points by signal, or other communication system;
- d. Adequate clearance is provided between parts or loads of lifting appliances and between the fixed objects such as walls and posts, or electrical conductors;
- e. The lifting appliances; when exposed to wind loading, are given sufficient additional strength, stability and rigidity to withstand such loading safely;
- f. No structural alterations or repairs are made on any part of the lifting appliances that affect the safety of such appliances without obtaining the opinion of the competent person to this effect.

7.6. WINCHES

- a. Winches shall not be used if their control levers operate with excessive friction or play;
- b. Double gear winches shall not be used unless a positive means of locking the gearshift is provided;
- c. There shall be no load other than the fall and the hook assembly on the winch while changing gears on a two-gear winch;
- d. Adequate protection shall be provided to the winch operator against abnormal weather;

- e. Temporary seats or shelters for winch operators that may pose hazard to the winch operator or any other building workers shall not be allowed to be used;
- f. Control levers shall be secured in the neutral position and, whenever possible, the power shall shut off if the winch is left unattended.

7.7. IN USE OF EVERY STEAM-WINCH

- a. Measures shall be taken to prevent escaping steam from obscuring any part of the construction site or other workplace or from otherwise hindering or injuring any building worker;
- b. Extension control levers which tend to fall off their own weight shall be counter-balanced;
- c. Winch operators shall not be permitted to use the which control extension levers except for short handles on wheel type controls and that such levers shall be of adequate strength, secure and fastened with metal connections at the fulcrum and at the permanent control lever;
- d. In use of every electric winch, no building worker shall be permitted to transfer, alter or adjust electric control circuits in case of any defect in such winch;

7.8. ELECTRIC WINCHES SHALL NOT BE USED FOR BUILDING WORK WHERE

- a. The electromagnetic brake is unable to hold the load; or
- b. One or more control points either hoisting or lowering are not operating properly.

7.9. BUCKETS:

It shall be ensured that tip-up buckets are equipped with a device that effectively prevents accidental tipping.

7.10. IDENTIFICATION AND MARKING OF SAFE WORKING LOAD:

- a. Every lifting appliance and loose gear shall be clearly marked for its safe working load and identification by stamping or other suitable means;
- b. Every derrick (**other than derrick crane**) shall be clearly marked for its safe working load when such derrick is used either in single purchase with lower block or in union purchases in all possible block positions;
- c. The lowest angle to the horizontal, to which the derrick may be used, shall be legibly marked;
- d. Every lifting appliance having more than one working load shall be fitted with effective means to enable the operator to determine safe working load at each point under all conditions of use;
- e. Means to ascertain the safe working load for lifting gears under such conditions in which such gears may be used shall be provided to enable a worker using such gears and such means safely, which shall comprise:
 - i) Marking of the safe working load in plain figures or letters upon the sling or upon a tablet or ring of durable material attached securely thereto in case of chain slings; and

- ii) The means specified or notices so exhibited as can be easily read by any concerned building worker stating the safe working load for the various sizes of the wire rope slings used.

7.11 LOADING OF LIFTING APPLIANCES AND LIFTING GEARS

- a. No lifting appliance, lifting gear or wire rope shall be used in an unsafe way and in such a manner as to involve risk to life of building workers and they are not loaded beyond their safe working load except for testing purposes under the direction of a **competent person** in the manner as specified in schedule;
- b. No lifting appliance and lifting gear, or any other material-handling appliance shall be used if the Inspector having jurisdiction under the Building and Other construction (regulation of employment and conditions of service) Act/Rules is not satisfied with reference to a certificate of test or examination or to an authenticated record maintained as provided under the Rules or if in his view the lifting appliance, lifting gear or any other material handling appliance is not safe for use in building or other construction work;
- c. No pulley block shall be used unless the safe working load and its identification are clearly marked on such block.

7.12. OPERATOR'S CAB OR CABIN SHALL

- a. Be made of fire resistant material;
- b. Have a suitable seat, a foot rest and protection from vibration;
- c. Afford the operator an adequate view of the area of operation;
- d. Afford the necessary access to working parts in the cab;
- e. Afford the operator adequate protection against the weather;
- f. Be adequately ventilated; and
- g. Be provided with a suitable fire extinguisher.

7.13. OPERATION OF LIFTING APPLIANCES:

Operator of every crane or lifting appliance shall possess adequate skill and training in the operation of the particular lifting appliances, provided further that

- a. No person under eighteen years of age shall be in control of any lifting machine, scaffold winch, or give signals to the operator;
- b. Precaution shall be taken by the trained operator to prevent lifting appliance from being set in motion inadvertently;
- c. The operation of lifting appliances shall be governed by signals in conformity with the approved standards;
- d. The operator's attention shall not be distracted while he is working;
- e. No crane, hoist, winch or other lifting appliance or any part of such crane, hoist, winch or other lifting appliance shall, except for testing purposes, be loaded beyond the safe working load;
- f. During the hoisting operation, effective precaution shall be taken to prevent any person from standing or passing under the load in such operation;

- g. Operator shall not leave lifting appliance unattended while power is on or the load is suspended to such appliance;
- h. No person shall ride on a suspended load of any lifting appliance;
- i. Every part of a load in course of being hoisted or lowered shall be adequately suspended and supported to prevent danger;
- j. Every receptacle used for hoisting bricks, tiles, slates or other material shall be suitably enclosed as to prevent the fall of any such material;
- k. The hoisting platform shall be enclosed when loose material or loaded wheel barrows are placed directly on such platform or lowering such materials or wheel barrows;
- l. No material shall be raised, lowered or slewed with any lifting appliance in such a way as to cause sudden jerks to such appliance;
- m. In hoisting a barrow, any wheel of such barrow shall not be used as a means of support unless adequate steps have been taken to prevent the axle of such wheel from slipping out of its bearing;
- n. Long objects like planks or girders shall be provided with tag line to prevent any possibility of danger while raising or lowering such objects;
- o. During the process of landing or material, a building worker shall not be permitted to lean out into empty space for finding out the loading and unloading of such material;
- p. When hoisting of load is done in an enclosed space, neither the lifting material nor the boom shall project outside the enclosed space;
- q. Adequate steps shall be taken to prevent a load, in the course of being hoisted or lowered from coming into contact with any object to avoid any displacement of such load and appropriate appliances provided and used for guiding heavy loads when raising or lowering heavy loads to avoid crushing of hands of building workers during such raising or lowering of loads.

7.14. HOISTS

- a. Hoist towers shall be designed according to the relevant national standards;
- b. Hoist shafts shall be provided with rigid panels or other adequate fencing at the ground level on all sides of such shafts and at all other levels on all sides of the access to such shafts while the walls of hoist shafts, except at approaches, extend at least two meters above the floor or platform of access to such shafts;
- c. Approaches to hoist shall be adequately lit and provided with gates that shall be guarded to maintain visibility at least of two meters height; and equipped with a device, which requires such gate to be closed before the platform of such hoist can leave the landing, and prevents the gate from being opened unless such platform is at the landing;
- d. The guides of hoist platforms shall offer sufficient resistance to bending and to bucking in the case of jamming, by providing a safety catch;
- e. Overhead beams and their supports are capable of holding the total maximum live and dead loads that such beams and supports will be required to carry, with a safety factor of at least five;

- f. A clear space shall be provided –
- i. Above the highest stopping place of a cage or platform to allow sufficient unobstructed travel of such cage or platform in case of over-winding and
 - ii. Below the lowest stopping place of such cage or platform;
- g. Adequate covering shall be provided above the top of hoist shafts to prevent materials from falling into such shafts;
- h. Outdoor hoist towers shall be erected on adequately firm foundations and securely braced, guyed and anchored;
- i. A ladder way shall extend from the bottom to the top of every outdoor hoist tower in case no other ladder way exists within easy reach and such ladder way shall comply with the relevant national standards;
- j. The rated capacity of a hoisting engine shall at least be one and a half times the maximum load that such engine will be required to move;
- k. All gearing on a hoisting engine shall be securely enclosed;
- l. Steam piping of hoisting engine shall be adequately protected against accidental contact of such piping with a building worker;
- m. Electrical equipment of a hoisting engine shall be effectively earthed;
- n. A hoist shall be provided with suitable devices to stop a hoisting engine as soon as the platform of such hoist reaches its highest stopping place;
- o. A hoisting engine shall be protected by suitable cover against weather and falling objects;
- p. A hoisting engine set up in a public thoroughfare shall be completely enclosed;
- q. All exhaust steam pipes shall discharge steam in such a manner that the steam so discharged does not scald any person or obstruct the operator's view;
- r. The motion of a hoist shall not be reversed without first bringing it to rest to avoid any harm from such reverse motion;
- s. A hoist not designed for the conveyance of persons shall not be set in motion from the platform of such hoist;
- t. Pawls and ratchet wheels of a hoist, requiring disengagement of such pawls from such ratchet wheels, before the platform of such hoist is lowered, shall not be used;
- u. A platform of a hoist shall be capable of supporting such maximum load that such platform may carry with a safety factor of at least three;
- v. A platform of a hoist shall be equipped with suitable safety gear which can hold such platform with its maximum load in case its hoisting rope breaks;
- w. On platform of a hoist, the wheel barrows or truck shall be efficiently blocked in safe positions;

- x. A cage of a hoist or platform where the building workers are required to enter into such cage or to go on such platform at landing levels, shall be provided with a locking arrangement to prevent such cage or platform from moving during the time a worker enters or leaves such cage or platform;
- y. The sides of platform of a hoist which are not used for loading or unloading, shall be provided with toe-board and enclosures of a wire mesh or any other suitable means to prevent the fall of any part of a load from such platform, further provided that
 - i. The platform of a hoist, which has any probability of falling of any part of a load from it, shall be provided with an adequate covering to prevent such fall;
 - ii. The counter weights of a hoist consisting of an assemblage of several parts shall be so constructed that such parts shall be rigidly connected together;
 - iii. The counter weights of a hoist shall run between guides;
 - iv. At every level of work the building workers shall be provided with adequate platforms for performing such work;
 - v. A legible notice in Hindi as well as in a local language shall be displayed in a conspicuous place of the platform of a hoist and that such notice shall state the maximum carrying capacity of such hoist in kilograms on the hoisting engine;
 - vi. On a hoist authorized and certified for the conveyance of the persons on the platform or in the cage and such notice shall state the maximum number of persons to be carried on such hoist at one time;
 - vii. On a hoist carrying goods and other materials such notice shall state that such hoist is not meant for carriage of persons.

7.15. FENCING AND MEANS OF ACCESS TO LIFTING APPLIANCES

- a. Safe means of access shall be provided to every part of lifting appliances;
- b. The operator's platform on every crane or tip driven by mechanical power shall be securely fenced and provided with safe means of access and where access to such platform is by a ladder, the sides of such ladder shall extend to a height reasonable beyond such platform or some other suitable handhold shall be provided in the platform;
- c. The handling place on such platform shall be maintained free from obstruction and slipping; and
- d. In case the height of such ladder exceeds six meters, the resting platforms shall be provided on such ladder at every six meters of its height and where the distance between last platform so provided and the top end of such ladder is more than two meters then on such top end.

7.16. RIGGING OF DERRICKS:

Every derrick shall have current and relevant rigging plans and any other information necessary for the safe rigging of such derrick and its gear.

7.17. SECURING OF DERRICK FOOT:

Appropriate measures shall be taken to prevent the foot of a derrick from being lifted out of its socket or supports.

7.18. CONSTRUCTION AND MAINTENANCE OF LIFTING GEAR

- a. Every lifting gear shall be –
 - i. of good design and construction, sound material and adequate strength to perform the work for which it is used;
 - ii. free from patent defects; and
 - iii. properly maintained in good repair and working order;
- b. Components of the loose gear, at the time of its use, shall be renewed if one of its dimensions at any point has decreased by ten per cent or more;
- c. A chain shall be withdrawn from use when it is stretched and increased in length which exceeds five per cent of its length or when a link of such chain is deformed or is otherwise damaged or defects in the welds have appeared on it;
- d. Rings, hooks, swivels and end links attached to a chain shall be of the same materials as that of such chain;
- e. The voltage of electric supply to any magnetic lifting device shall not fluctuate by more than **plus** or **minus** 10%.

7.19. TEST AND PERIODICAL EXAMINATION OF LIFTING GEARS

- a. A lifting gear shall be initially tested for the manufacturer by a competent person in a manner specified as per schedule annexed before taking into use or after undergoing any substantive alterations which renders its any part liable to affect its safety and such gear after such test shall subsequently be retested for the use of its owner at least once in every five years;
- b. A lifting gear in use shall thoroughly examined once at least in every twelve months by a competent person;
- c. A chain in use shall be thoroughly examined at least once every month by a responsible person for its use;
- d. Certificates of initial and periodical test and examinations of loose gears shall be obtained in the form annexed.

7.20. ROPES

- a. No rope shall be used for building or other construction work unless -
 - i) It is of good quality and free from patent defects; and
 - ii) In the case of wire rope, it shall be tested and examined by a competent person in the manner annexed;
 - iii) Every wire rope of lifting appliance or lifting gear used for building or other construction work shall be inspected by a responsible person for such use, once at least in every three month;

- b. Provided that after if any such wire is broken in such rope, the responsible person shall thereafter inspect it once at least in every month and ensure that;
- c. No wire rope shall be used for building or other constructing work if in any length of eight diameters of such wires, the total number of visible broken wires exceed ten per cent of the total number of wires in such rope, or such rope shows signs of excessive wear, corrosion or other defects which in the opinion of the person who inspects it, is unfit for use;
- d. Eye splices and loops of ropes for the attachment of hooks, rings and other such parts to wire rope shall be made with suitable thimble;
- e. A thimble or loop splice made in any wire rope sling shall conform to the following standards, namely:
 - i) Wire rope sling shall have at least three tucks with full strand of rope and two tucks with one-half of the wires cut out of each of such strand in all cases, such strands shall be tucked against the lay of the rope;
 - ii) Protruding ends of such strands in any splice of wire rope slings shall be covered or treated so as to leave no sharp points;
 - iii) A fiber rope or a rope sling shall have at least four tucks, tail of such tuck being whipped in a suitable manner; and
 - iv) A synthetic fiber rope or rope sling shall have at least four tucks with full strands followed by further tuck with one-half filaments cut out of each of such strand and final tuck with one-half of the remaining filaments cut out from such strands. Any portion of the splices containing such tucks, with reduced number of filaments, shall be securely covered with suitable tape or other materials;
 - v) Provided further that nothing contained above shall apply where any other form of splice, which may be shown to be as efficient as the splice with above standards, shall be used.

7.21. HEAT TREATMENT OF LIFTING GEARS

- a. All chains other than bridle chains attached to derricks and all rings, hooks, shackles and swivels used in hoisting or lowering of such derricks shall be effectively annealed under supervision of a competent person and at the following intervals, namely:
 - i) Such chains, rings, hoods, shackles and swivels which are not more than twelve and a half millimeter of length annealed at least once in every six months; and
 - ii) All other such chains rings hooks shackles and swivels shall be so annealed at least once in every twelve months;
- b. Provided that the clause (a) above shall not apply to -
 - i) Pitched chins, working on sprocket or sprocket wheels;
 - ii) Rings, hooks and swivels permanently attached to pitched chains, pulley blocks or weighing machines, and
 - iii) Hooks and swivels having ball bearings or other case hardened parts;

- c. A chain or a loose gear made of high tensile steel or alloy steel shall be plainly marked with a mark indicating that it is so made;
- d. No chain or loose gear made of high tensile steel or alloy steel shall be subjected to any form of heat treatment except where such treatment is necessary for the purpose of repair of such chain or loose gear and that such repair shall be made under the direction of the competent person;
- e. That the wrought iron gear, the past history of which is not traceable, shall be suspected of being heat treated at incorrect temperature shall be normalized before using it on any building or other construction work.

7.22. CERTIFICATE TO BE ISSUED AFTER ACTUAL TESTING AND EXAMINATION ETC:

A competent person shall issue a certificate after actual testing or examination of the apparatus specified and record of such test or examination shall be maintained for inspection.

7.23. REGISTER OF PERIODICAL TEST, EXAMINATION AND CERTIFICATION THEREOF

- a. A register in the form annexed shall be maintained and particulars of such test and examination of lifting appliances, lifting gears and heat treatment as required shall be entered in such register;
- b. Certificate in respect of each of the following shall be obtained from a competent person:
 - i) In cases of initial and periodical test and examination of the lifting appliances such as Winches, Derricks and their accessory gears, Cranes or Hoists and their accessory gears;
 - (ii) In case of test, examination and re-examination of loose gears;
 - (iii) In case of test and examination of wire ropes;
 - (iv) In case of heat treatment and examination of loose gears;
 - (v) In case of annual thorough examination of the loose gears, except where required particulars of such exemption have been enclosed in the register referred to in Form annexed and such certificates are attached to the register referred to as above and certificates kept at such construction site in case such register and certificate relate to lifting appliances, loose gear and wire ropes and
- c. Produced on demand and retained for at least five years after the date of the last entry made in such register;
- d. No lifting appliance or lifting gear in respect of which an entry is required to be made in register referred to above and certificate of test and examination are required to be attached in such register in the manner as specified, shall be used for building or other construction work unless the required entries have been made in such register and certificates.

7.24. VACUUM AND MAGNETIC LIFTING GEAR

- a. No vacuum lifting gear, magnetic lifting gear or any other lifting gear where the load on it is held by adhesive power, shall be used while workers are performing operations beneath such gear;
- b. A magnetic lifting gear used in connection with building or other construction work shall be provided with an alternative supply of power, such as batteries, which may come into operation immediately in the event of failure of the main power supply;

- c. No building worker shall work within the swinging zone of the lifting gear or load or building or other construction material suspended to such lifting gear.

7.25. KNOTTING OF CHAINS AND WIRE ROPES:

No chain or wire rope with a knot in it shall be used in building or other construction work.

7.26. CARRYING OF PERSONS BY MEANS OF LIFTING APPLIANCES ETC.

- a. No building worker shall be raised, lowered or carried by a power driven lifting appliance, except
 - i. On the drive's platform in the cage of a crane; or
 - ii. On a hoist; or
 - iii. On an approved suspended scaffold;
- b. Provided that a building worker may be raised, lowered or carried by a power driven lifting appliance:
 - i. In circumstances where the use of a hoist or of a suspended scaffold shall not reasonably be practicable, or
 - ii. On an aerial cableway or aerial ropeway, provided further that the following requirements are met:
 - iii. That the appliance referred to above can be operated from one position only and that
 - iv. Any winch used in connection with the appliance shall also comply with the requirements as laid down above.
- c. The appliance referred to above shall not carry any person except:
 - i. In a chair or cage,
 - ii. In a skip or other receptacle at least three feet deep which shall be suitable for safe carriage of a person and any such chair, cage, skip or other receptacle shall be made of good construction, sound material, and adequate strength and properly maintained with suitable means to prevent any occupant therein from falling out of it and shall be free from any material or tools which may interfere with the handhold or foothold of such occupant or otherwise endanger him; and
 - iii. Those suitable measures shall be taken to prevent the chair, cage skip or other receptacle from spinning or tipping in a manner dangerous to any occupant therein.

7.27. HOISTS CARRYING PERSONS

- a. No building worker shall be carried with the help of a hoist unless it is provided with a cage which:
 - i) Is so constructed as to prevent, when its gates are shut, any building worker carried by such hoist from falling out of it or from being trapped between any part of such cage and any fixed structure or other moving part of such hoist or from being struck by articles or materials falling down the hoist way on which such hoist is moving; and
 - ii) Is fitted on each of its side from which access is provided to a landing place with a gate which has efficient interlocking or other devices to secure so that such gate cannot be opened except when such cage is at a landing place and that such cage cannot be moved away from any such place until such gate is closed;

- b. Every gate in the hoist way enclosure of such hoist used for carrying persons shall be fitted with efficient interlocking or other devices to secure so that such gate cannot be opened except when the cage of such gate is at the landing place and that such cage cannot be moved away from the landing place until such gate is closed;
- c. In every hoist used for carrying building workers there are provided with suitable and efficient automatic devices to ensure that the cage of such hoist comes to rest at a point above the lowest point to which such gave may travel.

7.28. ATTACHMENT OF LOADS

- a. When a sling is used to hoist long materials, a lifting beam shall be used to space the sling legs for proper balance and when a load is suspended at two or more points with slings, the eyes of the lifting legs of such slings shall be shackled together and such shackled or eyes of the shackled slings shall be placed on the hook or the eyes of such lifting legs shall be shackled directly to the hoisting block, ball or balance beam, as the case may be;
- b. Every container or receptacle used for raising or lowering stone, bricks tiles, slates or other similar objects shall be so enclosed with the hoist as to prevent the fall of such objects;
- c. A loaded wheel barrows placed directly on a platform of a hoist for raising or lowering of such wheel barrows shall be so secured that such wheel barrows cannot move and such platform shall be enclosed to prevent the fall of the contents kept in such wheel barrows;
- d. Landings of hoists shall be so designed and arranged that building workers on such hoist be not required to lean out into empty space for loading and unloading on any material from such hoist

7.29. TOWER CRANES

- a. No person other than the operator trained and capable to work at heights shall be employed to operate tower cranes;
- b. The ground on which a tower crane stands shall have adequate bearing capacity;
- c. Bases for tower cranes and trucks for rail mounted tower cranes shall be firm and leveled and such cranes erected at a reasonably safe distance from excavations and operated within gradient limits as specified by the manufacturer of such cranes;
- d. Tower cranes shall be sited where there is a clear space available for erection, operation and dismantling of such cranes;
- e. Tower cranes shall be sited in such a way that the loads on such cranes shall not be handled over any occupied premises, public thoroughfares, railways or near power cables, other than construction works for which such cranes are used;
- f. Where two or more tower cranes are sited and operated, every care shall be taken to ensure positive and proper communication between operators of such cranes to avoid any dagger or dangerous occurrences;
- g. Tower cranes shall not be used for loading magnet, or demolition ball service, piling operation or other similar operations which could impose excessive load stresses on the crane structure of such cranes;

- h. The instruction of the manufacturer of a tower crane and standard safe practices regarding such cranes shall be followed while operating or using such cranes.

7.30. QUALIFICATION OF OPERATOR OF LIFTING WINCHES AND OF SIGNALER ETC.

- a. No person shall be employed to drive or operate a lifting appliance whether driven by mechanical power or otherwise or to give signals to driver of operator of such lifting appliance or to work as an operator of a rigger or derricks unless he is
 - i) Sufficiently competent and reliable;
 - ii) Possesses the knowledge of the inherent risks involved in the operation of lifting appliance;
 - iii) Medically examined periodically as specified and
 - iv) Is above eighteen years of age.

8.0 SAFETY IN THE USE OF TRANSPORT, EARTHMOVING EQUIPMENT & OTHER CONSTRUCTION MACHINERY

8.1 EARTHMOVING EQUIPMENT AND VEHICLES

- a. All vehicles and earthmoving equipment shall be made of good material, proper design and sound construction and be sufficiently strong for the purpose for which such equipment are properly used in accordance with standard safe operating practices;
- b. Provided that the truck or trailer employed for transporting freight containers shall be of the size sufficient to carry the containers, without over hanging and provided with twist locks conforming to approved standards, at all the four corners of each of such use by an authority under the relevant law for the time being in force and is inspected by a responsible person, at least once in a month and record of such inspection shall be maintained:
- c. All transport or earth moving equipment and vehicles shall be inspected at least once a week by a responsible person and in case any defect is noticed in such equipment or vehicle it shall be immediately taken out of use;
- d. Power trucks and tractors shall be equipped with effective brakes, headlights and tail lamps and maintained in good repair and working order;
- e. Side stanchions on power trucks and trailers for carrying heavy and long objects shall be
 - i. Of sound construction and free from defects;
 - ii. Provided with tie chains attached to the top across the loads for preventing such stanchions from spreading out; and
 - iii. Kept in position while loading and unloading;
 - iv. Safe gangways provided for to and fro movement of building workers engaged in loading and unloading of lorries, trucks, trailers and wagons;
 - v. Trucks and other equipment shall not be loaded beyond their safe capacity and carry workers engaged in loading and unloading of lorries, trucks trailers and wagons in an unsafe condition;
 - vi. Handles of trucks shall be so designed as to protect the hands of the building workers working on such trucks, or such handles provided with knuckle guards;
 - vii. No unauthorized person shall ride the transport equipment employed in such work;
 - viii. A driver of a transport equipment shall maneuver such equipment under the direction of a signaler;
 - ix. Adequate precaution such as isolating the electric supply or erecting overhead barriers of a safe height shall be taken when earth moving equipment or vehicles are required to operate in dangerous proximity to any live electric conductor;
 - x. Vehicles and earth moving equipment shall not be left on a slope with the engine of such vehicles or equipment running;

- xi. All earth moving equipment, vehicles or other transport equipment shall be operated only by such person who are adequately trained and possess such skills as required for safe operation of such equipment, vehicle or other transport equipment.

8.2. POWER SHOVELS AND EXCAVATOR

- a. A shovel or an excavator whether operated by steam or electric or by internal combustion, shall be constructed, installed, operated, tested and examined as per approved standards;
- b. Excavator equipped for use as a mobile crane shall be examined and tested in accordance with the requirements for such mobile cranes as laid down by the manufacturer; and
- c. Fitted with an automatic safe working load indicator;
- d. Buckets or grabs of power shovels shall be propped to restrict the movement of such buckets or grabs while being repaired or while the teeth of such buckets or grabs are being changed.

8.3. BULLDOZER

- a. Operator of every such bulldozer before leaving the dozer shall take the following steps:
 - i) Apply the brakes;
 - ii) Lower the blade and sipper and
 - iii) Put the shift lever into neutral;
 - iv) Dozer left on level ground at the close of the work for which such bulldozer is used;
 - v) The blade of a bulldozer kept low when such bulldozer is moving uphill;
 - vi) The bulldozer blades not used as brakes except in an emergency.

8.4. SCRAPERS

- a. A tractor and scraper shall be joined by safety line at the time of its operation;
- b. The scraper bowls shall be propped while blades of such scraper are being replaced;
- c. A scraper moving downhill shall not be left in gear.

8.5. MOBILE ASPHALT LAYERS & FINISHERS

- a. A mixture elevator shall be located within a wooden or sheet metal enclosure with a window for observation, lubrication and maintenance;
- b. Bitumen scoops shall have adequate covers;
- c. When asphalt plants are working on public road, adequate traffic control shall be established on such road and the building workers working with such plant provided with reflective jackets;
- d. A sufficient number of fire extinguishers shall be kept in readiness at such workplace where fire hazards may exist;
- e. The materials shall be loaded on the elevator after the drying drain has warmed up of such elevator;
- f. No open light shall be used for ascertaining the level of asphalt;

- g. Inspection opening shall not be opened till there is a pressure in the boiler, which may cause injury to building workers.

8.6. PAVERS:

Pavers shall be equipped with guards suitable to prevent building workers from walking under the skip of such pavers.

8.7. Road rollers: Before a road roller is used on the ground, such ground shall be examined for its bearing capacity and general safety, especially at the edges of slopes such as embankment on such grounds and shall not be moved downhill with the engine out of gear.

8.8. GENERAL SAFETY IN RESPECT OF POWERED CONSTRUCTION MACHINERY

- a. Every vehicle or earthmoving equipment shall be equipped with -
 - i) Silencers;
 - ii) Tail lights
 - iii) Power and hand brakes;
 - iv) Reversing alarm; and
 - v) Search light for forward and backward movement, which are required for safe operation of such vehicle or earthmoving equipment;
- b. The cab of vehicle or earthmoving equipment shall be kept at least one meter from the adjacent face of a ground being excavated;
- c. When cranes or shovel are traveling, the boom of such crane or shovel shall be in the direction of such travel and the bucket or scoop attached to such crane or shovel raised and without load except when such traveling is downhill.

9.0 SAFETY IN THE PROVISION OF RUNWAYS AND RAMP

9.1. USE OF RUNWAYS AND RAMPS:

- a. Runway or ramps shall not be less than 430 mm in width and constructed of not less than 25 mm thick planking or any other material of adequate strength to withstand the required load, supported substantially in relation to the span and braced with such runway or ramp, and design and construction of such runway or ramp shall be in accordance with the approved standards;
- b. Every runway or ramp located more than 3 m above the floor or ground shall be on open sides and provided with a guardrail of adequate strength and height of not less than 1 m.
- c. Use of runways and ramps by vehicles:
 - i. All runways and ramps shall be of sound construction, strength and securely braced and supported;
 - ii. Every runway or ramp for the use of transport equipment like trailers, trucks or heavier vehicles shall have a width of not less than 3.7 m and provide with timber curbs or any other material of adequate strength with not less than 200 mm by 200 mm in width placed parallel to, and secured to, the sides of such runway or ramp and such runways or ramps or ramps shall be designed in accordance with the approved standards.

9.2. SLOPE OF RAMPS:

Every ramp shall have a slope not exceeding one in four and the total rise of a continuous ramp used by building workers carrying material or using wheelbarrows shall not exceed 3.7 m, unless broken by horizontal landing of at least 1.2 m in length.

9.3. USE OF RUNWAYS OR RAMPS BY WHEELBARROWS, ETC.

- a. Every runway or ramp used for wheelbarrows and carts or hand trucks shall not be less than 1 m width and constructed of not less than 50 mm thick planking, and supported and braced suitably for such use;
- b. Every runway or ramp located more than 3 m above the floor or ground shall be provided on the open sides with suitable guardrails of adequate strength.

10. SAFETY IN HANDLING AND USE OF EXPLOSIVES

10.1 GENERAL PROVISIONS:

- a. The use of explosives shall be carried out in a safe manner to avoid injury to any person and under the direct supervision of a responsible person;
- b. No person other than authorized and competent one shall be allowed to handle and use explosives;
- c. Before using any explosive, necessary warning and danger signals shall be erected, at conspicuous places of such use to warn the building workers and the general public of the danger involved in such use.
- d. No person other than authorized and competent one shall be allowed to handle and use explosives.
- e. Smoke, open lamps, other type of hot or heat producing items and sparks shall be prohibited in or near explosives magazines or while explosives are being handled, transported or used.
- f. No person shall be allowed to handle or use explosives while under the influence of intoxicating liquors or dangerous drugs.
- g. The explosives shall be accounted for at all times. No explosives or blasting agents shall be abandoned.
- h. No fire shall be fought where the fire is in the imminent danger of contact with explosives. All employees shall be removed to a safe area and the fire area shall be guarded against intruders.
- i. Employees authorized to prepare explosive charges or conduct blasting operations shall use every reasonable precaution including but not limited to visual and audible warning signals, flags, or barricades to ensure employee safety.
- j. Due precautions shall be taken to prevent accidental discharge of electric blasting caps from current induced by induced voltage, lightning, adjacent power lines, dust storms, or other sources of extraneous electricity or otherwise. These precautions shall include:
- k. Short-circuiting of detonators in holes, which have been primed and shunted until wired into the blasting circuit.
- l. The suspension of all blasting operations and removal of persons from the blasting area during the approach and progress of an electric storm.
- m. The prominent display of adequate signs, warning against the use of radio transmitters, on all roads within 1000 ft of blasting operations. Whenever adherence to the 1000 ft distance would create an operational handicap, a competent and expert person shall be consulted to evaluate the particular situation, and an alternative provided, which are adequately designed to prevent any premature firing of electric blasting of caps. A description of any such blasting shall be reduced to writing and shall be certified as meeting the purposes of this subdivision by the competent person consulted. The description shall be maintained at the construction site during the duration of the work, and shall be available for inspection.

- n. Empty boxes and paper and fiber packing materials, which have previously contained high explosives, shall not be used again for any purpose, but shall be destroyed by burning at an approved location.
- o. Explosives, blasting agents and blasting supplies that are obviously deteriorated or damaged shall not be used.
- p. Delivery and issue of explosives shall only be made authorized persons into authorized magazines or approved temporary storage or handling areas.
- q. Blasting operations in the proximity of overhead power lines, communication lines, utility services, or other services and structures shall not be carried on until the operators and/or owners have been notified and measures for safe control have been taken. In such situations controlled blasting shall be restored to.
- r. All loading and firing shall be directed and supervised by competent persons thoroughly experienced in this field.
- s. Loaded boreholes shall not be left unattended after the end of the shift.
- t. Suitable and sufficient means of egress to ground level shall be provided in all cases of excavations, trenches, all other places where explosives are handled above or below ground level.
- u. At an appropriate time before the final blasting warnings, workers in the area shall be removed to a designated safe place.
- v. An unmistakable, audible, final warning shall be sounded one minute prior to the detonation of explosives; after completion, when the person in charge has established that safe conditions prevail, an "all clear" shall be sounded.
- w. To prevent persons entering any danger zone during blasting operations notices shall be given to all concerned.
- x. Notices referred above shall indicate:
 - i. that explosives are in use;
 - ii. the audible warning sound and the "all clear" and state when they will be sounded; and
 - iii. the warning flags in use, including an "all clear" flag.
- y. Precautions against lightning shall be provided in accordance with the Indian Electricity Act and Indian Explosives Act and Rules and regulations framed there under.
- z. Package containing explosives shall not be dragged, dropped or handled roughly.
- aa. Non-sparking tools shall be used to open keys.
- bb. The explosives shall not be carried in the box or otherwise on any individual.
- cc. Nothing shall be inserted in the open end of the blasting cap except fuses.

- dd. Deteriorated or damaged explosives shall not be used but shall be disposed or destroyed strictly in accordance with the approved methods and in the doing so the manufacturers or the appropriate authority's instructions shall be followed.
- ee. lightning shall be in accordance with Indian Electricity Act/Rules

10.2. TRANSPORTATION OF EXPLOSIVES

- a. Keep safe distance and to use non-sparking tools while opening packages containing explosives;
- b. Stop the use of explosives and handling thereof while the weather conditions are not suitable for such use or handling;
- c. Due precautions shall be taken to prevent accidental discharge of electric blasting caps from current induced by induced voltage, lightning, adjacent power-lines, dust storms or other sources of extraneous electricity or otherwise. These precautions shall include –
 - i. Suspension of all blasting operations and evacuation of persons;
 - ii. All warning signs shall be displayed within 200 m of blasting operations and in case putting up a sign at 200 m is impractical, the contractor shall consult the Engineer-in-charge for alternatives;
 - iii. All loading and firing shall be directed and supervised by competent persons thoroughly experienced in the field;
 - iv. To prevent persons entering any danger zone during blasting operations, notices shall be given to all concerned;
- d. In addition to these provisions, all measures and precautions that are required to be observed for use, handling, storing or transportation of explosives under the Rules framed under the Explosives Act, 1884 (4 of 1884) shall be observed;
- e. All the relevant statutory provisions, local laws and rules and regulations shall be complied with.
- f. Where the magazine is located near the construction site and blasting operation continues daily, actual requirement of explosives shall be drawn from the magazine and transported to the site. Any leftovers shall be returned to the magazine each time after the blast. In case of work at scattered places and for a small duration, portable magazines shall be used and kept within a fence in safe place and properly guarded.
- g. For carrying higher quantity (more than 5 kg of explosives) specially designed insulated containers shall be used. These containers shall be constructed of finished wood not less than 5cm thick or plastic not less than 6mm thick or pressed fibre not less than 10mm thick. There shall be no metal parts (not even nails, bolts, screws etc.) and the containers shall be provided with suitable non-conductive carrying device, such as rubber, leather or canvas handle or strap.
- h. Vehicles to be used for transportation explosives shall be in good working condition and shall have a tight wooded or non-sparking metal (copper, brass and the like) floor with sides and

ends high enough to prevent the explosives from falling off the vehicle. In open bodied vehicles, the explosives shall be covered with a waterproof and fibre tarpaulin.

- i. Electrical wiring in vehicle shall be fully insulated so as to prevent the danger of short-circuiting and at least two fire extinguishers of carbon dioxide type shall be carried. The vehicle shall be properly marked indicating adequate warning to the public in regard to the nature of cargo.
- j. No metals except approved metal truck shall be allowed to come in contact with cases of explosives, metal, flammable, or corrosive substance shall not be transported with explosives. As far as possible, transportation of any material along with explosives shall be prohibited.
- k. Smoking shall be prohibited in the vehicle carrying explosives.
- l. No unauthorized person shall be allowed in the vehicle, carrying explosives.
- m. Loading and unloading of explosives shall be done carefully.
- n. Explosives and detonators or blasting caps shall not be permitted to be transported in the same vehicle.
- o. Detonators and other explosives for blasting shall be transported to the site of work in the original containers or in securely locked separate non-metallic containers and shall not be carried loose or mixed with other materials.

10.3. STORAGE OF EXPLOSIVES AND BLASTING AGENTS

- a. Explosives and related materials shall be stored in approved facilities.
- b. Blasting caps, electric blasting caps, detonating primers, and primed cartridges shall not be stored in the same magazine with other explosives or blasting agents.
- c. Smoking and open flames shall not be permitted within 50 feet of explosives and detonators storage magazine.
- d. No Explosives or blasting agents shall be permanently stored in any underground area until the area has been developed to the point where at least two modes of exit have been provided.
- e. Permanent underground storage magazine shall be at least 300 feet from any shaft or other active under ground working area.
- f. Permanent underground magazines containing detonators shall not be located closer than 50 feet to any magazine containing other explosives or blasting agents.

10.4. DRILLING AND LOADING

- a. Before planning out the drilling operations for blasting purposes, nature of stratum and the over burden shall necessarily be examined to avoid possibilities of landslides after blasting.
- b. The face or rock shall be carefully examined before drilling to determine the presence of unfired explosives. No attempt shall be made to drill at a site if un-detonated explosives are suspected. In such case the boreholes shall be thoroughly cleaned before a cartridge is

inserted. Wooden tamping rods (not pointed, but cylindrical throughout) shall be used in the charging the holes. The cartridge will be on the top.

- c. The borehole shall be carefully checked for length, presence of water dust, etc. with a wooden temping pole or a measuring tape before loading.
- d. Surplus explosives shall not be stacked near working areas during loading/unloading.
- e. The line of detonating fuse extending into a borehole shall be cut from the spool before loading the remainder of the charge.
- f. A bore shall not be loaded with explosives after springing (enlarging the hole with explosives) or upon completion of drilling without making sure it is cool and it does not contain any hot smoldering material. Temperatures in excess of 65° C are dangerous.
- g. A bore near another hole loaded with explosives shall not be sprung.
- h. No force shall be used for inserting cartridges or any explosives into a bore hold or pass any obstruction in a borehole.
- i. No force shall be used for inserting a blasting cap or an electric blasting cap into explosive. The cap shall be inserted into a hole made with a pickers designed for the purpose. A hitch of the electric blasting cap leading wire shall be made on the primer cartridge so as to prevent pulling out the electric blasting cap from the explosive charge. In case of fuse, the fuse shall be tied to the explosive cartridge so that the blasting cap is not pulled out. Care shall be taken so that the blasting cap is not pulled out. Care shall be taken so that the electric blasting cap, leading wire or the length of the fuse does not get damaged during loading of the charge.
- j. No attempt shall be made to slit, drop, deform or abuse the primer.
- k. Blasting caps or electric blasting caps shall not be connected to detonating fuse except by methods recommended by the manufacturers of caps.
- l. Explosive cartridge shall not be cut, nor explosive removed from the cartridge for use.
- m. Metallic devices of any kind shall not be used in tamping. Wooden tamping tools with not exposed metal parts except non-sparking metal connectors for jointed poled shall be used. Violent tamping shall be avoided. Primer shall not be tamped.
- n. Care shall be taken to confine the explosives in the bore hold with sand, earth clay or other suitable combustible stemming material.
- o. Kinking or injuring of fuse or electric blasting cap wires shall be avoided when tamping.

10.5. ELECTRICAL SHOT-FIRING CIRCUIT

- a. In deciding the sizes of wires, fuses, circuits, blasting switches, etc., instructions issued by the manufacturers of these articles shall be followed, if they do not contradict with Indian Explosives Act or framed under it.
- b. No person shall attempt to uncoil the wires and open out the short-circuited bare leading wires of the electric blasting cap during approach of dust storm or near any source of large

charge of static electricity or near a radio transmitter. The manufacturer of the cap or the Inspectorate of Explosives shall be consulted regarding the distance from the transmitter beyond which electric short firing shall be conducted.

- c. Firing circuit shall be kept completely insulated from the ground of the other conductors, such as wires, rails, pipes or other paths or stray current.
- d. There shall not be any electric live wires or cables of any kind near electric blasting caps or other explosives except at the time and for the purpose of firing the blast.
- e. All electric blasting caps shall be tested singly and also when connected in a circuit in series using only an approved type of circuit continuity tester or ohmmeter.
- f. No attempt shall be made to use in the same circuit either electrical blasting caps made by more than one manufacturer or electric blasting caps of different design or function even if made by the same manufacturers unless such use is approved by the manufacturers.
- g. No attempt shall be made to fire a circuit of electric blasting caps with less than the minimum current specified by the manufacturer of that electric blasting cap.
- h. Care shall be taken to ensure that all wire ends to be connected are bright and clean.
- i. The electric cap wires or leading wires shall be kept short circuited until ready to fire.
- j. When energy for blasting is taken from power circuits the voltage shall not exceed 220v. The wiring controlling arrangements shall conform to the following:
- k. The blasting switch shall be strictly according to the specifications, externally operated double-throw switch, which when locked in the open position will short circuit and ground the leading wires. The switch shall be installed at the location where the firing is to be controlled.
- l. A 'safety' switch of the same type as the blasting switch shall be installed between the blasting switch and the firing circuit and lead lines, at a distance not to exceed 180cm from the blasting switch.
- m. Both the safety switch and the blasting switch shall be locked in the open position immediately after the shot and before any person is permitted to return to the blasting area. Key to the switches shall remain in the possession of the blaster at all times.
- n. Rubber covered or other adequately insulated copper wires in good condition shall be used for firing lines and shall have solid cores of appropriate gauge. Sufficient firing line shall be provided to permit the blaster to be located at a safe distance from the blast. Single conductor lead lines shall be used.
- o. Blasting operations in the proximity of overhead power lines, communication lines, utility lines, or other structures shall not be carried on until the operator or the owner, or both of such lines as been notified and precautionary measures deemed necessary, have been taken.
- p. All holes loaded on a shift shall be fired on the same shift.
- q. As far as possible, blasting shall be carried out using suitable exploder with 25 per cent excess capacity. Electric power from the mains shall be used only when it is absolutely necessary.

10.6. SHOT-FIRING WITH SAFETY FUSE

- a. The fuse shall be carefully handled to avoid damaging the covering. In very cold weather the fuse shall be slightly warmed before using so as to avoid cracking the waterproofing.
- b. Short fuse shall not be used. The length of a fuse shall not be less than 120cm. The rate of burning of the fuse shall be known and it would be necessary to make sure that it will take sufficient time in burning so as to enable all persons to reach a place of safety. The burning rate of the fuse shall not be more than 60 cm/min.
- c. The fuse shall not be cut until the operation to insert the fuse into a blasting cap is ready. The fuse shall be cut off about 2.5 to 5 cm to ensure a dry end. It shall be cut squarely across with a clean and sharp blade. The fuse shall be seated lightly against the cap charge and care shall be taken to avoid twisting after it has been placed in position.
- d. Blasting caps shall not be crimped by any means except by a cap crimper designed for the purpose. It shall be necessary to make sure that the cap is squarely crimped to the face.
- e. The fuse shall be lighted with a fuse lighter designed for the purpose. If a match is used, the fuse shall be slit at the end and the match head held in then slit against the power core and then the match head rubbed against an abrasive surface to light the fuse.
- f. The fuse shall not be lighted until sufficient stemming has been placed over the explosives to prevent sparks of live match heads from coming into contact with the explosives.
- g. The explosives shall not be held in hands when lighting the fuse.

10.7. UNDERGROUND WORK

- a. Only permissible explosives and in the manner as specified by the appropriate authority shall be used.
- b. Excessive quantities of explosives shall not be taken underground at any time. Black blasting powder or pellet powder shall not be used with any other explosive in the same borehole.

10.8. BEFORE AND AFTER FIRING

- a. Before firing, sufficient warning shall be given to enable the people working in the area to get off the danger zone. The danger zone shall be suitable cordoned off and flag men posted at important points.
- b. No loose materials, such as tools, drilling implements etc. Shall be left on the rock surfaces to be blasted.
- c. Blasting in the open shall be carried out during the fixed hours every day or on fixed days in the week. This information shall be amply publicized and the following precautions observed:
- d. On the project sites, where blasting operations are carried out, daily blasting hours shall be clearly printed on the sign-boards on all the roads approaching that area.
 - i. Road closing barriers should be provided to close the traffic on these roads, at least 400 meters away when the firing is to take place.

- ii. The beginning of the firing shall follow loud sirens and similarly loud sirens shall succeed the completion of the firing.
- e. The shot-firer shall not be allowed to return to the blasting site after firing, until at least 5 min have elapsed. In case of electric shot firing, the shot holes shall be examined after firing and in case of misfire no person shall be allowed to approach the blasting site for at least 5 min. In case of shot firing with safety fuse, utmost care shall be taken to count the number to ensure that all the shots have fired and in the event of misfire, no person shall be allowed to approach the blasting site for at least 30 min. In any case, a careful inspection for the remaining un-detonated explosive shall be made after firing the shots. All misfired shot holes shall be cross-marked. No other person than those duly authorized shall approach the holes until one of the following operations has been performed in respect of each of the misfired holes:
 - f. If the misfire is due to a faulty cable or faulty electrical connection the defect shall be remedied and the shot fired.
 - g. The stemming shall be floated out by use of water or air jet from hose until the hole has been opened to within 60 cm of the charge, whereupon water will be siphoned or pumped out, then a fresh new charge placed and duly detonated. Or
 - i. A careful search shall be made of unexploded material in the debris of the charge.
 - ii. If a shift charge is unavoidable, the person in-charge of one shift before leaving the work shall inform the person relieving him for the next shift of any cases misfired and shall point out their position duly cross marked and also state clearly what action has to be taken in the matter.

Note: The rules are made considering statutory provisions and other National/International standards. However, if any statutory provision overruling these laws is made, the statutory provisions shall overrule the NTPC Rules.

11.0 SAFETY IN EXCAVATION & TUNNELING WORK

SAFETY IN EXCAVATION

11.1 GENERAL PROVISIONS

- a. Before undertaking any activity, the soil shall be tested and in case of availability of any explosive gas, necessary arrangements must be made to remove/dilute such gases and in case they are found to be toxic or poisonous, the workplace must be purged and continuous ventilation maintaining the contamination below the permissible level ensured;
- b. The position of underground installations such as sewers, water pipes and electrical cables shall be verified and in case of their existence, they must be isolated;
- c. If they cannot be isolated or removed or shutdown, they shall be fenced, hung up or otherwise protected. On every part likely to be visited by persons or where transport vehicles ply, the area shall be suitably fenced, guarded or barricaded to prevent fall of persons, vehicles or livestock into the excavated area;
- d. Warning signs shall be erected and the in the night hours the area shall be illuminated to warn pedestrians and vehicular traffic;
- e. Arrangements shall be made to prevent external vibrations due to rail/road traffic;
- f. Blasting shall be carried out in accordance with the norms applicable in this regard. Special care shall be taken to control the impact of vibrations/tremor caused by blasting to protect excavations from cave-ins;
- g. Arrangements shall be made to save other buildings/structures in the affected zone or in the vicinity of the area of excavation, from collapse;

11.2 SHORING AND TIMBERING

- a. Site of excavations, where workers are exposed to danger from moving ground, shall be made safe by maintaining due slope not exceeding the angle of repose of different types of soil or otherwise by shoring, portable shields or other effective means;
- b. All trenches in the soil, other than rock or hard compact soil more than 1.5 m deep into which men enter, shall be securely shored and timbered under the supervision of a competent person and only the trained workers shall be allowed to substantially alter or dismantle the shoring or timbering;
- c. All struts, braces and walls in excavation shall be adequately secured so as to prevent their accidental displacement;
- d. In all excavations in soft or fissured rock or hard soil exceeding 2 m in depth, except those which are sloped to within 1.5 m of the bottom into which men enter, shall be securely shored and timbered;
- e. Where the sides of the excavations are sloped as outlined above, but not within the 1.5 m of the bottom, vertical sides shall be shored and the shoring shall extend at least 30 cm above the vertical sides. When open spaced sheathing is used, a toe-board shall be provided to prevent material rolling down the slope and falling into the excavated.

11.3. SHEATHING

- a. The sheathing should be placed against the side of the trench so that length of each piece of sheathing is vertical. It should be held securely in place against the wales by ensuring that sheathing is kept firmly pressed against the wall of the trench. Where the trench excavated is loose, sandy or soft soil or soil which has been previously excavated or soil which is under hydrostatic pressure, each piece of sheathing shall be driven into the bottom of the trench so as to firmly hold it in place;
- b. Where two or more pieces of sheathing are used one above another, the sheathing shall be so arranged that the lower pieces of sheathing shall overlap the lowest wales supporting the piece of sheathing next above it. These pieces of sheathing shall be firmly driven into the soil and securely supported by wales and struts, as the trench is made deeper.

11.4. WALES

- a. The wales shall be parallel to the bottom or the proposed bottom of the trench. Each wale shall be supported on cleats spiked to the sheathing or by posts set on the wales next below it and in the case of the lowest wale on the bottom of the trench itself. Where necessary, wedges may be provided between a wale and the sheathing it supports so that roughly uniformity is given to all individual pieces of sheathing.

11.5. STRUTS

- a. Struts shall be horizontal and at right angles to the wales or sheathing supported thereby. Struts shall be cut to the proper length required to fit in tightly between the wales. Where necessary, the struts shall be held securely in place by wedges, driven between the struts and the wales;
- b. Struts shall be placed on cleats spiked or bolted to the posts supporting the Wales.

11.6. LOOSE SITE MATERIALS:

No loose material shall be kept very close to the excavation creating possibility of its fall into the excavated area. A safe distance of at least 1 m shall be maintained.

11.7. PLANT & MACHINERY:

Movement of vehicles and heavy equipment shall be kept at a distance least equal to the depth of the excavation or at least 6 m for excavation deeper than 6 m and the workers shall be provided with proper tools.

11.8. MEANS OF ACCESS

- a. For trenches deeper than 1.5 m, safe means of access and egress shall be provided at intervals of every 15 m. Where it is not possible to provide safe means of access and egress as above, ladders shall extend from the bottom of the trench to at least 90 cm above the ground;
- b. Walkways, runways and sidewalks shall be kept clear of excavated materials or other obstructions and no side walls shall be undermined-undercut unless it is capable of carrying a minimum live load of 125 lbs per square feet;

- c. If planks are used for raising walkways, runways or sidewalks, they should be parallel to the length of the walk and fastened together against displacement;
- d. Lone worker shall not be allowed to work in the excavated area.

11.9. INSPECTIONS:

A competent person shall make inspections every day and necessary measures shall be taken to safeguard against possible cave-ins or slide or collapse of the excavations.

11.10. NOTIFICATION OF INTENTION TO CARRY OUT EXCAVATION AND TUNNELING WORK

- a. Within thirty days, prior to the commencement of such excavation or tunneling work, the contractor shall inform in writing the detailed layout plans, method of construction and schedule of such excavation or tunneling work to the Engineer in-charge of NTPC;
- b. In case compressed air is used in such excavation or tunneling work or any work incidental to or required for such excavation or tunneling work, the technical details and drawings of all man-locks and medical-locks together with names and addresses of all construction medical officers duly qualified and so appointed by such contractor for the purpose of such excavation or tunneling work shall be sent to the Engineer in-charge.

11.11. PROJECT ENGINEER

- a. The contractor undertaking any excavation or tunneling work shall appoint a Project Engineer for safe operation of such projects;
- b. Such Project Engineer shall exercise overall control of the operations and the activities at such project and be responsible for carrying out the activities safely.

11.12. RESPONSIBLE PERSON

- a. The contractor undertaking excavation or tunneling work at construction site of a building or other construction work shall appoint a responsible person for safe operation of such excavation or tunneling work;
- b. The name and addresses of such responsible persons shall be forwarded to the Engineer in-charge;
- c. Duties and responsibilities of the responsible person referred to above person shall include
 - i. To carry out smoothly such excavation or tunneling work;
 - ii. To inspect and rectify any hazardous situation relating to such excavation or tunneling work;
 - iii. To take remedial measures to avoid any unsafe practice or conditions relating to such excavation or tunneling work.

11.13. WARNING SIGNS AND NOTICES

- a. Suitable warning signs or notices, required for the safety of building workers carrying out the work of an excavation or tunneling, shall be displayed or erected at conspicuous places in Hindi

and in language understood by the majority of such building workers at such excavation or tunneling work;

- b. Such warning signs and notices with regard to compressed air working shall include:
 - i) The danger involved in such compressed air work;
 - ii) Fire and explosion hazards;
 - iii) The emergency procedures for rescue from such danger or hazards.

11.14. REGISTER OF EMPLOYMENT

- a. The contractor shall ensure that at a construction site of a building or other construction work where an excavation or tunneling work is being carried on, a register of employment of building workers carrying out such excavation or tunneling work is maintained and produced on demand;
- b. Periods of work of such excavation or tunneling work shall be maintained in a register on day-to-day basis and such register shall be produced on demand

11.15. ILLUMINATION

- a. All contractors carrying out excavation or tunneling work at a construction site of a building or other construction work shall provide for emergency generators on such construction site to ensure adequate illumination at all work places where such excavation or tunneling work is being carried out;
- b. In case of power failure, all workplaces where excavation or tunneling works are carried out shall be adequately illuminated

11.16. PNEUMATIC TOOLS:

Supply lines to pneumatic tools used within a tunnel are fitted with water trap or safety chain or safety wire, as the case may be.

11.17. STABILITY OF STRUCTURE DURING GENERAL EXCAVATION & TUNNELING:

The contractor shall ensure that where there is any doubt as to the stability of any structure adjoining the workplace or other areas to be excavated or where tunneling work is to be carried out –

- a. The Project Engineer shall arrange for measures like underpinning, sheet piling, shoring, bracing or other similar means to support such structure and to prevent injury to any building worker working adjacent to such structure or damage to property or equipment adjacent to such structure;
- b. Where any building worker engaged in excavation is exposed to hazard of falling or sliding material or article from any bank or side of such excavation which is more than 1.5 m above his footing, such worker shall be protected by adequate piling and bracing against such bank or side;

- c. The excavation and its vicinity shall be checked by a responsible person after every rain, storm or other occurrences carrying hazards and in case a hazard is noticed at such checking, adequate protection against slides and cave-in to prevent such hazard shall be provided;
- d. Temporary sheet piling installed for the construction of a retaining wall after excavation shall not be removed, except on the advice of the responsible person after an inspection carried out by such responsible person;
- e. Where banks of an excavation are undercut, adequate shoring shall be provided to support the material or article overhanging such bank;
- f. Excavated material shall not be stored at least 0.5 m from the edge of an open excavation or trench and the banks of such excavation or trench shall be stripped of loose rocks and other materials which may slide, roll or fall upon a building worker working below such bank;
- g. Adequate and suitable warning signs shall be put-up at conspicuous places at the excavation work to avoid any person falling into the excavations or trenches;
- h. The responsible person shall ensure at the excavation that no building worker is permitted to work where such building worker may be struck or endangered by the excavation machinery or material or article used in such excavation.

11.18. SAFE ACCESS AND EGRESS:

Ladders, staircases or ramps are provided, as the case may be, for safe access to and egress from excavation where the depth of such excavation exceeds one point 1.5 m and such ladders, staircases or ramps comply with the relevant national standards.

11.19. TRENCHES

- a. A trench or excavation shall be protected against falling of a person by suitable measures if the depth of such trench or excavation exceeds 1.5 m and such protection shall be an improved protection in accordance with the design and drawing of a Professional Engineer, where such depth exceeds 4 m;
- b. Where the depth of a trench requires two lengths of sheet piling, one above the other, the lower piling shall be set inside the bottom strings or wales of the upper piling and such sheet piling shall be driven down and braced as the excavation continues;
- c. All metal sheet piles used in excavation or a trench shall be welded end-to-end and secured by other similar means.

11.20. POSITIONING AND USE OF MACHINERY:

Any machinery used in excavation and tunneling work shall be positioned and operated in such a way that such machinery will not endanger the operator of such machinery or any other person in the vicinity.

11.21. BREATHING APPARATUS:

Suitable breathing apparatus shall be provided to a building worker while working in compressed air environment for his use at excavation or tunneling work and such breathing apparatus shall be maintained in good working condition at all times.

11.22. SAFETY MEASURES FOR TUNNELING OPERATIONS

- a. Where there is a danger of falling or sliding of material from the roof face or wall of a tunnel, adequate measures such as shoring, supporting by means of rock bolts, segments or steel sets shall be taken for the safety of building workers;
- b. The excavated areas shall be made safe by use of suitably designed and installed steel sets, rock bolts or similar other safe means;
- c. The responsible person shall examine and inspect the workplaces in a tunnel before the commencement of work in such tunnel and at regular intervals thereafter to ensure safety of the building workers in such tunnel;
- d. The portal areas of a tunnel with loose soil or rock, likely to cause injury to a person shall be adequately protected with supports.

11.23. SURROUNDINGS OF A SHAFT

- a. Surroundings of a shaft used in excavation or tunnel work shall be protected from being washed away by construction of sufficient height;
- b. Where a building worker is required to enter a shaft at an excavation or tunneling work, safe means of access shall be provided for such entry;
- c. Every shaft at excavation or tunneling work shall be provided with a steel casing, concrete piping, timber shoring or other materials of adequate strength for the safety of building workers working in such shaft;
- d. Such casing and bracing shall be provided to shafts at an excavation or tunneling work according to the appropriate design for such casing and bracing;
- e. A reinforced concrete raft and beam shall be provided around the opening of a shaft at an excavation or tunneling work if the ground surrounding such opening is unstable or unsafe.

11.24. LIFT FOR SHAFT:

Lift shall be provided for transport of building workers and materials or articles at an excavation or tunneling work required to descend more than 50 m in a shaft.

11.25. MEANS OF COMMUNICATION

Reliable and effective means of communication such as telephone or walkie-talkie shall be provided and maintained in working order for arranging better and effective communication at an excavation or tunneling work at the following locations, namely:

- i. Working chamber of an excavation;
- ii. Intervals of hundred meters along the tunnel;
- iii. Working chamber side of a man lock near the door of such man lock;
- iv. Interior or each chamber of a man lock;
- v. Location conspicuous lock attendant's situation;
- vi. A compressor plant;

- vii. A first-aid station, and
- viii. Outside the portal or the top of a shaft;
- ix. Such number of bells and whistles shall be made available at all times at the locations as are necessary for the safety of persons at such locations.

11.26. SIGNALS:

The standard audio or video signals shall be used in excavation or tunneling work and conspicuously located or displayed near entrance to the workplace and in such other locations as may be necessary to bring such signals to notice of all building workers employed in such excavation or tunneling work.

11.27. CLEARANCES

- a. The minimum lateral clearances of 0.5 m shall be maintained between any part of a vehicle and any fixture or any equipment used in an excavation or tunneling work after allowing the throw or swing of such fixture or equipment;
- b. The overhead clearance for a locomotive drive at excavation or tunneling work shall not be less than 1.20 m above the seat of such driver and not less than 2 m above the platform where such driver stands or of any other dimension in accordance with the approved standard.

11.28. SHELTERS:

The adequate number of shelters for the safeguard of the building workers are provided where, in the course of working, they are liable to be struck by a moving vehicle or other material handling equipment in a tunnel.

11.29. USE OF INTERNAL COMBUSTION ENGINE:

No internal combustion engine shall be used underground in excavation or tunneling work unless such engine is so constructed that the air entering the engine gets cleared before entry and the engine emits no fumes or sparks.

11.30. INFLAMMABLE OILS:

Inflammable oils with the flash point below the working temperature that is likely to be encountered in a tunnel shall not be used in excavation or tunneling work.

11.31. COUPLING AND HOSES:

All high-pressure hydraulic hoses and couplings shall be adequately protected against any possible damage in excavation or tunneling work.

11.32. HOSE INSTALLATION:

All hydraulic lines and plants working at a temperature exceeding 750 c shall be protected by adequate insulation or otherwise against accidental human contact in excavation or tunneling work.

11.33. FIRE RESISTANT HOSES:

No fire hydraulic hoses other than fire resistant hydraulic hoses are used when hydraulically activated machinery and equipment are employed in tunnels.

11.34. FLAMEPROOF EQUIPMENT:

Only flameproof equipment of appropriate type as per approved standards shall be used where there is a danger of flammable or explosive atmosphere being prevalent inside the tunnel.

11.35. STORING OF OIL AND FUEL UNDERGROUND:

All oils, greases or fuels stored underground in excavation or tunneling work shall be kept in tightly sealed containers and in fire resistant areas at safe distances away from explosive and other flammable chemical and appropriate flameproof installation shall be used in such storage areas.

11.36. USE OF GASES UNDERGROUND

- a. Petrol or liquefied petroleum gas or any other flammable substances shall not be used or stored inside the tunnel except with the prior approval of the Project Engineer;
- b. After the use of the petroleum or liquefied petroleum gas, or highly inflammable substances, all remaining petroleum or liquefied petroleum gas or highly inflammable substances shall be removed immediately from such tunnel;
- c. No oxy-acetylene gas shall be used in a compressed air environment in excavation or tunneling work.

11.37. WATER FOR FIRE FIGHTING

- a. Adequate number of water outlets shall be provided on excavation or tunneling work and readily made accessible throughout the tunnel for fire fighting purposes and such water outlets shall be maintained for effective fire fighting;
- b. All air locks shall be equipped with fire fighting facilities at excavation or tunneling work;
- c. An audible fire alarm shall be provided to warn the building workers whenever a fire breaks out on an excavation or tunneling work;
- d. Adequate number and types of fire extinguishers, in accordance with relevant national standards, shall be provided and made readily available to fight any outbreak of fire at an excavation or tunneling work;
- e. Fire extinguishers with vaporizing liquids and high pressure carbon dioxide shall not be used in tunnels or other confined spaces;
- f. The instructions regarding steps to be followed to fight outbreak of fire, at an excavation or tunneling work, written in Hindi or local language understood by the majority of the building workers employed on such excavation or tunneling work, shall be displayed at conspicuous and vulnerable places of such excavation or tunneling work.

11.38. FLOODING

- a. Water tight bulkhead doors shall be installed at the entrance of a tunnel to prevent flooding during a tunneling work where more than one tunnel is driven from a shaft;
- b. All necessary measures shall be taken to ensure that no building worker is trapped in any isolated section of a tunnel when any bulkhead door of such tunnel is closed;
- c. Where there is likelihood of flooding or water rushing into a tunnel during a tunneling work, arrangements shall be made for immediate starting of water pumps to take out water of such flooding or water rushing and for giving alert signals to the building workers and other persons to keep them away from danger.
- d. Airtight steel curtains shall be provided in areas liable to flooding at tunneling work and in case of descending tunnels, such curtains shall be provided in the top half of such tunnels to ensure the retention of pockets of air for rescue purpose.

11.39. REST SHELTERS

- a. Where building workers employed in a compressed air environment in a tunneling work are required to remain at the work site for one hour or more after de-compression from pressure exceeding one bar, adequate and suitable facilities shall be provided for such building workers to rest;
 - a. Every man-lock, medical-lock and any other facility inside these locks in a tunneling work shall be maintained in a clean state and in good repairs;
 - b. A first-aid room shall be provided and readily available at a construction site of a tunneling work;
 - c. Each man-lock attendant at the station shall be provided with a first-aid box.

11.40. PERMISSIBLE LIMIT OF EXPOSURE OF CHEMICALS

- a. The working environment in a tunnel or a shaft in which building workers are employed shall not contain any of the hazardous substances in concentrations beyond the permissible limits;
- b. The responsible person referred to shall conduct necessary test before the commencement of a tunneling work for the day and at suitable intervals as fixed by the Engineer in-charge, to ensure that the permissible limits of exposure are not exceeded and a record of such test shall be maintained and made available for inspection.

11.41. VENTILATION:

All working areas in a free air tunnel shall be provided with the approved ventilation system and the fresh air supplied in such tunnel shall not be less than 6 m³ per minute for each building worker employed underground in such tunnel and the free air-flow movement inside such tunnel not less than 9 m³ per minute.

11.42. AIR SUPPLY INTAKE POINT:

The air intake points for all air compression shall be located at places where such intake air does not get contaminated with dust, fumes, vapor and exhaust gases or other contaminants.

11.43. EMERGENCY GENERATORS

- a. Every compressed air system in a tunnel shall be provided with emergency power supply system for maintaining continued supply of compressed air in such compressed air system, which shall be capable of operating air compressor and ancillary systems of such compressed air system;
- b. The emergency power supply system shall be maintained and made readily available at all times.

11.45. AIR MAINS:

Every air-main supplying air to the working chamber, man-lock or medical-lock used at an excavation or tunneling work shall be protected against accidental damage and where it is not practicable to provide such protection, a stand-by air-main shall be provided.

11.46. BULKHEAD AND AIR LOCKS

- a. A bulk head or air tight diaphragms retaining compressed air, when used within a tunnel or a shaft, shall be constructed to withstand the maximum pressure at 1.25 the maximum working pressure of such bulk head or diaphragm and such bulk head or diaphragm shall be tested before its each use by a responsible person to ensure that such bulk head or diaphragm is in proper working order;
- b. Such responsible person shall keep the record of each test and such record shall be produced for inspection.
- c. The bulk head or diaphragm shall be made of sound material of adequate strength, which shall be able to withstand the maximum pressure on which they are subjected to at any time of their use;
- d. A bulkhead anchorage and air lock shall be tested at its work place at an excavation or tunneling work immediately after their installation at such place.

11.47. DIAPHRAGM:

All diaphragms, which are in the form of horizontal decks across a shaft used at excavation or tunneling work, shall be securely anchored

11.48. PORTABLE ELECTRICAL HAND TOOLS:

All portable electrical hand tools and inspection lamps used underground or in a confined space shall be operated at a voltage not exceeding 24 V.

11.49. CIRCUIT BREAKER

- a. Adequate numbers of differential ground fault circuit breakers shall be installed for every electrical distribution system and its sub-systems used at an excavation or tunneling;
- b. Work and the sensitivity of each of circuit breaker shall be adjusted in accordance with the requirement set out in accordance with the approved standards;
- c. No semi-enclosed fuse unit shall be used in underground place.

11.50. TRANSFORMER:

The contractor shall ensure no transformer is used in any section of a tunnel under compressed air unless such transformer is of the dry type and conforms to the approved standards.

11.51. LIVE WIRES:

There shall be no exposed live wire in working areas at an excavation or tunneling work which are accessible to building workers other than those authorized to work on such live lines.

11.52. WELDING SETS:

All welding sets used in a tunnel shall be of adequate capacity and of suitable type, duly approved.

11.53. QUALITY AND QUANTITY

- a. Every working chamber at an excavation or tunneling work where compressed air is used, the supply of such air shall be maintained at not less than 0.3 m³ per minute per person working therein;
- b. A reserve supply of compressed air shall be made available at all times for man-locks and medical locks used at a tunneling work;
- c. The air supplied in a compressed air environment at a tunneling work shall be, as far as practicable, free from contaminants, namely, dust, fumes and other toxic substances.

11.54. WORKING TEMPERATURE:

The temperature in any working chamber at an excavation or tunneling work where building workers are employed shall not exceed 29⁰ c and the arrangement shall be maintained for kipping records in which the temperatures measured by dry bulb and wet bulb inside such working chamber once in every hour and for producing such records for inspection on demand.

11.55. MAN-LOCKS AND WORKING IN COMPRESSED AIR ENVIRONMENT

- a. Man-locks used at a tunneling work shall be of adequate strength, made of sound material and designed to withstand any pressure, internal or external, to which it may be subjected in the normal use or in an emergency;
- b. Doors of man-locks at an excavation or tunneling work shall be made of steel and used at a tunneling work for keeping the work airtight and devices shall be provided for sealing the doors when such locks are under pressure. The anchorage of a man-lock used at tunneling work shall have adequate strength to withstand the pressure exerted by air on the man-lock. There shall be adequate room available for the workers for working in the man-locks;
- c. Where work is carried out in any compressed air tunnel, a Man-lock in accordance with the approved standards shall be used;
- d. Where a man-lock is used, safety Instructions in Hindi and in local language understood by majority of building workers employed there, shall be displayed at conspicuous places;
- e. Except in an emergency, compression and de-compression operations shall be carried out in a man-lock and in an emergency any material-lock may be used;
- f. A record of compression and de-compression shall be kept in writing and produced for inspection on demand;
- g. Material lock shall be used with the permission of the Engineer in-charge where it is impracticable to install both the man-lock and the material-lock at;
- h. The man-lock at tunneling work shall not be used for any purpose

- i. other than compression or de-compression of building workers;
- j. No de-canting of building workers at tunneling work shall be carried
- k. out without prior approval of the Engineer in-charge except in an emergency;
- l. In case a building worker collapses or is taken ill during his de-compression in a man-lock, the lock attendant of such man-lock shall raise the pressure to a level equal to the maximum pressure which that building worker was exposed to in the working chamber prior to such de-compression and such lock attendant shall immediately report the matter relating to such collapse to the medical lock attendant and medical officer on duty;
- m. A building worker who had previously received training with a trained building worker to work in a compressed air environment at tunneling work shall be employed to work independently in such a compressed air environment;
- n. A building worker who had undergone three de-compressions from a pressure exceeding one bar in a period of eight hours at tunneling work shall not be allowed to enter a compressed air environment except for the purpose of carrying out rescue work;
- o. A building worker employed in a compressed air environment for a period of eight hours in a day at tunneling work shall not be employed again in such environment unless he has spent not less than twelve consecutive hours of rest at atmospheric pressure;
- p. No building worker shall be engaged in a compressed air environment at a pressure, which exceeds three bars at a tunneling work unless prior permission, in writing, has been obtained from the Engineer in-charge;
- q. No building worker shall be employed in a compressed air environment for more than fourteen consecutive days in a month;
- r. A register of employment of all building workers in compressed air environment shall be maintained;
- s. An identification badge shall be supplied to a building worker employed in compressed air environment;
- t. The badge of a building worker shall contain particulars of his name, location of the medical-lock allotted to him for work, the telephone number of the Construction Medical Officer concerned for his treatment and the instructions in case of his illness of unknown and doubtful causes;
- u. Record of all identification badges supplied to building shall be kept in a register;
- v. Every building worker whose name appears in the register shall wear the badge supplied to him at all times during his duty hours;
- w. Suitable warning signs shall be displayed in the compressed air for the prohibition of the following, namely:
 - i) Use of alcoholic drinks;
 - ii) Use and carrying of lighters, matches or other sources of ignition;
 - iii) Smoking; and

iv) No entry to person who has consumed alcoholic drink

11.56.SAFETY INSTRUCTION:

All building workers employed in compressed air environment at tunneling work shall follow the instructions issued for their safety in the course of such employment.

11.57.MEDICAL-LOCK

- a. A suitably constructed medical lock shall be maintained at tunneling work where building workers are employed in a working chamber at a pressure exceeding one bar;
- b. Where more than one hundred building workers are employed in a compressed air working environment exceeding one bar at tunneling work, one medical-lock is provided for every one hundred building workers or part thereof and such medical lock shall be situated as near as possible to the main-lock used at such tunneling work.

12.0. SAFETY IN PILING WORK

12.1. GENERAL PROVISIONS

- a. All pile driving equipment shall be of good design and sound construction, taking into account the ergonomic principles and properly maintained;
- b. A pile driver shall be firmly supported on a heavy timber sill, concrete bed or other secured foundation;
- c. In case a pile driver is required to be erected in dangerous proximity to an electrical conductor, all necessary precautions shall be taken to ensure safety;
- d. The hoses of steam and air hammer shall be securely lashed to such hammer so as to prevent them from whipping in case of connection or break;
- e. Adequate precaution shall be taken to prevent the pile driver from over turning and hammer from missing the pile;
- f. A responsible person for inspecting pile-driving equipment shall inspect such equipment before taking it into use and takes all appropriate measures as required for the safety of building workers before commencing piling work by such equipment;
- g. Where there is any question of stability of a structure for its adjoining areas to be piled, such structure shall be supported, where necessary, by underpinning, sheet piling, shoring, and bracing or by other means to ensure safety and stability of such structure and to prevent injury to any person.

12.2. PROTECTION OF OPERATOR:

The operator of every pile driving equipment shall be protected from falling objects, steam, cinders or water by substantially covering or otherwise or by other means.

12.3. INSTRUCTION TO AND SUPERVISION OF BUILDING WORKERS WORKING ON PILE-DRIVING EQUIPMENT:

Every building worker working on a pile driving equipment shall be given instructions regarding safe work procedure to be followed in piling operation and shall be supervised by a responsible person throughout such work.

12.4. ENTRY OF UNAUTHORIZED PERSON:

The contractor shall ensure at a construction site of a buildings or other construction work that all piling areas where pile-driving equipment is in use are effectively cordoned off to prevent entry of unauthorized persons.

12.5. INSPECTION AND MAINTENANCE OF PILE DRIVING EQUIPMENT

- a. Pile-driving equipment shall not be taken into use until it has been inspected by a responsible person and found to be safe for such use;
- b. A responsible person for such inspection at suitable intervals to ensure safety to the building worker working on such equipment shall inspect pile driving equipment in use;

- c. All pile lines and pulley blocks shall be inspected by a responsible person before the beginning of each shift of piling operations.

12.6. OPERATION OF PILE-DRIVING EQUIPMENT

- a. Only experienced and trained building worker shall operate pile driving so as to avoid any probable danger from such operation;
- b. Pile-driving operations shall be governed generally prevalent and accepted signals so as to prevent any probable danger from such operations;
- c. Every building worker employed in pile driving operation or in the vicinity of such pile driving operation shall wear ear protection and safety helmet or hardhat and safety shoes;
- d. Piles shall be prepared at a distance, at least equal to twice the length of the longest pile, from the place of pile-driving operations;
- e. When a pile driver is not in use, the hammer of such pile driver shall be blocked at the bottom of the heads of such pile driver.

12.7. WORKING PLATFORM ON PILING FRAMES:

Where a structural tower supports the lead of a pile driver, leads at which it is necessary for the building workers to work and such platforms except on the hammer of such pile driver or lead sides of such platform and where such platforms cannot be provided with such railing and toe boards, a safety belt shall be provided to each such building worker.

12.8. PILE TESTING

- a. The testing of pile shall be conducted under the supervision of a responsible person for such testing;
- b. All practicable measures like displaying of warning notices, barricading the area and other similar measures shall be taken to protect the area where the pile testing is carried out;
- c. Entry to a pile testing area shall be prohibited to general public to ensure safety.

12.9. PILING, SHORING AND BRACING

- a. Planks used for sheet piling in excavation or tunneling work shall be of sound material with adequate strength;
- b. Shores and braces used in excavation or tunneling work shall be of adequate dimensions and so placed as to be effective for their intended purposes;
- c. Earth supported shores or braces used in excavation or tunneling work shall bear against a footing of sufficient area and stability to prevent the shifting of such shores or braces.

13.0. SAFETY IN THE ERECTION, USE AND DISMANTLING OF SCAFFOLDS

13.1. SCAFFOLD CONSTRUCTION

- a. Every scaffold and every component thereof shall be of adequate construction, made of sound material and free from defects and safe for the purposes for which it is intended for use;
- b. In case bamboo is used for scaffolding, such bamboo shall be of suitable quality, good condition, free from protruding knots and stripped off to avoid any injury to building workers during handling such bamboo;
- c. All metal scaffolds used in building or other construction work shall conform to the approved standards;

13.2. SUPERVISION BY A RESPONSIBLE PERSON: No scaffold shall be erected, added, altered or dismantled except under the supervision of a responsible person.

13.3. Maintenance

- a. The scaffold used in building or other construction work shall be maintained in good repairs and the measures taken against its accidental displacement or any other hazard;
- b. No scaffold or part thereof shall be partly dismantled and allowed to remain in such a condition unless –
 - i) The stability or safety of the remaining portion of such scaffold has been ensured by a responsible person for the safety of such scaffolds;
 - ii) In case the remaining part of such scaffold cannot be used by the building workers, necessary warning notice written in Hindi and in a language understood by the majority of the building workers that such scaffold is unfit for use, shall be displayed at the place where such scaffold is erected.

13.4. STANDARDS, LEDGERS, PUTLOGS

- a. Standards of a scaffold shall be plumb, where practicable, fixed sufficiently close together to secure the stability of such scaffold having regard to all the possible working situations and conditions for the intended use of such scaffold, spaced, as close as practicable, to ensure safety and stability of such scaffold;
- b. Adequate measures are taken to, prevent displacement of a standard of a scaffold either by providing sole plate or a base plate, as necessary;
- c. Ledgers of metal scaffold are placed at vertical intervals with due regard to safety and stability of such scaffold;
- d. Bamboo ledgers are kept as nearly as possible and are placed and fastened to the standards of a scaffold with due regard to the stability of such scaffold.

13.5. WORKING PLATFORM

- a. Working platform shall be provided around the face or edge of a building adjoining at every upper most permanent floor of such building under construction and at any level where construction work of such building is carried out;
- b. A platform shall be designed to suit the number of building workers to be employed on each bay of a scaffold work on such platform and the materials or articles and tools to be carried with them in such bay;
- c. The safe working load and the number of building workers to be employed in each bay of a scaffold shall be displayed for the information of all the building workers employed at such construction site.

13.6. BOARD, PLANK AND DECKING

- a. Board, plank and decking used in the construction of a working platform shall be of uniform size and strength and shall be capable of supporting the load and number of building workers keeping in view the safety of such building workers;
- b. Metal decking, which forms part of a working platform, shall be provided with non-skid surface;
- c. No board or plank which forms the working platform shall be projected beyond its end support unless it is effectively prevented from tripping or lifting and board, plank or decking shall be fastened and secured;
- d. At any one time, not more than two working platforms per bay, shall be used to support building workers or materials or articles at such bay;
- e. Adequate measures shall be taken to prevent injury which may be caused by falling material and objects by using safety nets or other suitable means;
- f. Concrete, other debris or materials shall not be allowed to accumulate at any platform on a scaffold;
- g. Where a work is to be done at the end of a wall, working platform at such workplace shall be faced or, wherever practicable, at least 0.6 m beyond the end of such wall.

13.7. REPAIR OF DAMAGED SCAFFOLD

- a. No building worker shall be permitted to work on a scaffold that has been damaged or weakened unless adequate safety measures have been taken to ensure the safety of such building worker;
- b. Necessary warning signs shall be displayed at such places where repairs of scaffold are undertaken.

13.8. OPENING

- a. There shall be no opening in any working platform except for allowing access to such working platform;
- b. Wherever opening on a platform is unavoidable, necessary measures for protection against falling of objects or building workers from such platform shall be taken by providing suitable safety nets, belts or any other similar means;
- c. Access from one working platform to another platform on a scaffold, if required, shall be provided with suitable and safe ladder for the use of building workers working on such platforms;

- d. Every opening or shaft in the floor shall be provided with suitable means to protect the fall of a person or material by providing suitable fencing or railing of height not less than 900 mm.

13.9. GUARDRAILS: Every side of a working platform from which a person is liable to fall shall be provided with suitable and safe guardrails and toe board of adequate strength to prevent fall of any building worker, material or tools from such platform.

13.10. SCAFFOLD USED BY BUILDING WORKERS OF DIFFERENT EMPLOYERS

- a. Where a scaffold or a part of a scaffold is used, which has previously been used by another employer for his building workers, such scaffold or part thereof shall be used only after its inspection and examination by a responsible person for ensuring that such scaffold or part thereof is safe and fit for such use;
- b. If any rectification, alteration or modification in a scaffold or part thereof, needed to suit its use, shall be made in consultation with the responsible person.

13.11. PROTECTION AGAINST ELECTRIC POWER LINE:

The contractor shall ensure that all necessary and practical measures for protection are taken to prevent any building worker, working on a scaffold, from coming into contact with the electric wires or dangerous equipment.

13.12. SCREENING NET AND WIRE NETS:

Where a scaffold is erected in an area where the construction activities may pose hazards to pedestrians or vehicular traffic nearby from the falling of objects, wire nets or screening nets shall be used to envelope such scaffold.

13.13. TOWER SCAFFOLD

- a. The height of every tower scaffold used in building or other construction work shall not be more than eight times the lesser to the base dimension of such scaffold;
- b. A tower scaffold shall be lashed to a building or a fixed structure before being used by the building workers;
- c. Any tower scaffold which can be moved or castered shall be –
 - i) Constructed with due regard to the stability and, if necessary, adequately weighted at the base;
 - ii) Used only on plain and even surface; and
 - iii) Has casters provided with positive locking devices to hold such scaffold in position;
- d. No building worker shall remain on board scaffold or leave behind tools and material when it is being shifted from one position to another position.

13.14. GEAR FOR SUSPENSION OF SCAFFOLD

- a. Chains, ropes or lifting gears used for suspension of a scaffold shall be of adequate strength, made of sound material and suitable for the purpose of their use and maintained in good repairs;
- b. Chains, wires, ropes or metal tubes used for the suspension of a scaffold shall be:

- i) Properly and securely fastened to every anchorage point and to the scaffold ledgers of other main supporting members used for the support of such scaffold; and
- ii) So positioned as to ensure stability of the scaffold.

13.15. TRESTLE SCAFFOLD AND CANTILEVER SCAFFOLD

- a. No trestle scaffold shall be constructed with more than three tiers or if its working platform is more than 4.5 m above the ground or floor or other surface upon which such scaffold is erected;
- b. Trestle scaffold shall be designed by professional engineer and shall have the approval of the Engineer in-charge before being taken into use.
- c. No trestle scaffold shall be erected on a suspended scaffold;
- d. No cantilever or jib scaffold shall be used unless it is adequately supported, fixed and anchored on opposite side of its support and have out triggers of adequate length and, where necessary sufficiently, supported and braced to ensure safety and stability of such scaffold;
- e. No working platform resting on bearers let into a wall at one end and without other support shall be used unless such bearers are of adequate strength, braced through the wall and securely fastened on the other side.

13.16. SCAFFOLD SUPPORTED BY BUILDING

- a. No part of a building shall be used as support or part of a scaffold unless such part of the building is made of sufficient strength and made of sound material to afford safe support;
- b. Overhanging eaves gutters shall not be used for supporting scaffold;
- c. Suspended scaffold shall be made of in accordance with the approved standards before being used by the building workers.

13.17. USE OF WINCHES AND CLIMBERS FOR SUSPENDED SCAFFOLD

- a. No scaffold shall be raised or lowered by winches or climbers unless such scaffold is made of sound material, adequate strength and has been tested and certified safe for use of winches or climber by a competent person before being taken into use;
- b. All suspended scaffolds counter-balanced by counter weights shall be of approved types before being taken into use for building or other construction work;
- c. The working platform of a suspended scaffold shall be securely fastened to the building or structure as to be safe and to prevent such platform from swing;
- d. The safe working load that a suspended scaffold can carry, shall be displayed where such scaffold is being used

13.18. SAFETY DEVICES FOR SUSPENDED SCAFFOLD

- a. Every suspended scaffold, raised or lowered by the winches or climbers, shall be provided at each of its suspension point with a safety rope with automatic safety device mounted on each of such rope so that such safety rope with such automatic safety device support the platform of such

scaffold in the event of failure of the primary suspension wire ropes, winches, climbers or any part of the mechanism used for raising or lowering such suspended scaffold;

b. Provided that the clause (a) shall not apply -

- i) Where the platform of such scaffold is supported at two independent suspension wire rope at or near each end of such platform so that in the event of failure of one of such suspension wire rope, the other wire rope is capable of sustaining the weights of such platform and its load and prevent it from tilting; or
- ii) Where a system is incorporated which operates automatically to support the platform of such scaffold and its load in the event of failure of the primary suspension wire rope of such scaffold.

14.0. SAFETY IN THE ERECTION OF STRUCTURAL FRAME & FORMWORK

14.1. GENERAL PROVISION

- a. The trained building worker under the direct supervision of a person, responsible for structural frame and formwork, shall be employed for erection of such structural frame or formwork, dismantling of building and structure and performance of and engineering work formwork, false work and shoring work;
- b. Adequate measures shall be taken to guard against hazards arising from any temporary state of weakness or unsuitability of a structure.

14.2. FORMWORK, FALSE WORK AND SHORING

- a. Formwork and false work shall be so designed, constructed and maintained that such formwork and false work are able to support the load that may be imposed on them;
- b. Such formwork shall be so erected that working platform, means of access, bracings, means of handling and stabilizing could easily be fixed with such formwork.

14.3. ERECTION OR DISMANTLING OF STEEL AND PREFABRICATED

- a. Erection or dismantling of any pre-fabricated structure shall be made safe against danger by using appropriate means such as ladders, gangways or fixed platforms, buckets, boatswains chair or other appropriate means suspended from lifting appliances, safety harness, life lines, catch nets or catch platforms, power-operated mobile working platforms etc.;
- b. The work of erection or dismantling of buildings or structures or formwork or false work or shoring or any other civil engineering work shall be carried out by trained building workers under the supervision of a person responsible for such work;
- c. Steel or prefabricated structures shall be so designed and made that such structures can be safely transported or erected; and weight of each unit of such structures shall be clearly marked on such unit;
- d. The design of each such part shall maintain stability of each part of the structures referred to in clauses above when erected, and to prevent danger, the design shall explicitly take into account –
 - i) The relevant conditions and methods of attachment in the operations of stripping, transport, storing and temporary support during erection of such parts;
 - ii) Safeguards, such as provision of railings with working platforms, and for mounting such railings and platforms easily on the structural steel or prefabricated parts;
- e. The hooks and softer devices built in or provided on the structural steel or prefabricate parts that are required for lifting and transporting such parts shall be so shaped, dimensioned and positioned to withstand the stresses to which such hooks or other devices are subjected;

- f. Prefabricated parts made of concrete shall not be stripped or erected before such concrete has set and hardened sufficiently to the extent provided for in the plans, and such parts are examined by the responsible person for any sign of damage before their use;
- g. Store-places shall be so constructed that –
 - i) There shall be no risk of structural steel or prefabricated parts falling or overturning;
 - ii) Storage conditions shall generally ensure stability and avoid damage having regard to the method of storage and atmospheric conditions; and
 - iii) Racks shall be set on firm ground and designed so that units cannot move accidentally in such store-places;
- h. Structural steel or pre-fabricated parts shall not be subjected to stresses prejudicial to their stability while they are stored or transported or raised or set down;
- i. Tongs, clamps and other appliances for lifting structural steel and prefabricated part shall be:
 - i) In such shape and dimensions as to ensure a secure grip without damaging and marked with the maximum permissible load in the most unfavourable lifting conditions; and
 - ii) Structural steel or pre-fabricated parts shall be lifted by such methods and appliances that prevent them from spinning accidentally;
- j. Structural steel or pre-fabricated parts shall be provided with railings and working platforms before raising such parts to prevent any danger of falling of building workers, materials or articles at the time of any work with such parts;
- k. All reasonably practical measures shall be taken to avoid injury to building workers, building structure or equipment while structural steel or pre-fabricated parts are handled or stored or transported or raised or lowered;
- l. Structures shall not be worked on during violent storms or high winds or any other such hazardous situation;
- m. The risk of falling to which building workers, moving on high or sloping girders, may be exposed is limited by all means of adequate collective protection or by the use of a safety harness which shall be well secured to a sufficiently strong supports;
- n. Structural steel parts, which are to be erected at a great height, shall, as far as practicable, be assembled on the ground;
- o. When structural steel or pre-fabricated parts are being erected, a sufficiently extended area underneath the workplace shall be barricaded or guarded;
- p. Steel trusses, which are being erected, shall be adequately shored, braced or guyed until they are permanently secured in position;
- q. Structural members shall not be forced into place by the hoisting machine while any building worker is in such a position that he is likely to be injured by such operation.

14.4. FORMWORK

- a. All formwork shall be properly designed keeping in view the safety of building workers, buildings or structures;
- b. A responsible person for structural frame and formwork shall –
 - i. Inspect and examine the material, timber, structural steel and scaffolding for its strength and suitability before being taken into use;
 - ii. Lay-down procedures to cover all stages of such structural frame and formwork;
 - iii. Supervise such structural frame and formwork;
 - iv. Take all necessary steps or measure to correct any situation with a view to prevent accident or dangerous occurrence during performances of such structural frame and formwork.

14.5. DE-SHORING

- a. When shoring is removed, sufficient props shall be left in place of such shoring to prevent any possible hazard; and
- b. Deshoring shall be adequately braced and tied together with support to prevent any hazard.

15.0. SAFETY IN CONCRETE WORK

15.1. GENERAL PROVISIONS REGARDING USE OF CONCRETE

- a. All construction with the use of concrete or reinforced concrete shall be based on plans including specification of steel and concrete and other material to be used in such construction –
 - i. Giving technical details regarding methods for safe placing and handing of such materials and indicating the type, quality and arrangement of each part of a structure of such construction; and
 - ii. Explaining the sequence of steps to be taken for completion of such construction;
- b. Formwork and shores used for concrete work shall be structurally safe and properly braced or tied together so as to maintain position and shape of formwork or shores;
- c. Formwork structure used shall have sufficient catwalks and other secure access for inspection of such structure if such structure is in two or more tiers;
- d. No machinery or any object should fall below by using wire nets, screen nets etc.

15.2. PREPARATION AND POURING OF CONCRETE AND ERECTION OF CONCRETE STRUCTURE

- a. A building worker handling cement or concrete shall –
 - i) Wear close-fitting clothing, gloves, helmet or hardhat, safety goggles, proper footwear and respirator or mask to protect himself from danger in such handling;
 - ii) Keep as much of his body covered as is required to protect himself from danger in such handling;
 - iii) Take all necessary precautions to keep cement and concrete away from his skin in such handling;
- b. Lime pits shall be fenced or enclosed and filled and emptied by such devices, which do not require workers to go into the pit;
- c. Moving parts of the elevators, hoists screens bunkers, chutes, grouting equipment used for concrete work and of other equipment used for storing, transport and other handling ingredients of concrete shall be securely fenced to avoid contact of building workers with such moving parts;
- d. Screw conveyors used for cement, lime and other dusty materials shall be completely enclosed.

15.3. BUCKETS

- a. Concrete buckets used with cranes or aerial cableways shall be free from projections from which accumulations of concrete could fall;
- b. Movements of concrete buckets shall be governed by signals necessary to avoid any danger by such movements.

15.4. PIPES AND PUMPS

- a. A scaffolding carrying a pipe for pumped concrete shall be strong enough to support such pipe at a time when such pipe is filled with concrete or water or any other liquid and carry the combined load of the all the building workers who may be on such scaffold at such time, safely;
- b. Every pipe for carrying pumped concrete shall be –
 - i) Securely anchored at its end point and at each curve on it;
 - ii) Provided near the top of such pipe with an air release valve;
 - iii) Securely attached to a pump nozzle by a bolted collar or other adequate means;
- c. The operation of concrete pumps shall be governed by standard signals;
- d. Building workers employed around a concrete pump shall wear safety goggles;

15.5. MIXING AND POURING OF CONCRETE

- a. The concrete mixture shall not contain any material, which may unduly affect the setting of such concrete, weaken such concrete or corrode steel used with such concrete;
- b. When dry ingredients of concrete are being mixed in confined spaces such as silos –
 - i) The dust shall be exhausted at the time of such mixing and
 - ii) In case the dust the dust cannot be exhausted, as specified, the workers shall wear respirators at the time of such mixing;
- c. When concrete is being tipped from buckets, building workers shall be kept out of the range of any kickbacks of such buckets;
- d. Loads shall not be dumped or placed on settling concrete.

15.6. CONCRETE PANELS AND SLABS

- a. All parts of a concrete panel or concrete slab shall be hoisted uniformly;
- b. Concrete panels shall be adequately braced in their final positions and such bracings shall remain in such positions until such panels are adequately supported by other parts of the construction for which such panels are used;
- c. Temporary bracings of concrete panels shall be securely fastened to prevent any part of such panels from falling when such panels are being moved.

15.7. STRESSED AND TENSIONED ELEMENTS

- a. Building workers shall not stand directly over jacking equipment while stressing of concrete girders and beams is being done;
- b. A pre – stressed concrete unit shall not be handled except at points on such unit and by the devices specified for such work by the manufacture of such devices;
- c. During transport, pre-stressed concrete girders or concrete beams shall be kept upright by bracing or other effective means;

- d. Anchor fittings for pre-tensioned strands of pre-stressed concrete girders of concert beams are kept in a safe condition in accordance with the instruction of manufacturer of such anchor fittings;
- e. Building workers shall not stand behind jacks or in line with tensioning elements and jacking equipment during tensioning operations of pre-stressed concrete girders of concrete beams;
- f. Building workers do not cut wires of pre – stressed concrete girders or concrete beams under tension before such concrete used of such girder or beams is sufficiently hardened.

15.8. VIBRATORS

- a. A building worker, who is in good physical condition, shall operate vibrators used in concreting work;
- b. All practical measures shall be taken to reduce the amount of vibration transmitted to the operators working in concreting work and
- c. When electric vibrators are used in concreting work
 - i) Such vibrators shall be earthed;
 - ii) The leads of such vibrators shall be heavily insulated; and
 - iii) The current shall be switched off when such vibrators are not in use.

15.9. INSPECTION AND SUPERVISION

- a. A person responsible for a concreting work shall supervise the erection of the formwork, shores, braces and other supports used for such concreting work, make a through inspection of every formwork to ensure that such formwork is safe, regularly inspect the formwork, shores, braces, reshores and other supports during the placing of concrete, keep all records of inspections referred to above at the workplace relating to such inspection and produce them for inspection upon the demand.
- b. Any unsafe condition, which is discovered during the inspections, shall be remedied immediately.

15.10. BEAMS, FLOORS AND ROOFS

- a. Horizontal and diagonal bracings shall be provided in both longitudinal and transverse direction as may be necessary to provide structural stability to formwork used in concreting work and shores used in such concreting work shall be properly seated on top and bottom and secured in their places;
- b. Where shores used in concreting work rest upon the ground, base plates shall be provided for keeping such shores firm and in level;
- c. Where the floor to ceiling height of a concreting work exceeds 9 m or where the formwork deck used in such concreting work is supported by shores constructed in two or more tiers, or where the dead, live and impact loads on the formwork used in such concreting work exceed 700 kilogram per m², the structure of such formwork shall be designed by a professional engineer in the relevant field and the specifications and drawings of such formwork kept at such construction site and produced on demand.

- d. Where a professional engineer designs the structure of the formwork used in concreting work, such engineer shall be responsible for the supervision of construction and the stability of such structure.

15.11. STRIPPING

- a. Stripping of formwork used in concreting work shall not commence until the concrete on such formwork is fully set, examined and certified to this effect by the responsible person and record of such examination and certification is maintained;
- b. Stripped forms in concreting work shall be removed or stock piled promptly after stripping from all areas in which building workers are required to work or pass;
- c. Protruding nail, wire ties and other formwork accessories not required for subsequent concreting work shall be pulled, cut or otherwise made safe.

15.12. RE-SHORING

- a. Re-shoring used in concreting work shall be provided to a slab or beam for its safe support after its stripping or where such slab or beam is subjected to superimposed loads due to construction above such slab or beam;
- b. The provisions applicable to shoring in a concreting work shall also be applicable to reshoring in such work or pass.

16.0. SAFETY IN CONSTRUCTION, REPAIR & MAINTENANCE OF STEEP ROOFS

16.1.WORK ON STEEP ROOFS:

All practicable measures shall be provided to protect the building workers against sliding when carrying outwork on steep roofs.

16.2. CONSTRUCTION AND INSTALLATION OF ROOFING BRACKETS

- a. Roofing brackets shall be constructed to fit the pitch of steep roof and such brackets shall be used to provide level working platform;
- b. Roofing bracket shall be secured in its place by nailing pointed metal projections attached to the underside of such bracket and securely driven into a steep roof on which it is used or secured by a rope passed over the ridgepole and tie of such roof.

16.3. CRAWLING BOARDS

- a. All crawling boards used for work on steep roofs shall be of adequate strength, made of sound material and of the type approved for the purpose of their use;
- b. Crawling boards shall be kept in good repairs and inspected by a responsible person before being taken into use;
- c. Crawling boards shall be secured to a steep roof on which it is used by ridge hooks or other effective means;
- d. A firmly fastened lifeline of adequate strength shall be strung beside each crawling board throughout its length while using such crawling boards.

17.0. SAFETY IN CATCHES PLATFORMS, HOARDINGS & CHUTES

17.1. CATCH PLATFORM

- a. Catch platform shall not be used for storage of material or as a working platform;
- b. Catch platform shall at least be of 2 m wide and inclined so that the position of outer edge of such platform is 1500 mm higher than the inner edge;
- c. The open end of catch platform shall be properly fenced to the height not less than 1 m.

17.2. HOARDINGS:

Hoardings shall be constructed when the Registering Authority / Assistant Labour Commissioner considers it necessary for protection of building workers and directs such employer to construct such hoardings.

17.3. CHUTES, ITS CONSTRUCTION AND USE

- a. Wooden or metal chutes which are at an angle of more than 45⁰ to the horizontal and used for the removal of materials shall be closed on all sides except at their openings used for receiving or discharging of materials or articles;
- b. All openings of chutes except their top openings shall be closed when not in use;
- c. Every chute –
 - i. Shall be constructed of sound material, adequate strength and suitable for the purpose it is intended for use;
 - ii. Exceeding 12 m in height shall be constructed in accordance with the design and drawings of professional engineer for such;
 - iii. A suitable warning notice shall be displayed at conspicuous locations, written in Hindi and in a local language, at the discharge end of every chute;
 - iv. Shall be cleared when debris has accumulated to a height, which can pose danger to building worker, but such clearance shall be done in no case less frequently than once a day.

18.0. SAFETY IN WORK ON OR ADJACENT TO WATER

18.1. TRANSPORT OF WORKERS BY WATER

- a. When any building worker has to proceed to or from any workplace by water for purposes of carrying on a building or other construction work, proper measures shall be taken to provide for his safe transportation and vessels used for such purpose shall be in charge of a responsible person, properly equipped for safe navigation and maintained in good condition;
- b. Maximum number of persons which can be safely carried in a vessel shall be marked plainly and conspicuously on such vessel and such number shall not be exceeded during use of such vessel for carrying persons;
- c. Adequate protecting shall be provided to the building workers in such vessel from inclement weather;
- d. Such vessel shall be manned by adequate and experienced crew;
- e. In case the bulwarks of such vessel are lower than 60 cm from the level of the deck of such vessel, the open edge of such bulwarks shall be fitted with suitable fencing to a height of at least 1 m above such deck and the post and stanchions and similar parts used in such fencing shall not be spaced more than 2 m;
- f. The number of life buoys on deck of such vessel shall at least be equal to the number of crew members of such vessel and shall not be less than two;
- g. All life buoys on deck of such vessel shall be kept in good state of maintenance and so placed that if such vessel sinks then they will remain afloat and one of such buoys shall be within the immediate reach of the Steersman of such vessel and another is situated after part of such vessel; and
- h. The position of the steersman of the vessel shall be such that he has a reasonably free view of all sides.

18.2. PREVENTION FROM DROWNING

- a. Where, on or adjacent to the workplace of any contraction site, there is water into which a building worker employed for work on such site, in the course of his employment, may fall and has the risk of drowning, suitable rescue equipment shall be provided and kept in an efficient state of ready use and measures shall be taken to arrange for the prompt rescue of such building worker from the danger of drowning and where there is a special risk of such fall from the edge of adjacent land or from a structure adjacent to or above the water, or from floating stage on such water, secure fencing shall be provided near the edge of such land, structure or floating stage, as the case may be, to prevent such fall, and such fencing may be removed or allowed to remain unerected for the time and to the extent necessary for the access of building workers to such work or the movement of material for such work;
- b. For handling rescue equipment, at least two persons knowing diving should be available at such sites.

19.0 SAFETY IN COFFERDAMS & CAISSONS

19.1 EVERY COFFERDAM AND CAISSON SHALL BE

- 19.1.1 Of good construction, sound material and of adequate strength, provided with adequate means for workers to reach safely at the top of such cofferdam or caisson in the event of an inrush of water and safe means of access to every place where workers shall be employed;
- 19.1.2 Work relating to construction, positioning, modification, dismantling of cofferdams or caissons shall be carried out under the supervision of a responsible person and inspected by the responsible person at the specified intervals;
- 19.1.3 A worker shall be allowed to work in a cofferdam or caisson after such cofferdam or caisson has been inspected and found safe by responsible person within such preceding period as approved and a record of such inspection maintained.

19.2 WORK IN COMPRESSED AIR IN A COFFERDAM OR CAISSON SHALL BE

- 19.2.1 Carried out in accordance with the procedure laid down;
- 19.2.2 Carried out by such building workers who have completed eighteen years of age and are medically examined and found fit for the work;
- 19.2.3 Carried out under the supervision of a responsible person;
- 19.2.4 If the work in cofferdam or caisson is carried out in shifts, a record of the time spent by each worker in each such shift for carrying out the work shall be maintained in a register with particulars or time taken for the compression of such building worker, if any;
- 19.2.5 At every work site or project in a cofferdam or caisson, where workers are employed to work in compressed air environment, a construction medical officer assisted by a nurse or trained first-aid attendant, shall be available at all times and there shall be one standby reserve compressor to meet the emergency.

19.3 PRESSURE PLANT AND EQUIPMENT

- 19.3.1 Pressure plant and equipment for which it is used shall be –
- 19.3.2 Properly maintained in good repairs and working condition and fitted with a suitable safety valve or other effective device to provide maximum safe discharge pressure from being exceeded at any time; a suitable pressure gauge with a dial range not less than 1.5 times and not exceeding twice the maximum working pressure, easily visible and designed to show at all times, the internal pressure in kilogram per square centimeter and marked with the maximum safe working pressure, a suitable stop valve or valves by which the pressure plant or the system of the pressure plant may be isolated from the source supply of pressure or otherwise;
- 19.3.3 Every pressure plant or equipment shall be thoroughly examined by the competent person, externally, once in every period of six months; internally, once in every period of twelve months; and by hydraulic test, once in a period of four years.

20. SAFETY IN DEMOLITION WORK

20.1 PREPARATION

- 20.1.1 All glass or similar material or article in exterior openings shall be removed before commencing any demolition work and all water, steam, electric, gas and other similar supply lines put off and suitably capped and the concerned department of the appropriate authority informed and permission obtained wherever required before commencing;
- 20.1.2 Wherever it is necessary to maintain water, gas or electric line or power during such demolition, such line shall be so located or protected with substantial coverings so as to protect it from damage and to afford safety to the building workers and the general public.

20.2 PROTECTION OF ADJACENT STRUCTURES

20.2.1 Examination of walls etc. of adjacent structures –

- i) During demolition process, the contractor shall examine the walls of all structures adjacent to the structure to be demolished to determine the thickness, method of support to such adjacent structures and;
- ii) In case, such employer has reason to believe that any of such adjacent structure is unsafe or may become unsafe during such demolition process, he shall not perform demolition activity unless stability to such unsafe adjacent structure from collapsing has been taken. All roads and open spaces adjacent to the site of demolition work shall be closed or suitably protected by bracketing.

20.3 DEMOLITION OF WALLS, PARTITIONS, ETC.

- 20.3.1 Any demolition of walls or partitions shall be proceeded in a systematic manner as per the standard safe operating practices approved and all work above each tier of any floor beams shall be completed before the safety of the supports of such beam is impaired;
- 20.3.2 Masonry shall be neither loosened nor permitted to fall in such masses or volume or weight as to endanger the structural stability of any floor or structural supports;
- 20.3.3 No wall chimney or other structure or part of a structure shall be left unguarded in such a condition that it may fall, collapse or weaken due to wind pressure or vibration;
- 20.3.4 In the case of demolition of exterior walls by hand, safe footing shall be provided for the workers employed in, such walls or partitions, which are to be demolished by hand shall be not left standing more than one storey high above the uppermost floor on which persons are working.

20.4 **METHOD OF OPERATION:** The contractor shall ensure that debris, bricks and other materials or articles are removed by means of chutes, buckets or hoists and through openings in the floors.

20.5 ACCESS TO FLOOR

- 20.5.1 Safe access to and egress from every building shall be provided at all times in the course of demolition by means of entrances hallways, stairways or ladder runs which shall be so protected as to safeguard the workers using such means from falling material or articles;

- 20.5.2 Demolition of structural steel etc. shall be demolished column by column and tier by tier and every structural member, which is being demolished, shall not be under any stress, and such structural member shall be suitably lashed to prevent it from any uncontrolled swinging, dropping or falling or falling;
- 20.5.3 Large structural members shall not be thrown or dropped from the building, but carefully lowered by adopting suitable safe method;
- 20.5.4 Where a lifting appliance like a derrick is used for demolition, the floor on which such lifting appliance rests shall be completely planked over or supported and such floor shall be of adequate strength to sustain bearing load for such lifting appliance and its operation.

20.6 STORAGE OF MATERIAL OR ARTICLE

- 20.6.1 No materials or articles shall be not stored or kept on platform, floor or stairways of a building being demolished, provided that this clause shall not apply to the floor of a building when such floor is of such strength as to support safely the load to be superimposed by storing such material or articles;
- 20.6.2 No access to any stairway or passageway shall be affected or blocked by storing any material or article;
- 20.6.3 Suitable barricades shall be provided so as to prevent materials or articles from sliding or rebounding into any space used by the workers.

20.7 FLOOR OPENINGS:

Every opening used for the removal of debris from every floor which is not closed to access, except the top or working floor, shall be provided with an enclosure from such floor to its ceiling, or such opening is so barricaded that no building worker shall access to within a horizontal distance of 6.0 m from such opening through which debris is being dropped.

20.8 INSPECTION:

A person responsible for demolition work shall make continuous inspections during demolition process so as to detect any hazard resulting from weakened or deteriorated floors or walls or loosened materials or articles, and that no building worker shall be permitted to work where such hazard exist unless remedial measured like shoring or bracing shall be taken to prevent such hazards.

20.9 WARNING SIGNS, BARRICADES, ETC.

- 20.9.1 Barricades and warning sign shall be erected along every side throughout the length and breadth of a building or other construction work to be demolished to prevent unauthorized persons from entering into the during demolition operations;
- 20.9.2 During the demolition of an exterior masonry wall or a roof from a point more than 12 m above the adjoining ground level of such wall or roof, if persons below such wall or roof are exposed to falling objects, suitable and safe catch platform shall be provided and maintained at a level not more than 6 m below the working level except where an exterior built-up scaffold is provided for safe and adequate protection of such persons;
- 20.9.3 Suitable and standard warning signs shall be displayed or erected at conspicuous places or position at the workplace;

20.10 MECHANICAL METHOD OF DEMOLITION

20.10.1 The following requirements shall be fulfilled in case the mechanical method of demolition like use of swinging weight, clamshell bucket, power shovel, bulldozer or other similar mechanical methods are used for the purpose of demolition namely –

- i) The building or structure or structure or remaining portion thereof shall be not more than 12 m in height;
- ii) Where a swinging weight is used for demolition, a zone of such demolition having a radius of at least 1.5 times the height of the structure of portion thereof being demolished shall be maintained around the points of impact of such swinging weight;
- iii) Where a clamshell bucket is being used for demolition, a zone of demolition shall be maintained within eight metres of the liner of travel of such bucket;
- iv) Where other mechanical methods are being used to affect total or partial collapse of a building or other construction work, there shall be maintained, in the area into which the affected portion of such building or other construction work may fall, a zone of demolition at least 1.5 times the height of such affected portion thereof; and
- v) No person other than building workers or other persons essential to the operation of demolition work shall be permitted to enter a zone of demolition, which shall be provided with substantial barricades.

21. FIRE EXTINGUISHERS & OTHER APPLIANCES OF FIRE FIGHTING

21.1 FIRE EXTINGUISHERS & OTHER MEANS OF PREVENTION AND PROTECTION

21.1.1 Every contractor shall have a fire protection and prevention plan developed and implemented keeping in view the following:

- i) The specific work practices requiring fire control measures;
- ii) Response measures to be taken in case of fire;
- iii) Equipment required;
- iv) Personnel requirements and responsibilities;
- v) Schedules of daily and weekly inspection;
- vi) Open flames and fires are prohibited in all underground construction;
- vii) Readily visible signs to be posted in the fire prone/inflammable/explosive areas prohibiting smoking use of open flames and other hot work.
- viii) A system of Permit-to-Work.

27.1.2 For the protection of the workers from the outbreak of fire, the contractor shall Provide, maintain and regularly inspect the Fire extinguishing equipment, which shall be sufficiently provided to extinguish any probable fire;

Suitability of portable fire extinguishers			
Class of fire	Type of extinguisher		
	Water	DCP	CO ₂
A	Yes	Yes	Yes
B	No	Yes	Yes
C	No	Yes	Yes
D	No	Yes	Yes
Electrical	No	Yes	Yes

27.1.3 Ensure availability of an adequate supply of water at ample pressure;

27.1.4 Make available

- i. Adequate number of trained persons required to operate the fire extinguishing equipment;

- ii. Properly maintain Fire extinguishing equipment and inspect them at regular intervals of not less than once in a year by the responsible person and a record of such inspections maintained;
- 27.1.5 Portable fire extinguishers provided in the operator's cabin of earthmoving machinery, material handling systems, construction equipment etc. shall be regularly inspected, maintained and replenished/refilled;
- 27.1.6 The operators and the helpers of such equipment shall be trained in the methods operating the equipment and fighting the fire effectively;
- 27.1.7 All combustion engine power equipment shall be so located that the exhausts are well away from combustible material;
- 27.1.8 No smoking shall be allowed at or in the vicinity of operations, which constitute fire hazards and shall be conspicuously posted with No smoking or open flame **signs**;
- 27.1.9 In the flammable environment as described in IS: 9570, the electrical fittings and equipment shall be of flame proof type conforming to IS: 2206 & IS; 2148;
- 27.1.10 Arrangements shall be made to contain sparks generated during welding, cutting or other operations and spark shall not be allowed to fall down on combustible material kept below; All means of exit shall be kept free of obstruction at all times;
- 27.1.11 Appropriate type of fire extinguishers according to IS: 5698 shall be kept in fully charged condition at the places which have potential risk of fire;
- 27.1.12 The contractor shall educate his or his sub-contractors' men working in the vicinity of fire risk, on how to operate these equipment and know in particular circumstances which type of extinguishers is to be used;
- 27.1.13 The contractor shall take full responsibility for the upkeep and replenishment/refilling of the fixed and portable fire extinguishers.

APPENDIX

Annexure I

IMPORTANT INDIAN STANDARDS RELATED TO SAFETY

Personal Protection

- IS: 1179-1967 Equipment for eye and face protection during welding
- IS: 4770-1991 Rubber gloves for electrical purposes
- IS: 8519-1977 Guide for selection of industrial safety equipment for body protection
- IS: 8520-1977 Guide for selection of industrial safety equipment for eye, face & ear protection
- IS: 8807-1978 Guide for selection of safety equipment for protection of arms and hands
- IS: 1224-1985 Safety shoes
- IS: 2925-1984 Safety helmets
- IS: 8940-1978 Code of practice for maintenance and care of industrial safety equipment eye and face protection
- IS: 8990-1978 Code of practice for maintenance and care of industrial safety clothing
- IS: 10667-1983 Guide for selection of industrial safety for protection of foot and leg
- IS: 816-1969 Code of practice for safety and health requirements in electric and gas welding and cutting operations
- IS: 818-1968 Code of practice for safety and health requirements in electric and gas welding and cutting operations
- IS: 7194-1994 Assessment of noise exposure during work for hearing conservation purposes

Civil Engineering Construction

- IS: 2750- 1967(Part II) Steel scaffolds
- IS: 875-1987 Structural safety of building: loading standards
- IS: 4014-1967 Code of practice for steel tubular scaffolding
- IS: 3696 Safety code of scaffolds and ladders
- IS: 4138-1977 Safety code for working in compressed air
- IS: 4912-1978 Safety requirements for floor and wall openings, railings and toe boards
- IS: 7293-1974 Safety code for working with construction machinery
- IS: 9944-1992 Recommendations on safe working load for natural and man-made rope slings
- BS: 1129 Portable timber ladders, steps, Trestles & lightweight staging
- BS: 1139 Metal scaffolds
- BS: 5973 Code of practice for access & working scaffolds
- BS: 5974 Code of practice for temporary installed scaffolds and access equipment
- BS: 5975 Code of practice for falsework

Fire Protection

- IS: 2190-1992 Code of practice for selection, installation and maintenance of portable first-aid fire extinguishers
- IS: 5896 Code of practice for selection, operation and maintenance of fire-fighting appliances

IS: 8433-1984 Code of practice for dissolved acetylene cylinders

Electrical

IS: 3043-1987 Code of practice for earthing

IS: 5424-1969 Rubber mats for electrical purposes

IS: 3646 (Part II) Artificial lightings

IS: 2148 & IS: 2206 Flame proof electrical fittings

Machinery

IS: 1860-1980 Code of practice for installation, operation and maintenance of electric passenger and goods lifts

IS: 1991-1987 Safety requirements for the use, care and protection of abrasive grinding wheels

IS: 5903-1970 Safety devices for gas cylinders

IS: 8216-1976 Guide for inspection of lift wire ropes

IS: 8964-978 Recommendations for safety conditions for woodworking machines

IS: 9474-1980 Principles of mechanical guarding of machinery

IS: 11461-1985 Code of practice for compressors safety

IS: 13367-1992 Code of practice for safe use of cranes

BASIC STRUCTURE OF SAFETY PLAN

- 01- Safety Policy
- 02- When was the Safety Policy last reviewed
- 03- Details of implementation procedure / methods to implement Safety Policy / Safety Rules
- 04- Qualification & Experience of Safety Officers
- 05- Review of Accidents analysis - Methods to ensure safety & health and steps identified for prevention of accidents
- 06- Unit/site Executive responsible for ensuring safety at various levels in the workplace
- 07- List of Employees trained in safety at the commencement of execution of the job; details of training – its module and contents
- 08- Safety Training Targets, Schedules, Methods to be adopted for providing safety training to all employees
- 09- Details of checklists for different jobs/ work & responsible persons to ensure Compliance
- 10- Regular Safety Inspection Methods and Periodicity and the list of members authorized
- 11- Risk Assessment, Safety Audit by professional agencies, their Periodicity
- 12- Implementation of recommendations of Audit / Inspections. - Procedures for implementation & follow-up
- 13- Provision for treatment of Injured persons at work site
- 14- Review of overall safety by top Management and Periodicity
- 15- System for implementation of statutory provisions.
- 16- Issue of PPE to employees, Periodicity / stock on hand, etc.

Signature
Head of Organization
With Date & Stamp

Annexure - III

CONFINED SPACE WORK PERMIT

Date of Work :	Initiator:	Permit No.:
Description of work :		
Name of person supervising:		Dept./Function:
Names of workmen involved in the job :		
1	2	
3	4	
Exact Location of Work:		
JSA Reference No.		
Job Instruction & Confirmation Sheet Ref. No		
Valid From : Time Date: To Time: Date:		
Other relevant information (if any)		
Initiated by Engineer / Supervisor of Agency		Checked by Agency Safety Representative
Name		Name
Signature		Signature
Date		Date
Check list for Authorization of Work Permit		
Minimum and Mandatory Precautions		Y/ N / NA
1	Permit form filled in completely?	
2	Have wind, atmospheric, and work area conditions (e.g. cold, hot, snow, poor lighting & Ventilation etc.) been considered throughout the job so that work can be done safely?	
3	All necessary Personnel Protective Equipment like Breathing Set, Waist Rope, Light Mounted Helmet etc. is put on by all the workmen?	
4	A lifeline, a rope tied on the safety belt of the person entering the confined space is provided?	
5	All practicable measures are taken to ensure that the atmosphere inside is not deficient in oxygen and does not contain flammable vapors and no hazardous gases like H ₂ S. (Open at least 2 manholes & keep for 2 hours)?	
6	One fully trained person is stationed at ground level/outside to assist the inside workers and emergency contact No's available?	
7	All the workers trained for emergency?	

8	Safe means of access and egress provided?	
9	Is the suitable fire extinguisher available at work location?	
10	Are they Using only 24V lamps & working tools inside the confined space?	
Following additional precautions need to be taken before the start of the work		
Permit Issued By:		
	Approved by Principal Agency work in charge	Endorsed by Principal Agency HSE Dept
Name		
Signature		
Date		
Permit Close Out by: Name & Signature (Principal Agency)		
Date :		Time :
Note: All extra information on preparation and precautions to be provided on the reverse side of this PTW.		

HOT WORK PERMIT

Date of Work :		Initiator:		Permit No.:	
Description of work :					
Name of person supervising:			Dept./Function:		
Names of workmen involved in the job :					
1		2			
3		4			
Exact Location of Work:					
JSA Reference No.					
Job Instruction & Confirmation Sheet Ref. No					
Valid From : Time Date: To Time: Date:					
Other relevant information (if any)					
Initiated by Engineer / Supervisor of Agency			Checked by Agency Safety Representative		
Name				Name	
Signature				Signature	
Date				Date	
Exact location of work					
Relevant information					
Check list for Authorization of Work Permit					
Minimum and Mandatory Precautions					Y/ N / NA
1	Permit form filled in completely?				
2	Form filled in correctly and in full.				
3	Has the work area been inspected for any abnormalities - specify on wind, atmosphere, surroundings, etc.				
4	Are the necessary PPE provided and do the workmen know their use?				
5	Is the fitter, experienced and knowledgeable enough to carry out the job?				
6	Area has to be cleared of any flammables and combustible material.				
7	Electrical equipment to be protected and grounded.				
8	Are fire-fighting equipment - extinguishers, water, sand buckets etc, located nearby for ready in case of any mishap?				
9	Gas cylinders in upright state/ trolleys/ flash-back arrestors/ hose condition/ NRVs, etc.				
10	Is the area easily accessible?				

Additional precautions to be taken:		
This permit is valid only for one week. A fresh hot work permit has to be taken for continued works for the next week.		
Permit Issued By:		
	Approved by Principal Agency work in charge	Endorsed by Principal Agency HSE Dept
Name		
Signature		
Date		
Permit Close Out by: Name & Signature (Principal Agency)		
Date :		Time :
Note: All extra information on preparation and precautions to be provided on the reverse side of this PTW.		

PERMIT FOR LIFTING OF MATERIAL

Date of Work :	Initiator:	Permit No.:
Description of work:		
Name of person supervising:		Dept./Function:
Names of workmen involved in the job :		
Exact Location of Work:		
JSA Reference No.		
Job Instruction & Confirmation Sheet Ref. No		
Valid From : Time Date: To Time: Date:		
Other relevant information: (If any)		
Initiated by Engineer / Supervisor of agency		Checked by Agency Safety Representative
Name		Name
Signature		Signature
Date		Date
Check list for Authorization of Work Permit		
1	Details of type of crane(s) to be used?	
2	Name of Lift Co-ordinator, Rigger/Crane Operator?	
3	Adequate and suitable lifting gears available and in good condition	
4	Have soil, wind, atmospheric, and work area conditions (e.g. cold, hot , snow, poor lighting & Ventilation etc.) been considered throughout the job so that work can be done safely?	
5	Lifting Equipments, Lifting gears and Slings are tested and certified?	
6	Are all operators trained, competent and healthy (Having Licenses / Experience Certificate)?	
7	Are all the examinations and tests carried out on the equipment (Crane) and certified by competent persons?	
8	Is the safe working load (SWL) marked on all lifting tools & tackles?	
9	Lifting area cordoned off?	
10	Tag lines provided to control the swing of load?	
11	Load tied properly and secured against toppling and falling?	
12	Signalman/Rigger is provided and competent?	
13	Proper communication available between operator and rigger?	
14	Is the vehicle for transportation adequate for the load?	

Following additional precautions need to be taken before the start of the work:			
Permit Issue b By:			
Approved by Principal agency work incharge		Endorsed by main agency HSE Dept	
Name		Name	
Signature		Signature	
Date		Date	
Permit Close Out by: Name & Signature (Main agency)			
Date :		Time :	
Note: All extra information on preparation and precautions to be provided on the reverse side of this PTW.			

WORKING AT HEIGHT PERMIT

Date of Work :	Initiator:	Permit No.:
Description of work :		
Name of person supervising:		Dept./Function:
Names of workmen involved in the job :		
1	2	
3	4	
Exact Location of Work:		
JSA Reference No.		
Job Instruction & Confirmation Sheet Ref. No		
Valid From : Time Date: To Time: Date:		
Other relevant information		
Initiated by Engineer / Supervisor		Checked by Agency Safety Representative
Name		Name
Signature		Signature
Date		Date
Check list for Authorization of Work Permit		
Minimum and Mandatory Precautions		Y/ N / NA
1	Permit form filled in completely?	
2	Work area below is temporarily cordoned/barricaded	
3	The scaffold erected has pipes and clamps in good condition.	
4	Diagonal / lateral bracings pipes are provided to ensure stability	
5	Access ladder is provided to reach the work location	
6	Planks / sheet used in temporary platform are in good condition	
7	Planks / sheets are tied properly using binding wire	
8	Temporary platform is having temporary side railing	
9	Workers are wearing Helmet, Shoes & Safety belt in good condition.	
10	For Anchoring of safety belt at height rigid support / life rope line is provided	
11	Experienced workers are engaged for work	
12	Portable elect equip/fibre body checked for its healthiness including earthing	
13	The sling / pulley blocks / ropes are tested for fitness	

14	Workers are briefed on Safety Precautions to be taken	
	Power hand tools used at eight are connected through 30mA ELCB.	
Following additional precautions need to be taken before the start of the work		
Permit Issued By:		
	Approved by Principal Agency work in charge	Endorsed by Principal Agency HSE Dept
Name		
Signature		
Date		
Permit Close Out by: Name & Signature (Principal Agency)		
Date :		Time :
Note: All extra information on preparation and precautions to be provided on the reverse side of this PTW.		

DEFINITIONS

1. **Building or other construction work:** means the construction, alteration, repairs, maintenance or demolition, of or, in relation to, buildings, streets, roads, railways, tramways, airfields, generation, transmission and distribution of power, water works, oil and gas installations, electric lines, tunnels, bridges, viaducts, pipelines, towers, cooling towers and such other work as may be specified.
2. **Building worker:** means a person who is employed by a contractor to do any skilled, semi-skilled or manual, supervisory, technical or clerical work for hire or reward, whether the terms of employment be expressed or implied, in connection with any building or other construction work;
3. **Establishment:** means an establishment who or which employs building workers in any building or other construction work, and includes an establishment belonging to a contractor;
4. **Contractor:** means a person who undertakes to produce a given result for any establishment, other than a mere supply of goods or articles of manufacture by the employment of building workers or who supplies building workers for any work of the establishment, and includes a sub-contractor or any other agency engaged on his behalf;
5. **Employer:** in relation to an establishment, means the owner thereof that is the contractor himself.
6. **Competent Person:** means a person so approved by the Central Government who belongs to a testing establishment in India possessing adequate qualification, experience and skill for the purpose of testing, examination or annealing and certification of lifting appliances, lifting gears, wire ropes or pressure plant or equipment;
7. **Responsible Person:** means a person appointed by the employer to be responsible for the performance of specific duty or duties and who has sufficient knowledge and experience and the requisite authority for the proper performance of such duties;
8. **Danger:** means danger of accident or of injury or danger to health;
9. **Hazard:** means danger or potential danger;
10. **Hazardous substance:** means any substance, which due to its explosiveness, inflammability, radioactivity, toxic or corrosive properties and similar hazardous characteristics may Cause injury; or Affect adversely the human system; or Cause loss of life or damage to property or environment;
11. **Hazardous Process:** comprises roof work, steel erection, and work under and over water, demolition and work in confined space;

12. **National Standard:** means standards as approved by the Bureau of Indian Standards (BIS) and in the absence of such standards, the standards approved by the Central Government for a specific purpose;
13. **Lifting Appliance:** means a crane, hoist, derrick, winch, jack, pulley block or other equipment used for lifting materials, objects or building workers;
14. **Lifting gear:** means ropes, chains, hooks, slings and other accessories of a lifting appliance;
15. **Safe Operating Practice:** Means the practice followed in building and construction activities for the safety of workers and for safe operation of machinery and equipment used in such activities. Such practices shall conform to all or any of the following:
 - Relevant Standards approved by BIS;
 - National Building Codes;
 - Manufacturer's instruction on safe use of equipment and machinery;
 - Code of practice on safety in construction industry published by International Labour Organization .
16. **Safe working load:** in relation to an article of lifting gear or lifting appliance, means the load which is the maximum load that may be imposed on such article or appliance with safety in the normal conditions as assessed and certified by a competent person;
17. **Workplace:** means all places where building workers are required to be present or to go for work and which are under the control of an employer;
18. **Personal Protective Equipment (PPE):** are the protective devices made available for individual or collective use of the workers likely to be affected by the hazards of the workplace or process;
19. **Construction & Erection Manual (E&C) Rules:** all references to E&C Manual shall mean the Construction & Erection Rules that are detailed hereunder;
20. **Engineer in-charge:** All references to the Engineer in-charge shall mean the person in-charge of a building and construction of the NTPC.
21. **Interpretation of words not defined: words and expressions not defined or used in this Manual shall have the same meaning as generally assigned in common engineering practices**