भारत हैवी ईलैक्ट्रिकल्स लिमिटेड

BHARAT HEAVY ELECTRICALS LIMITED

पारेषण व्यापार अभियांत्रिकी प्रबंधन

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

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ग्राहक/ CUSTOMER	UP RAJYA VIDYUT UTPADAN NIGAM LTD. (UPRUVNL)
परामर्शदाता/ CONSULTANT	DEVELOPMENT CONSULTANTS PVT. LTD. (DCPL)
REVIEW CONSULTANT	NATIONAL THERMAL POWER CORPORATION LTD (NTPC LTD.)
परियोजना/ PROJECT	1 X 660 MW PANKI TPS – 400 KV SWITCHYARD

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Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS

Distribution	To	TBEM	TBMM	TBQM	Vendor
	Copies	1	1	1	4

PRE- QUALIFYING CRITERIA (PQR) FOR BIDDERS

Fire Detection and Protection System:

The bidder/its sub-vendor should have designed, supplied, erected and commissioned at least two (2) numbers of Fire protection Systems, each of contract value not less than INR 35.0 million or equivalent in foreign currency (exchange rate applicable as on date of Techno-commercial bid opening), in thermal power plant installations. Each of the above fire protection systems should have comprised of:

a) Fire hydrant system.

b) High velocity water (HVW) spray or medium velocity water (MVW) spray or sprinkler system.

c) Fire water pumping and pressurizing arrangement.

The systems mentioned above should have been designed to the recommendations of Tariff Advisory Committee of India or Oil industry safety directorate (OISD) or any other International reputed authority (like LPC-UK or NFPA, USA) and these systems should have been in successful operation for at least two (2) years prior to the date of techno- commercial bid opening i.e. 02-11-15.

In addition, the analogue addressable type fire alarm system proposed to be supplied shall be sourced from a firm who has supplied at least two (2) similar systems which have been approved or listed by UL-USA/ FM-USA/ LPC-UK/ Similar agency and should have been in successful operation for at least two (2) years prior to the date of techno-commercial bid opening. Further, the Inert gas fire extinguishing system shall be sourced from an agency who has designed and supplied at least two (2) inert gas total flooding fire extinguishing system each having a total risk volume of at least 1000 cum. These systems must have been designed to the recommendation of Tariff advisory committee of India or any other International reputed authority (like LPC-UK or NFPA, USA) and should have been in successful operation for at least two (2) years prior to the date of techno-commercial bid opening i.e. 02-11-15.

In support of the above credentials, the bidder should submit copy of Purchase order along with performance certificate from customer.

(#) Successful operation means certificate issued by the Customer/ end user certifying the operation without any adverse remark.

Only Bidders qualifying PQR requirements will be made technically acceptable for further bid evaluation activity.

SECTION 1
INTENT, SYSTEM REQUIREMENT, DESIGN CRITERIA AND SCOPE

1.0 INTENT OF SPECIFICATION

1.0.0 This specification is intended to cover following activities and services in respect of all the equipment of the **Fire detection and protection System to be provided for 400 kV Substation of 1 x 660 MW Panki Thermal Power Station, Distt, Kanpur** of **UP Rajya Vidyut Utpadan Nigam Ltd. (UPRVUNL).**

i) Detailed design of all the equipment and equipment system(s).
ii) Complete manufacturing including shop testing.
iii) Providing engineering data, drawings, and O & M manuals as per specified format etc. for owners/purchaser's review, approval and records.
iv) Packing and transportation from the manufacturer's works to the site including customs clearance/port clearance, if required.
v) Receipt, storage, preservation and conservation of equipment at site.
vi) Fabrication, pre-assembly, if any, erection testing and putting into satisfactory operation all the equipment including successful completion of trial operation.
vii) Performance and Guarantee tests after successful completion of trial operation.

1.0.1 The requirements specified under SECTION 2, SECTION 3, SECTION 4 & SECTION 5 of the specification shall be considered as part of this section. In the event of any conflict between the various sections/sub-sections of this specification, SECTION 1 shall prevail. ***UPRVUNL contract specification attached with SECTION 2 shall be adhered strictly and requirements of the same regarding systems applicable for switchyard part shall be provided by the contractor.***

1.0.2 It is not the intent to specify herein all the details of design and manufacture. However, the equipment and the system shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to Purchaser/ Owner, who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material, which in his judgment is not in full accordance herewith.

1.0.3 **Contract shall be on lumpsum basis for the scope defined in the specification. Variations in quantities during contract stage without any change in input from BHEL side shall not have any commercial implications. The Bidder shall be responsible for providing all material, equipment and services, specified or otherwise which are required to fulfill the intent of ensuring operability, maintainability and the reliability of the complete work covered under this specification**.

1.0.4 The Bidder shall deem to have understood completely all the tender drawings and documents and quoted accordingly.

1.0.5 **Deviation:** There shall preferably be no deviation on technical specification. The bidder shall sign and stamp the "Certificate for No Deviation" enclosed in Schedule-2, Section-5 towards confirmation. Except for these deviations/variations covered under Deviation Schedules which are accepted by the Purchaser before the award of the Contract, it will be the responsibility of the Bidder to fully meet the intent and the requirements of the specification within the quoted price. *Deviations in any other form including clarifications / assumptions / etc will not be considered and it will be construed that the bid conforms strictly to the specification*.

1.0.6 The Bidder to note carefully that the parameters, estimated capacities of equipment indicated and the tender drawings in the specification are only for the guidance of the Bidder. The system shall be designed as per relevant standards/ codes and exact capacities and quantities are to be estimated by the Bidder. All such estimations and design calculations shall be submitted for Purchaser's approval.

1.0.7 It is the responsibility of the successful Bidder to obtain necessary approval/ clearance from statutory organizations wherever applicable for the equipment/ systems under the scope specified.

1.0.8 The term '**Owner**' appearing in this specification shall refer to **UP Rajya Vidyut Utpadan Nigam Ltd. (UPRVUNL),** the term 'Consultant' shall refer to **DCPL**, the term 'review consultant' shall refer to **NTPC**, the term '**Purchaser'** shall refer to **BHEL** and the term '**Contractor**' shall refer to the **successful Bidder**.

2.0 FIRE FIGHTING REQUIREMENTS FOR VARIOUS AREAS

The makes/models and technical features offered for various firefighting system components/ equipment shall comply with the standards of TAC/ BIS/ UL/ VDs and FM / NFPA/ FOC as applicable The key elements of fire protection cum detection scheme and the related areas are presented as under:

System	Areas Protected
Hydrant System	i. Switchyard Control Building ii. Outdoor 400 kV Switchyard
HVW Spray System	i. 80 MVAr Reactor (1 no.)
Inert gas flooding system	i. Switchyard Control Room
Addressable Fire Detection & Alarm System	i. Switchyard Control Building
Portable Fire Extinguisher	i. Switchyard Control Building

3.0 SYSTEM REQUIREMENT, DESIGN PHILOSOPHY & CONTRACTOR'S SCOPE

This system shall be designed to provide fire detection and protection services for Switchyard and its control Building. The Fire detection, Protection & Alarm system shall be designed in line with the guideline stipulated in NFPA-850 & IS-3034. Design criterion shall be based on "**Ordinary Hazard Occupancies**" classification as described in Tariff Advisory Committee's (TAC) guidelines. All equipment or systems in the designed fire detection cum protection arrangement shall be completely in compliance with the regulations of Tariff Advisory Committee (TAC) of India/ Loss Prevention Association (LPA) / National Fire Protection Association (NFPA)/ LPCB/ VDs.

The responsibility of getting approval from statutory body & TAC accredited professionals rests exclusively on Bidder. This include discussions with authorised approving agencies, arranging inspection at site, revision / modifications as suggested by the authorities for obtaining complete approval of the system and ensure maximum discount for insurance premium to Owner. The Fire Protection, detection and Alarm System shall comply with NFPA -72/72E and IS: 2189 standards

3.1 DETECTION SYSTEM

a) The Fire Detection and Alarm System will comprise of a network of Addressable intelligent multisensor detectors (fire/ smoke), Microprocessor based Fire Alarm Control Panel, Manual Call Points, Modules, Notification Appliances, Cables and other accessories required to form a network (i.e. Terminal Boxes and Junction Boxes).

b) All detection and sensing devices forming an integral part of the microprocessor based, addressable, intelligent fire detection and alarm system shall be approved by UL/ FOC/ Any other internationally recognized body acceptable to the Owner. 100 % hot standby Redundant Microprocessor based Fire Detection and Alarm system shall be provided.

c) In case of fire the detector or device envisaged in respective area will pick up appropriate signal and conveys to fire alarm panel located in respective areas. These signals triggers visual and audio alarms. The system initiates operation of extinguishing systems such as deluge system, sprinklers and transmits alarm and fault signals to predetermined points. The system must ensure that more number of detectors / devices can be connected in a loop and there will be a facility for additional loop modules for future expansion.

d) The fire detectors shall be inherently addressable, which provide continuous surveillance in an area. The Microprocessor based Fire Alarm Control Panel will process the input signals from detectors at various locations of the plant and actuate the respective protection system. The detectors shall be sensitive to very low smoke densities of the order of 0.05 gm/cum.

e) The system will have following self-diagnostic features:

- Detector cabling will be completely supervised for open circuit and short circuit.
- Unauthorized removal of a detector head from its base will be supervised to give a fault alarm on the connected control panel.
- Annunciation will be provided for battery low voltage, battery earth fault, fuse blown and loss of main AC supply.

- Alarm verification features.

f) Addressable multi-sensor type smoke detectors shall be provided in all areas of Control Building except for the Battery rooms, AHU room & Pantry where Addressable corrosion proof rate of rise of heat detector with fixed temperature element shall be provided.

g) Multisensor detectors shall be provided for both above false ceiling and below false ceiling area in all the air conditioned areas of the control building except for the Battery rooms & Pantry where Addressable corrosion proof rate of rise of heat detector with fixed temperature element shall be provided.

h) However combination of both multisensor and photoelectric smoke detectors for above and below false ceiling of inert gas protected areas.

i) Manual call points shall be located as per Cl. no. 6.3.8 of IS 2189. The manual call points will normally be provided for every 30 m distance in indoor areas.

j) The number of Detectors and their location will be so selected such that the internal area of the building is completely covered by the detectors. The zones of individual Detectors will overlap and no blind zone will be left. The design coverage area for detector shall not exceed 25 sq. m for each detector for AC areas and 35-40 m^2 for non A/C areas. However other factors like beam depth and area separation criterion shall also be implemented in deciding coverage of each of the detectors.

k) Detector shall not be mounted within 500 mm of obstruction. However in case of minor obstruction, like light fittings etc. the distance may be reduced to 250 mm. Wherever beam depth exceeds 450 mm and center to center of beam exceeds 2500 mm, separate detector shall be provided for each pocket.

l) For Detectors mounted above false ceiling, a separate response Indicator shall be mounted directly below the detector (on the false roof). When the detector is mounted below the false floor or in inaccessible position, response indicator for each of the detector shall be mounted on a separate box which shall be suitable for mounting on the wall.

m) Two loop Fire Alarm Panel (1 working + 1 spare loop) of analogue addressable type shall be dedicated to Switchyard control building which shall evaluate the signals received from the detectors, transmit the fire or trouble alarms (audio-visual) to pre-arranged points, supervise and monitor the complete fire detection circuits.

n) The 100% hot standby redundant micro-processor based fire detection and fire alarm panel shall be designed such as to have built in redundancy to ensure availability at all times.

o) As a part of Emergency Voice Communication System, telephone set shall be provided with Fire alarm panel. Speaker shall be provided in switchyard control room. Pre-recorded voice messages shall be sounded through these speakers to alert the people.

p) Fire alarm control panel shall have filters to ignore false alarm and increase sensitivity to real fire from sensors and provision for automatic re-calibration of sensitivity levels of over/ under sensitive detectors. The sensitivity of each detector should be automatically raised if detectors are

gradually polluted due to dust and dirt entering inside the detector. If detectors are more polluted the control panel shall give a warning. The trouble report shall indicate the location of device requiring service.

q) All devices shall be individually identifiable for its type, its zone location, and alarm set value, alarm and trouble indication by a unique alpha numerical label. The detectors shall be self-compensating for ambient temperature and humidity. The detectors shall display a steady LED when in the alarm state. The LED shall flash when in standby or normal mode.

r) Complete fire detection, alarm monitoring and annunciation system from the panel shall be operated on DC supply. Further panel shall be provided with Two (2) sets (1 working & 1 standby, 100% capacity) of 24 Volt (2x12V) sealed type maintenance free lead-acid battery with charger for fire alarm panel**,** with provision for automatic change over from mains to batteries, automatic charging etc. The Batteries shall be approved by listing authority.

s) The Battery driven Power supply shall be available to fire panel and shall be designed to provide supply for a minimum period of 10 hours. Minimum ampere hour capacity of the Battery shall be selected accordingly.

t) Bidder shall compute the ampere hour capacity at suitable discharge rate based on above duty and furnish the calculation which shall consider the duty cycle and 25% & 15% compensation for ageing & unforeseen future growth respectively of each battery unit. The maximum and minimum ambient shall be 45^0C and 8^0C respectively. The minimum voltage at the end of the load cycle shall not be less than 1.8 volts per cell.

u) The detector cable and other control cable shall be armored, screened and twisted, PVC Cu. FRLS cables type “S” in external areas and for inside building. Type “S” cable shall satisfy requirements of Article 760 NFPA 70.

v) The wiring shall be of style 7 as per NFPA - 72 with loop/ short circuit isolators.

w) Fire alarm panel of the switchyard will be in ring topology with FAP of the main plant. All the panels will be in a ring, when there will be fire anywhere, all the panels will get signal.

x) Adequate no. of Back-lit maintained type emergency exit signs as per TAC shall be provided.

y) Sounder cum flashers shall be required at the exit gates along with the hooters/ sounders along with Manual call points. With each Manual call Point, hooter/ Sounder flashers shall be considered. The distance between consecutive MCP and Hooter shall be in such fashion that a person should not travel more than 30 mtr distance from the nearest one.

- **INTERFACES**

Fire detection & alarm system will have three interfaces-

i) Interface with air conditioning system of switchyard control building to shut down the AHU equipment in building.

ii) Interface with fire dampers to close it in case of fire.

iii) Interface with Main fire alarm panel in the power plant main control room.

Distance between main plant control room & switchyard control building is **550 m** approx.

Dual redundant optical fiber data highway shall be used to wire switchyard FAP with main plant FAP located in main plant control room. Switchyard fire alarm panel will be put in a ring topology with other panels of main plant FDA, hence necessary network cards requirement shall be ensured accordingly by contractor. *Refer Cl. No. 9.02.05 of UPRUVNL-DCPL Technical specification provided as Annexure to Sec-2 of this technical specification for details regarding FO cable to be provided*.

3.2 Protection System

3.2.1 Hydrant System

a. Hydrant systems for the switchyard area shall be tapped off from main hydrant header for main plant. Double feed will be provided to the switchyard hydrant ring mains from the tap-off point. Each of the tap-off point will be along with a gate valve as indicated in the switchyard layout drawing provided with this specification. These tap-off points will be provided by the purchaser. Minimum water pressure at the tap-off point will be 8.5 Kg/ cm^2 (approx.).

b. **Hydrant system is designed for Ordinary Hazard Classification.**

c. An underground ring shall be formed around the switchyard. Isolation gate valves shall be provided in the ring main so that a portion of the loop can be taken out for maintenance without any loss of system in the balance part. Hydrants valves & water monitors shall be provided in the switchyard fire water piping network as per requirement inline with TAC guidelines. Hydrant risers in staircases shall be provided with isolation valves. Each isolating valve shall be provided with limit switch.

d. Hydrant piping network in switchyard shall consist of hydrants valves & water monitors and shall be provided in the periphery of the switchyard area.

e. System shall be designed in a way so that minimum terminal pressure of 3.5 kg/cm^2 can be maintained at the farthest/remotest hydrant point of the switchyard.

f. All the outdoor hydrants shall be provided with a front glass type hose of FRP type (3mm thickness) carrying 2 nos. 15 mtrs hose along with branch pipe coupling and nozzle.

g. Hydrants shall not be located less than 2m from building. No building shall be deemed to be protected by a hydrant unless such hydrant is within 15 m of the building. When height of the structure, tower exceeds 15 mtr, the concerned hydrant shall be replaced by water monitor.

h. Friction drop shall be calculated based on Hazen Williams's equation considering "C" as 100.

i. However Velocity in Fire water Pipes shall be as per TAC recommendation. The velocity in the hydrant/ Spray header shall not exceed 3 m/sec.

j. All hydrant pipe ring mains/ pipe lines shall be routed underground duly covered with coating and wrapping as per specification. Road, Rail or pipe trench crossing shall be through RCC Hume pipes duly covered with coating and wrapping as per specification. Hume pipe for road crossing shall be NP3 class and that for rail crossing shall be NP4.

3.2.1.0 Specific Data

i) ***Refer Data sheets section of Annexure to Section 2 – UPRVUNL specification regarding equipment specification/ MOC/ standards/ type to be provided for various FPS & FDA items.***

ii) Hydrant valves shall be of 63 NB dia. Single/ double headed, oblique type having Stainless steel construction (SS to IS: 3444) conforming to IS: 5290.

iii) Hoses shall be rubber impregnated woven jacketed type conforming to IS: 636 Type - B. Branch pipes shall be straight jet type conforming to IS: 903, Nozzle type- Hexagonal, detachable. MOC - SS to IS: 3444.

iv) Water monitor shall conform to IS: 8442 of horizontal and vertical swivel type.

v) **PIPING**

Specific features of piping for Fire Protection System shall be as follows: -

1. Pipe thickness shall be 6.35 mm for sizes 200 to 350NB, 7 mm for 400 NB and 8 mm for sizes 450 NB and above.
2. The pipe protection shall be as follows: To prevent soil corrosion, buried pipes shall be properly lagged with 4 mm thick wrapping and coating corrosion protection tape as per IS: 10221.

A. Above ground piping

a. Material GI for spray system after deluge valve / MS for other system

b. Standard (Pipes) IS 1239/ IS 3589. Galvanized as per IS: 4736.

c. Standard (Fitting) IS 1239 part II/ TAC

d. Type of joint Welded / Flanged

e. Type of protection: Painted (Two coats of Grey zinc primer. Two coats of enamel paint of 75 microns thickness with color shade conforming to IS: 5).

f. Class Heavy

B. Underground piping

a. Material MS

b. Standard (Pipes) IS 3589/ IS 1239 Part – I

c. Standard (Fitting) IS 1239 part II for fittings NB 150 & below & Fabricated from parent pipes for NB 200 & above.

d. Type of joints Welded

e. Type of protection IS 10221/ IS 15337-2003.

f. Class Heavy

C. Fittings

i. Unless otherwise specified all elbows/ bends shall be long radius type.

- Minimum thickness to match with that of pipe for pipe size 65 mm NB and above. For pipe size above 150 mm NB, minimum thickness shall be 6 mm. For pipe size 50 mm NB & below rating shall be 3000 lbs or wall thickness matching with that of corresponding pipe.
- The material shall conform to ASTM A234 Gr. WPB or ASTM A 105.

ii. Fittings (Normally filled with water): Elbow, Tee & Reducers.

All fittings and flanges for galvanized pipes shall be galvanized as per IS: 4736.

- Screwed Fittings up to 50 mm diameter
- Butt welded fittings 65 NB to 150 NB
- Site fabricated from parent pipe and fabricated as per BS: 2633/ BS: 534
- (90 degree elbow 3 cut, 4piece construction. 45 deg. elbow 2 cut, 3 piece construction)
- Slip-on flanges/blind flanges as per IS: 2062 Gr.A, Dimension/ Drilling standard as per ANSI B 16.5/ IS-1538 Table IV & VI F/F.
- SS-304 for Bolt & Nuts.

D. VALVES

i) All isolation valve/cut-off valves shall be CI as per IS: 210, FG 260 body, with 13% Cr. SS stem & seating surfaces of gate valves as per guidelines/requirements specified in TAC. All butterfly valves shall be CI as per IS: 210, FG 260 body, SS to AISI: 410 stem & seating surfaces of gate valves as per guidelines/ requirements specified in TAC manual. All globe/ check valves of sizes 50 NB and below shall be gunmetal valves conforming to IS: 778. These valves shall have screwed ends.

ii) Gate valves shall be outside screw rising spindle type for above ground Piping and Non Rising Spindle type for underground Piping.

iii) Gate valves shall be provided with hand wheel, position indicator, pressure-equaliser for valves 350 mm NB and above and drainage arrangement. Limit Switches shall be provided in all isolation valves include gate and butterfly valves. Gate valve shall be provided with back seating bush to facilitate gland renewal during full open condition.

iv) Globe valve shall have adequate profile for controlling action, check valve shall be swing check type and shall have arrow inscription to show the direction of flow.

v) Whenever any valve is found to be so located that it cannot be approached manually from the nearest floor/gallery/platform, hand wheel with floor stand or chain operator shall be provided for the same.

vi) For the operation of valves located in the valve pits, suitable arrangement shall be provided to operate the valves from the ground level (i.e. from the top of Valve Pit). For this purpose wrench-operated valve may be looked for.

vii) All check valves of sizes 65 NB and above shall carbon steel valves conforming to BS: 1868: all

globe valves of sizes 65 NB & above shall be CI valves confirms to BS: 5152 Valve shall have provision of locking arrangements in open and closed position. All the flanges & counter flanges will conform to IS-2062 Gr. A Slip on (Dimension/Drilling as per ANSI B 16.5 Cl. 150 /IS: 1538) All valves shall be of Minimum class of 150. Strainer Body shall be as per IS: 2062 (tested).

viii) All fitting used in GI piping shall be threaded type. Welding shall not be permitted on GI piping.

ix) All piping system shall be capable of withstanding the maximum pressure (1.5 times of the maximum working pressure) arising from any condition of operation and testing including water hammer effects.

x) Cast iron gate/sluice valve will be used for isolation of flow in pipe lines and shall be as per BS-5150. Valves shall be of rising spindle type. PN 1.6 class.

3.2.2 HVW Spray System

- HVW Spray system is envisaged for reactors, 80 MVAr – 1 no.
- One no. tap-off point for HVW spray system of 150 NB size along with a gate valve will be provided as indicated in switchyard layout enclosed. This tap-off point will be provided by the purchaser.

I. General

a. System shall be pressurized continuously to normal working pressure up to the Deluge valves.

b. It shall consist of spray main tapped from the main spray header of power plant, Deluge valve, Isolation valves, Y-type strainer, spray nozzles/ projectors, spray nozzles piping network, detection system, instrumentation, junction boxes, cables etc.

c. Switchyard Spray System shall be tapped off the main spray header of power plant.

d. Minimum pressure at this tap-off point will be 8.5 Kg/ cm^2 (approx.).

II. Design Criteria

a. The system for HVW spray system shall consist of water supply system, suitable number of spray nozzles, deluge valve, quartzoid bulb detectors, strainers, pipes and necessary valves, instrumentation, junction boxes, cables etc. Deluge valves shall be UL listed for complete valves & trim assembly.

b. Minimum running water pressure at any projector/spray nozzle shall be not less than 3.5 Kg/ Sq.cm and not greater than 5.0 Kg/ sq.cm.

c. Design discharge density shall be as per the rules of water spray system of Tariff Advisory Committee (TAC). Discharge density for HVW spray system shall be 10.2 lpm /sqm. The velocity in feed pipes shall not be more than 10m/s as per cl. No. 3.2.3.6.2.7 of TAC manual for Spray System.

d. Gate valve shall be provided at upstream & downstream of each of the deluge valve. The size shall be same as that of the deluge valve.

e. Fast acting butterfly valves will be provided in the bypass line of deluge valve, so that this valve

can be kept closed and can be operated manually, if there is any malfunction of deluge valves. Butterfly valves shall of CI as per IS: 13095.

f. Water motor gong shall form part of accessories to be provided with deluge valve. Local audible alarm is produced by water motor gong.

g. A strainer ('Y' type) shall be provided at upstream of deluge valve. Strainer body shall be MS fabricated as per IS: 2062 and internal shall be of SS.

h. Strainer wire shall be SS (AISI 316), 30 SWG, and 30 mesh. Strainer area shall be at least 4 times the pipe cross-section at the pipe inlet, pressure drop across strainer in clean condition shall not exceed 1.0 kg/cm^2 at design flow of deluge valve.

i. Limit switch (open & close) for Deluge valves shall be provided for upstream & downstream isolation valve.

j. Pressure gauges at both upstream and downstream of deluge valves, and in the detector pipe network shall be provided.

k. Pressure switches shall be provided in spray and detector piping to exhibit "FIRE" and "SPRAY ON" annunciations and as well as for interlock.

l. Wet type detection shall be provided for actuating the Deluge system. QB detectors are set at 79ºC. At the preset temperature the detector burst and releases the pressure with the detector piping network around the reactor & actuating the flow of water across deluge valve.

m. Sprayers/ projectors/ nozzles shall be arranged in the form of a ring around reactor and number of such rings/ tiers shall be decided considering maximum gap between two (2) consecutive tiers of rings shall be as per TAC. The distance of the deluge valves from the protected equipment shall be 6 m (min.) in line with TAC manual.

n. MOC for HVW spray nozzles shall be SS-304.

o. Pipe structure for pylon support around reactor shall be fixed to the bottom of sump with the help of Anchor fasteners. The structure will be in two pieces with a flanged joint at around Zero level above chequered plate. Pipe size for pylon, size of Anchor fasteners etc. shall be adequate for the support to provide sufficient rigidity against vibration & load during operation.

p. As per the modern practice of fire detection system, all Deluge Valves (DV's) will be networked to Micro-processor analogue addressable Fire Alarm Panel.

q. Facility for manual initiation of deluge valves locally, through hand operations (manually by operating the push button) shall also be provided.

r. Each of the outdoor deluge valves and its accessories shall be provided with deluge valve housing. (As per TAC).

s. Local control panel for deluge valves shall be provided. Remote actuation of the deluge valve shall be provided.

3.2.3 INERT GAS SYSTEM:

a) Following areas shall be protected with inert gas extinguishing system:

i) Switchyard Control Building:

- Control room

b) Inert gas system shall strictly comply with Cl. No. 24.4.5 of DCPL Firefighting specification provided as Annexure – 1 to Sec – 2 of this specification.

c) The inert gas system shall employ IG-01, IG-100, IG-55 or IG-541 as per NFPA-2001.

d) The System consists of gas release panel, cylinders, nozzles, directional valves, check valves, manifolds etc.

e) The gas release panel shall be power by 230 V AC. Standby power supply shall be catered by 24 V DC batteries. The gas release panel shall have a battery backup for 24 hours of normal condition and 15 minutes of alarm condition.

f) The gas release panel of the cylinder bank shall be connected to the main fire alarm panel located in control room for FIRE signal.

g) All cylinder and its components shall be UL/ FM/ LPCB/ VDS listed. Other items like pipes, fittings, cables, gas release panel etc. shall be as per OEM standard.

h) Common cylinder bank with directional valve systems are provided for each protected area. Main cylinders will be calculated based on the single largest risk in each protected area and these cylinders will be located in the cylinder storage room near the protected area.

i) 100% standby inert gas cylinders shall be provided.

3.2.4 Portable Fire Extinguishers

- The switchyard control building including cable spreader room shall be provided with:
  a. Carbon dioxide of 4.5 kg capacity portable fire extinguisher conforming to IS 15683.
  b. Dry chemical powder type 6 kg capacity portable fire extinguishers conforming to IS 15683.
  c. Trolley mounted 22.5 kg CO_2 extinguisher conforming to IS 2878 shall be provided for control room.
  d. Trolley mounted 50L mechanical Foam type extinguisher shall be provided inline with the requirements as per TAC guidelines.
- Mobile extinguishers shall be provided with a wheeled trolley for movement. Trolley mounted extinguishers shall be provided with 6 or 9 meter long high pressure discharge hose with horn/ telescopic applicator.
- Spanner and other accessories as required shall be supplied with each fire extinguisher.

- As required by Tariff Advisory Committee (TAC), 20% spare charge of the total no. of extinguishers installed, with a minimum of six recharges, shall be supplied for each type of extinguishers.
- Fire extinguishers shall be fitted with pressure gauges as applicable to indicate whether the extinguisher is charged or in need of a recharge.
- Selection of type and location of installation of fire extinguishers for the various rooms of the switchyard control building shall be done in accordance with TAC guidelines.
- All extinguishers shall be mounted at strategic locations in bunches and/or individually to TAC approval. These extinguisher cylinders shall have the approval of Chief Inspector of Explosive (CIE), Nagpur.

4.0 MANDATORY SPARES

1.0	**FIRE HOSES WITH COUPLINGS**	**Qty.**
1	7.5m long fire hoses with end connectors	10% of population
2	15 m long fire hoses with end connectors	10% of population
2.0	**BRANCH PIPES WITH NOZZLES**	
1	Nozzles with branch pipes quick coupling ends	10% of population
2	Nozzles of water monitors	10% of population
3.0	**DELUGE VALVE ASSEMBLIES**	
1	Complete deluge valve assembly alongwith internals	10% of population each type
2	Clapper assembly complete (consisting of clapper seat rubber, screws, etc.)	10% of population
3	Solenoid coils	10% of population each type
4.0	**VALVES (GLOBE/BUTTERFLY/NRV)**	
1	Complete valves	10% of population of each type and size with minimum 1 No.
2	Reduction gear operator (globe/butterfly)	10% -do-
3	Flap/Door with pin (NRV)	10% -do-
4	Disc (butterfly/globe)	5% -do-
5	Gate (gate valve)	5% -do-
6	Stem (all types)	5% -do-
7	Seal rings (all types)	10% -do-
8	Flap rings (NRV)	10% -do-
9	Gaskets	10% -do-
10	Bearing (butterfly valve)	10% -do-
5.0	**Y-TYPE STRAINERS**	
1	Strainers elements with 0-rings and stiffners.	20% -do-
6.0	**HVW SPRAY SYSTEM**	
1	Spray nozzles	10% -do-

2	QB Detectors	20% -do-
7.0	**HYDRANT VALVE**	
1	Hydrant valve complete (internal) single headed with instantaneous female coupling	20% of population
2	Hydrant valve complete (external) single headed with instantaneous female coupling	20% -do
3	Hydrant valve complete(double headed) with instantaneous female coupling	10% -do-
4	Water monitor sets with nozzle branch pipe etc.	10% -do-
5	Spindle with nuts of Hydrant valve	10% -do-
6	Bonnet, gland nut, rubber assembly of hydrant valve	10% -do-
7	Seat, check nut, washer assembly of hydrant valve	10% -do-
8	Rubber washer for female coupling	20% -do-
9	Instantaneous female coupling assembly complete for hydrant valve	20% -do-
10	Lock pin assy for hydrant valve	20% -do-
8.0	**SMOKE / HEAT DETECTORS**	
1	Photo-electric type detector(Addressable)	10% of population
2	Ionisation type detectors(Addressable)	10% -do-
3	Indicators assembly for smoke detectors provided in false ceiling	5% -do-
9.0	**FIRE ALARM CONTROL/ANNUNCIATION PANELS (Addressable)**	
1	Auxiliary relays/Contactors	10% of population
2	Control cards for annunciation facia, fire detection system, gas extinguishing etc of each type	10% -do-
3	All PCB assembly cards, loop cards including mother boards etc.	10% -do-
4	LCD display units of panels	10% -do-
5	Interface units/ modules for non-addressable devices, output relay modules, supervisory control modules etc	10% -do-
6	Power supply modules	10% -do-
10.0	**PORTABLE EXTINGUISHERS**	
1	Portable extinguishers	10% of each type & size
	a) Water Type	
	b) Foam Type	
	c) CO_2 Type	
	d) Dry Chemical Type	
11.0	**INERT GAS EXTINGUISHING SYSTEM**	
1	Nozzles	2 No. of each type & size

2	Automatic & Manual release system	1 No. of each type & size
3	Cylinder valve with safety pressure relief device	1 No. of each type & size
4	Gas cylinder	5 No. of each type & size
5	Flexible hoses(if applicable)	2 No. of each type & size
6	Solenoid coils	2 No. of each type & size

5.0 SCOPE OF SUPPLY & SERVICES

5.1. Exact requirements shall be worked out during detailed engineering after award of contract. The scope of the work under the contract shall be deemed to include all such items, which although not specifically mentioned in the bid documents and/or in the bidder's proposal, but are required to make the equipment/system complete for its safe, efficient, reliable and trouble free operation, unless the same is specifically excluded from the Bidder's scope of work under clause 5.0 of this section.

5.2. Bidders shall consider makes for various equipments as per Annexure B which shall be subjected to Owner's approval during design engineering stage. Price implication to BHEL later on account of non-acceptance of proposed vendors by Owner shall not be considered.

5.3. Bidder shall also consider the following while quoting for the system:

i) Power & Control cables for fire protection system (except for cable for detection and alarm system & FO cable) will be supplied on free issue basis to contractor. BHEL shall procure various sizes of cables (as per Annexure 'A' of this section) for the complete requirement of sub-station. Contractor shall have to choose their cables from the available sizes only and necessary modifications in their equipment for termination of these cables shall be made by contractor.

ii) Since laying & termination of all power & control cables is in contractor's scope, supply of cable accessories such as lugs, glands, cable tags & markers etc. shall be included by the bidders in their offers alongwith supply of cable (2C X 1.5 sq.mm, FRLS, twisted pair, armoured Cu cable & FO cable) for fire detection and alarm system.

iii) Necessary cable trays will be supplied on free issue basis to the contractor, however necessary hardware for fixing the same on walls or elsewhere shall be included by the bidders in their offers.

iv) Earthing material viz. GS flat & wire will also be supplied on free issue basis to contractor; however requirement shall be given by the bidders in their respective bids.

v) Bidder shall ensure that sufficient quantities of commissioning spares are made available for timely completion of commissioning of the system. The bidder shall furnish a list of Commissioning spares that will be brought by him. The unused commissioning spares shall be returnable to the bidder.

vi) The contractor shall lay the underground piping required for hydrant system and also shall construct RCC pedestals & pylon supports for above ground pipe if required.

vii) Pipe size for pylon, size of Anchor fasteners etc. shall be adequate for the support to provide sufficient rigidity against vibration & load during operation. The whole arrangement shall be in bidder's scope. The contractor shall justify adequacy of design during engineering.

viii) Conducting performance guarantee tests as per approved procedure to the satisfaction of Owner / Purchaser and handing over an operational system to the owner. Procedure for performance guarantee test shall be submitted by contractor for customer review and approval.

ix) Contractor shall submit valid Type test report for approval by owner. Fresh type test of equipment is not envisaged. It is presumed that equipment offered is duly type tested.

Type Test Certificate for degree of protection shall be submitted for all the electrical panels shall be as per customer specification.

In case the type test reports are found un-satisfactory, tests shall be carried out afresh by contractor without any additional cost implication to BHEL.

5.4. Scope of Services

A. Erection, Testing & Commissioning (ETC) requirements

i) The scope of ETC shall include receipt of material at site, unloading, safe storage of material, handling of equipment/ material at site, erection of equipment /material at site including fabrication, equipment and system testing, commissioning of the entire system, conducting performance guarantee tests to the satisfaction of Owner / Purchaser and final handing over to the owner of the entire system.

ii) Furnishing technical calculations in support of equipment selection or sizing as and when required.

B. With Other Electrical System

i) Preparations of cable interconnection diagram for equipment supplied under this contract and accordingly offer guidance to the purchaser for laying necessary cables. Termination details shall also be furnished in the said interconnection table.

ii) Laying & Termination of Power and Control cables for the equipment under the scope of this specification. Bidders shall include all cable accessories like lugs, glands, cable tags, markers etc in their respective bids.

iii) Earthing of all installations (to the nearest earth mat/ earthing pad) supplied under the scope of this specification.

C. With Civil System

i) Providing location of pipes crossing the road & trenches and laying of adequately sized Hume pipes.

ii) Making RCC pedestals for above ground piping wherever required.

D. All machinery tools & tackles and consumables required for erection/testing / commissioning of the system shall be arranged by the Bidder.

E. Minor modifications, alterations in system installation as per customer's specific requirements shall be done without any extra cost to purchaser.

F. Bidders to ensure that sufficient quantity of spares are made available for timely completion of commissioning of the system. The bidder shall furnish a list of commissioning spares that will be brought by him. The unused commissioning spares shall be returnable to the bidder.

G. **Obtaining approval from TAC/ TAC accredited agency on documents & installations.**

i) Obtaining, "As Built" certification from purchaser or owner on applicable drawings. Completing documentation as per specification requirement.

ii) Obtaining customer's written acceptance of satisfactory completion of job. (Acceptance of PG + handing over of plant and mandatory spares (if any)).

iii) Any other service not explicitly illustrated herein but which may be required to complete the system with its desired functionality or in the spirit of contract shall also deemed to be under the scope of bidder.

H. Civil Works

Major civil works such as foundations, cut outs etc, shall be in Purchaser's scope. The Bidder shall however supply foundation bolts & hardware and undertake minor civil works such as grouting, filling up of crevices/ cut outs etc. Any damage caused to civil works during ETC work of the equipment/system shall have to be made good to the original finish by the Contractor at no extra cost to the Purchaser.

In addition the following shall be in the scope of Contractor:

i) Laying of underground piping and construction of RCC pedestals to support the above ground piping for hydrant wherever required.

ii) RCC supports to the base of pylon pipes (if required) of HVW system of various transformers/ reactors.

iii) Each of the outdoor deluge valves and its accessories shall be provided with deluge valve housing. (As per TAC). Construction of deluge valve housing with RCC roof and its painting (inside & outside).

6.0 Exclusions

a) Supply of power & control cables except for detection cable. However laying and termination of these cables shall be in contractor's scope. ***The bidder shall furnish quantity and type of cables required complete system in their respective bids. Laying & termination is in contractor scope.***

b) Supply of necessary cable trays for laying power and control cables, however hardware for fixing the same on wall trenches or elsewhere shall be included by the bidder in his bid.

c) Supply of GI flat for earthing of equipments.

7.0 Painting

Painting of Pipes

A. Buried Piping

Internal surfaces

i. Surface cleaning by sand blasting.
ii. Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
iii. Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.
iv. The total dry film thickness of 150 microns.
v. Tests to be carried out after application: Bond/ Adhesion test, Holiday test

External surfaces

i. Surface cleaning by Sand Blasting.
ii. Coal tar primer compatible with coal tar enamel grade. The number of coats shall be two with a DFT of 35 microns each.
iii. Coal tar enamel shall be applied. A single spiral inner wrap of glass fibre tissues shall be applied overlapping at least 25 mm ensuring impregnation of glass fibre tissues in the first coat. The second coat of enamel and second outer wrap of glass fibre felt, Type – I to IS: 7193-1974 will be applied in the same way confirming to Table – 10 of IS –10221 – 1982.
iv. The total thickness of the coating will not be less than 4.0 mm
v. Alternatively wrapping with coal tar based anticorrosion tape conforming to IS 15337: 2003 is also acceptable in lieu of s.no. (iii) above. Wrapping thickness shall be 4.0 mm.

NOTE: CW piping shall be encased in 500 mm thk RCC.

vi. Tests to be carried out after application: Bond/ Adhesion test, Holiday test

B. Overground Piping

Internal surfaces

i. Surface cleaning by sand blasting.
ii. Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
iii. Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.
iv. The total dry film thickness of 140 microns (min).

External surfaces

i. Surface cleaning by Sand Blasting.
ii. Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
iii. Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

iv. The total dry film thickness of 140 microns (min).

Other requirements

a) Paint manufacturer's instructions shall be followed in method of application, handling, drying time etc.
b) The color of the finish paint shall be as per approved color-coding.
c) If finish paint was applied in shop, one coat of finish paint shall be applied at site.
d) The dry film thickness of paint shall not be less than 0.15 mm.

Color code for identification

The pipes shall be color painted/banded for identification as per the approved color-coding scheme and shall be generally as per IS-9404.

8.0 Engineering Drawings/ Documents

Engineering shall start immediately after the award of the contract.

Submission of all drg. / data sheet – Within 6 weeks from the PO date.

Approval of all drg. / data sheet – Within 9 weeks from PO date.

8.1 OPERATION & MAINTENANCE (O&M) MANUAL

Operation and Maintenance manuals shall be specifically compiled for the project by the bidders. The draft O&M manual shall be submitted along with the supply of the items. The O&M manual shall contain the following information:

a. Description of the system and equipment with design particulars.
b. Instruction for erection.
c. Instruction for operation, maintenance and repair.
d. Recommended inspection practices and inspection schedule.
e. Ordering information for all replaceable parts.
f. Recommendation for type of lubricants and frequency of lubrication.

9.0 Handing & Taking Over

It is the responsibility of the contractor to maintain the plant till it is handed over. Any defect noted during the period shall be rectified by the contractor without any price implication to BHEL. Also suitable PG tests shall be conducted by the contractor to show the achievement of guaranteed parameters in line with the requirements of specification/ standards/ codes and to the satisfaction of Purchaser/ Owner.

10.0 Various Heads to be quoted for

9.1.1 Based on the above input it is recommended that the bidders shall submit their LUMPSUM offers in the prescribed format only

TABLE- I

Sl. No.	Item Description	Unit	Qty	Ex-works Rate	Total Ex-works	ETC rate	Total ETC price
1.0	Hydrant System	Lot	1				
2.0	HVW Spray System	Lot	1				
3.0	Inert gas flooding system	Lot	1				
4.0	Fire Detection system	Lot	1				
5.0	Portable Extinguishers	Lot	1				
2.0	Supply of Spares	Lot	1			NA	
Total LUMPSUM Price FOR THIS PACKAGE							

9.1.2 It may be noted that BOQ furnished by the bidder against main heads as per Table-I in Cl. 9.1.1 shall not be considered as limits to scope of supply and ETC. Being a lumpsum offer, any other item, which is not specifically mentioned in this specification 'OR' any item not considered by the bidder in his BOQ 'OR' additional quantity of any given item in Bidder's BOQ, which is required for satisfactory operation of the system shall be supplied and erected without any additional cost implication to BHEL.

10.0 Inspection & Testing

All the equipments shall be inspected prior to dispatch in line with relevant IS, approved GTP/ drawing and technical specification, BHEL/ customer approved QAP.

ANNEXURE-'A'

CABLE SIZES BEING PROCURED BY BHEL FOR SUB-STATION

2C x 2.5 sq mm PVC/Copper, Armoured Control Cable
5C x 4 sq mm PVC/Copper, Armoured Control Cable
5C x 2.5 sq mm PVC/Copper, Armoured Control Cable
7C x 2.5 sq mm PVC/Copper, Armoured Control Cable
10C x 2.5sqmm PVC/Copper, Armoured Control Cable
14C x 2.5 sq mm PVC/Copper, Armoured Control Cable
19C x 2.5 sq mm PVC/Copper, Armoured Control Cable
2C x 10 sq.mm XLPE/Aluminium, Armoured Auxiliary Power Cable
4C x 16 sq.mm XLPE/Aluminium, Armoured Auxiliary Power Cable
3.5C x 35 sq.mm XLPE/Aluminium, Armoured Auxiliary Power Cable
3.5C x 95 sq.mm XLPE/Aluminium, Armoured Auxiliary Power Cable
3.5C x 400 sq.mm XLPE/Aluminium, Armoured Auxiliary Power Cable
1C x 50 sq.mm XLPE/Aluminium, Armoured Auxiliary Power Cable
1C x 630 sq.mm XLPE/Aluminium, Armoured Auxiliary Power Cable

ANNEXURE- B TO SECTION-1

11.0 Sub-Vendor List

Bidder shall choose make of materials from list enclosed in Annexure-B to this section only. However final applicable make is subject to ultimate customer approval. Bidder can provide any other make that is not included in the list only if it is acceptable to ultimate customer without any cost implication to BHEL.

SUB-VENDOR LIST FOR FIRE FIGHTING SYSTEM

S.N.	ITEMS	APPROVED SUB-VENDOR	PLACE	REMARK
1	HYDRANT VALVES & BRANCH PIPE, NOZZLES & COUPLINGS	SHAH BHOGILAL KALPANA NEWAGE H SARKAR VENUS	AHMEDABAD AHMEDABAD SURENDRA NAGAR KOLKATA	ISI MARKED ISI MARKED ISI MARKED ISI MARKED
2	STRAINERS (Y-TYPE & BASKET TYPE)	SAROJNI ENTERPRISES JAYPEE INDUSTRIES	NEW DELHI MUMBAI	ISI MARKED
3	FITTINGS & FLANGES	M S FITTINGS METAL LLOYDS BHARAT FORGE TUBE PRODUCTS NITIN PROFILE	KOLKATA MUMBAI PUNE BARODA BARODA	
4	MS/ GI ERW PIPES	JINDAL SURYA ROSHINI GOOD LUCK TUBES TATA	GHAZIABAD BAHADUR GARH SIKANDRABAD JAMDESHPUR	ISI MARKED
5	FIRE HOSES	NEWAGE CHATTARIA RUBBER	SURENDRA NAGAR BARUCH	ISI MARKED ISI MARKED
6	DELUGE VALVES	HD FIRE	THANE	UL/FM
7	HV SPRAY NOZZLE	HD FIRE KIDDE (I) LTD. TYCO	THANE MUMBAI USA	UL/FM / LPCB/VDS APPROVED
9	QUARTZOID BULB SPRINKLERS	TYCO/ HD FIRE NEWAGE INDUSTRIES	USA MUMBAI	UL/FM/ LPCB/ VDS
10	SOLENOID VALVE	ROTEX	BARODA	

		AVCON	MUMBAI	
11	MICROPROCESSOR BASED FIRE ALARM PANEL, DETECTORS & OTHER ALARM DEVICES	SIMPLEX SCHRACK BOSCH ESSER HONEYWELL NOTIFIER EST (EDWARD SIGNATURE SERIES)	USA AUSTTRIA GERMANY FRANCE FRANCE USA	UL/FM/ VDS APPROVED
12	COATING & WRAPPING MATERIAL/TAPE	MP TAR PRODUCTS RUSTECH IWL	BHILAI MUMBAI	
13	CAST IRON GATE VALVE & AIR RELEASE VALVE	SHAH BHOGILAL KALPANA NEWAGE H SARKAR VENUS	KOLKATA JALLANDAR KOLKATA	ISI MARKED
14	PRESSURE GAUGE	AN INSTRUMENTS H GURU	KOLKATA KOLKATA	
15	PRESSURE SWITCH	INDFOS SWITZER SOR INC. DRESSER INDUSTRIES INC.	GHAZIABAD CHENNAI USA USA	
16	PAINT	SHALIMAR ASIAN PAINTS BERGER		
17	POWER & CONTROL CABLE	TORRENT POLYCAB DELTON, PARAMOUNT		ISI MARKED
18	OPTICAL FIBER CABLE	FINOLEX POLYCAB		ISI MARKED ISI MARKED
19.	FIRE EXTINGUISHER	KANEX SAFEX		ISI MARKED ISI MARKED

SECTION - 2

EQUIPMENT SPECIFICATION

2.0 CODES AND STANDARDS

The design, manufacture, inspection and testing of complete system shall comply with the latest applicable Indian/British/American standards. The equipment shall conform to the latest edition to the following standards:

a. "Fire Protection Manual" - Issued by the Regional Committees of Tariff Advisory Committee (TAC).
b. Underwriters Laboratories of USA
c. LPCB – United Kingdom
d. National Fire Codes of National Fire Protection Association (NFPA) of USA.

2.1 GENERAL DESIGN AND CONSTRUCTIONAL REQUIREMENT

It is not the intent to specify herein all the details of design and manufacture. However the equipment and the system shall conform in all respects to high standards of design engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser /Owner who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgment is not in full accordance herewith.

- **DCPL - UPRVUNL technical specification for firefighting system is provided as Annexure to Section-2. This Annexure contains specification for the entire thermal power plant however contractor shall adhere to requirements mentioned in this annexure that is applicable to switchyard portion of the project.**

- **Equipment specification stipulated in Annexure to Sec-2 shall be strictly adhered to for various items to be provided as a part of firefighting package for the Switchyard.**

2.2 SHOP & SITE TESTS

2.2.1 SHOP TESTS

All acceptance and routine tests in accordance with relevant IS codes/standards shall be carried out by the contractor/manufacturer as per BHEL/ Customer approved QAP. Charges for all these routine and acceptance tests for all the equipment & components shall be deemed to be included in the bid price.

Contractor shall submit the QP for all such equipments calling inspection/ testing for purchaser's approval in the prescribed format enclosed as Schedule-5 in Section 5 of the technical specification. This Owner/Purchaser approved QP shall be the basis of inspection/ testing.

2.2.2 SITE TESTS

The Contractor shall prepare and submit detailed field quality plans in the format prescribed, setting out the quality practice and procedures to be adopted by him for assuring quality of each equipment/material from the receipt of material at site, during storage erection, pre-commissioning to final commissioning of the system. These procedures shall necessarily include all checks/tests conducted at site for preservation, assembly, alignment, positioning of equipment, foundation preparation, welding/bolting heat treatment, non-destructive examination, hydraulic test, running test, performance test etc.

Performance test and guarantee

After erection at site, the Fire Protection system shall be subjected to tests to show achievement of guaranteed parameters in line with the requirements of specification/ standards/ codes and to the satisfaction of Purchaser/ Owner.

The Contractor shall take full responsibility for the safe and efficient operation of each of the equipment as well as the whole system. If the shop/ site tests indicate failure of the equipment or if the system does not meet the guarantee in any respect, the Contractor may be required to make alterations in the system/ equipment. Such alterations shall be carried out after purchaser's/ Owner's approval at no extra cost to purchaser. Additional tests required to show the effect of such alterations should also be performed at no extra cost to Purchaser. Above mentioned tests shall be carried out separately for each sub-system. All the testing instruments shall be tested/ calibrated in accordance with the applicable codes & standards. Under PG testing, interlocks, protections, vibrations & noise levels shall also be checked. Detailed procedure for PG test shall be submitted by the contractor in advance. The Contractor shall give guarantee of satisfactory and trouble free operation of the equipment/ systems for a duration described in Section-3 of this specification.

The following codes and standards shall be applicable for conducting test unless otherwise modified or supplemented by the enclosed procedure and mutually agreed to between the purchaser and contractor.

1. NFPA – 72 E3: Standard on Automatic Fire Detectors.
2. Fire Protection manual of TAC (Latest edition) IS 3034: Fire safety

24.0 FIRE DETECTION, ALARM & PROTECTION SYSTEM

24.1 INTRODUCTION.

This section covers the requirements envisaged for Fire Detection and Protection System including Alarm and Communication which will be used to control any outbreak of fire in the 1 x 660 MW Unit and its auxiliary plants to reduce consequential damages by containing and extinguishing the same. Bidder's scope of work covers system design, engineering, manufacturing, supply, assembly, packing, transportation FOR Site including shop painting, final painting at site, freight and transit insurance as applicable for all materials and equipment,, warehousing, field construction, erection, connecting piping and wiring, cabling, shop and site tests, putting them into successful commissioning of the entire fire detection and protection system including supply of all fire extinguishing equipment and systems, fire detectors, manual call points, heat sensing cables, all local, remote and repeater panels, computers and peripherals, hardware and licensed versions of software as detailed hereunder, meeting all code requirements to make the system complete and all other services as specified in relevant sections in accordance with the intent and requirements of this specification. A comprehensive Fire Detection, Protection & Alarm System shall be provided by the Bidder covering all the areas of the power plant.

Various types of protection systems and associated equipment / system components shall be completely in compliance with the regulations of Tariff Advisory Committee (TAC) of India/NFPA. **The Fire detection, Protection & Alarm system shall be designed in line with the guideline stipulated in NFPA-850 & IS-3034.** BIDDER shall also obtain necessary approvals from the local statutory body and authorised fire protection and detection system insurance agencies as applicable for the complete system. This include discussions with authorised approving agencies, arranging inspection at site, revision / modifications carried out at site as suggested by the authorities/ Owner for obtaining complete approval of the system and ensure maximum discount for insurance premium to Owner. The responsibility of getting approval from statutory body & TAC accredited professionals rests exclusively on Bidder. This include discussions with authorised approving agencies, arranging inspection at site, revision / modifications as suggested by the authorities for obtaining complete approval of the system and ensure maximum discount for insurance premium to Owner. Any other additional equipment not specifically mentioned in the technical specification but is found necessary to meet the requirements of TAC & local statutory body and also for safe and sound operation of the plant are to be included at no extra cost to Owner. It is Bidder's responsibility to take care of all Site routing / modifications as suggested by approving agency and Owner related to fire protection and detection system during erection and commissioning time without any price implication to Owner.

Filtered Water shall be used for firefighting system. The fire pumps shall be installed in the Clarified water pump house. Fire water pumps shall draw their supply from Clarified water reservoir. Pumps shall be installed in such a manner that water available in the reservoir for fire water requirements is atleast equivalent to the quantities as specified.
Effective capacity of fire water storage shall be decided based on TAC requirements. However the effective capacity, in any case, shall not be less than 2500 cum with all accessories as specified.

24.2 SYSTEM DESCRIPTION

The complete system is divided into the following systems:-

i) Fire Protection System
ii) Fire detection and alarm system
iii) Fire Station and Other facilities.

24.3 FIRE PROTECTION SYSTEM:-

Following types of Fire Protection system shall be provided.

i) Hydrant System.
ii) Automatic High and Medium Velocity Water Spray Systems.
iii) Automatic Fixed Foam system for Fuel Oil storage Tanks.
iv) Automatic inert Gas system.
v) Portable and Mobile Fire Extinguishers.

24.4 DESIGN CRITERIA

24.4.1 CODES AND STANDARDS

The Complete Fire detection and protection ssystem shall be designed in Conformity with Tariff Advisory Committee (TAC) / IS 3034 / NFPA, USA. Any other Standard which are not mentioned in the technical specification but are found necessary to meet the requirement of TAC and also for safe and sound operation of the plant are to be included at no extra cost to the employer.

All equipment in the entire fire protection & detection system shall have the approval from one of the followings:

i) UL of USA
ii) LPCB-UK
iii) BIS-India
iv) FM-USA
v) VDS- Germany

However, the design and installation of complete system and requirement shall be approved by statutory authorities.

24.4.2 DESIGN PHILOSOPHY FOR HYDRANT SYSTEM.

The Plant is covered under “Ordinary Hazard” according to TAC. The Hydrant System of Fire Protection essentially consists of a large network of pipe with suitable number of Ring Mains, both underground and over ground which feeds water to number of hydrants valves – indoor as well as outdoor and to number of outdoor type fixed installations and Water Monitors. Water in the pipe network shall be kept pressurised by jockey pump arrangement. These hydrant valves / Water Monitors shall be located throughout the entire powerhouse and other buildings. Hosepipes of suitable lengths fitted with standard accessories like branch pipes, nozzles etc. are kept in “Hose Boxes” along with each Hydrant for both indoor & outdoor. When the fire hoses are coupled to the hydrant valves through the instantaneous coupling, jet of water will be directed towards the fire. Where the height of the Hazard is more than 15 mtr corresponding Hydrants will be replaced by 75mm Water Monitors.

Operation of hydrant system shall be semi-automatic. A pressurised hydrant / spray main shall be maintained through the jockey pumps. Small system leakages will be met up by make-up water supply from jockey pump. Jockey pump shall cut-out automatically when the pressure reaches the higher limit. When hydrant valves in the hydrant system or deluge valves in the water spray system opens, the water pressure in the corresponding water pipe shall fall rapidly. Water shall be supplied from the jockey to make up this water loss but inadequate to meet the demand. As a result of this, water pressure in the water main shall decrease further and impulse from pressure transmitter shall start the fire pump of the respective system through the auto starting panel. When the header pressure of fire water pumps falls below a preset limit, 1st motor driven fire water pump placed in "auto mode" shall be automatically cut-in. If the header pressure is not built-up even after the running of 1st pump and falls further down, this low pressure shall be detected by pressure transmitter which in turn shall cut in automatically the second motor driven pump in hydrant system. Similarly the 3rd motor driven pump and standby Diesel Engine driven pump will come into operation based on the system required sequentially. In each case above, if any of the above pumps is not started even after the signal from pressure transmitter is through, "pump fails to start" alarm shall be annunciated in the local control panel.

The Water for Spray and Hydrant System shall feed through separated headers. 1 No isolation Valve with a non return valve shall be employed in between Hydrant Pumps and Spray pumps so that the water from hydrant pumping system shall feed to spray header in case of emergency.

Hydrant system protects the following building/facilities:

i) Entire Power House within the boundary limits of power house.
ii) TG Building, Service building
iii) Mill Reject Handling System compressor house.
iv) ESP Control Building
v) Fly ash equipment building.
vi) HFO & LDO Pump House Area.
vii) HFO & LDO storage tanks and dyke area
viii) Compressor House cum Diesel Generator Area.
ix) Generator, Station, Unit transformers and all auxiliary Transformer
x) CW Pump House.
xi) Water Pretreatment Plant.
xii) Sludge Pump House.
xiii) Clarified Water cum fire water pump house.
xiv) Raw Water Intake Pump House.
xv) DM Plant with acid and alkali bulk storage tanks.
xvi) Chemical House.
xvii) Coal Handling Plant and Coal Storage Yards including all transfer points, bunker bay conveyors, sub-stations and control room, office building.
xviii) Crusher House.
xix) Coal Handling Control Building
xx) Ash Handling Plant Area including Ash Slurry Pump House, Ash Water Pump House, FA Conveying Blower Room, MCC room
xxi) All storage areas including O & M Store
xxii) Effluent treatment Plant

xxiii) Open Storage Yard.
xxiv) Transformer Yard, Switchyard & Grid Control Room Building.
xxv) Service Building.
xxvi) Administrative building
xxvii) CPU Regeneration building
xxviii) All gate houses
xxix) Canteen
xxx) Workshop
xxxi) Chimney area
xxxii) Diesel filling station
xxxiii) Fire water pump house
xxxiv) Cooling Tower Area
xxxv) Fire Station
xxxvi) Ash silo area
xxxvii) Peripheral area of switchyard

i) The Fire protection system design viz. water requirement, Fire water reservoir, number of main and standby fire pumps, hydrants and accessories etc shall be designed as per TAC guidelines.

ii) Provision of "double headed hydrants" as per the configuration of "risk area" shall be acceptable. For protection of crushed coal stock piles in Coal Handling area which are of elevated position, water monitor shall be provided.

iii) Minimum terminal pressure of 3.5 Kg/Cm^2 shall be maintained at the farthest/ remotest hydrant point.

iv) Suitable number of hydrant ring mains shall be provided and entire power plant area shall be suitably divided amongst these ring mains. These ring mains shall be interconnected with isolation valves. It shall be possible to enable to take up part of any of the ring mains for the maintenance without any loss of system in the balance part.

v) All the landings of boiler staircases, turbine buildings and other multistoried buildings, transfer points in the Coal handling plant etc shall be provided with hydrant landing valves. Water monitors shall be provided for tall buildings, Coal stockpiles, ESP area apart from ground hydrant and Landing Valve.

vi) All hydrant pipe mains/pipe lines shall be routed underground as per TAC. The underground Pipe lines shall be provided with coating and wrapping as per IS:10221/IS:15537. Road, rail, cable trench, cable channels or pipe trench crossing shall be through RCC hume Pipe of appropriate pressure class. In main plant areas, pipes shall be laid in RCC trenches(with precast slab covers). Alternatively hydrant pipes shall be laid over ground on separate RCC pedestals or on pipe trestles along with other pipe lines, but not on fuel pipe lines.

vii) All hydrant valves shall be of stainless steel conforming to IS: 5290.

viii) Fire hydrants in general shall be spaced 45 mtr apart. For building etc at least one hydrant shall be provided for every 45 mtr of external wall measurement and for internal hydrant/landing valves spacing shall be 30 M (maximum).

ix) Hydrants shall not be located less than 2m from building. No building shall be deemed to be protected by a hydrant unless such hydrant is within 15 m of the building. When height of the structure, tower exceeds 15 mtr, the concerned hydrant shall be replaced by water monitor.

x) Friction drop shall be calculated based on Hazen Williams equation considering "C" as 100.

xi) However Velocity in Fire water Pipes shall be as per TAC recommendation. The velocity in the hydrant/Spray header shall not exceed 3 m/sec.

Note : **All islolating valve in Hydrant system shall be non rising spindle type Gate vale only (For Under Ground Pipelines) and OS&Y type (for Above ground headers)**

Each isolating valve shall be provided with limit switch.

B) <u>PIPE , FITTINGS, VALVES & SPECIALITIES :-</u>

All pipelines under Bidder's scope of work shall be sized considering flow velocities as indicated in "Design Basis and Inputs".

- Design condition of piping and material of construction, galvanisation etc. for pipes and fittings, handling different fluid shall conform to piping data sheet enclosed.
- Pipes shall be provided with vent connection and vent valves at all high points and drain connection & drain valves at all low points. Drain valves shall be lock-closed type.
- Gate valves shall be outside screw rising spindle type for above ground Piping and Non Rising Spindle type for under ground Piping.
- Gate valves shall be provided with hand wheel, position indicator, pressure-equaliser for valves 350 mm NB and above and drainage arrangement. Limit Switches shall be provided in all isolation Valves include Gate and butterfly Valves. Gate valve shall be provided with back seating bush to facilitate gland renewal during full open condition. Globe valve shall have adequate profile for controlling action, check valve shall be swing check type and shall have arrow inscription to show the direction of flow.
- Whenever any valve is found to be so located that it cannot be approached manually from the nearest floor/gallery/platform, handwheel with floor stand or chain operator shall be provided for the same.
- For the operation of valves located in the valve pits, suitable arrangement shall be provided to operate the valves from the ground level (i.e. from the top of Valve Pit). For this purpose wrench-operated valve may be looked for.
- All Valves above 200 mm NB shall be gear Operated.

All instrument root valves shall be stainless steel Gr. 316 globe type.

C) Safety Relief Valves

- Safety/Relief valves shall be of direct spring loaded type and shall have a tight, positive and precision closing.
- All safety valves shall be provided with manual lifting lever.
- Valves used for air and any other compressive fluid shall be of pop type.
- Safety/Relief valves shall be constructed and adjusted to permit the fluid to escape without increasing the pressure beyond 10% above the set blow off pressure. Valve shall reset at a pressure not less than 2.5% and more than 5% of the set pressure.
- Releasing capacity of the safety/relief valves shall be as per the applicable codes and standards and shall be subject to the approval of the Engineer.
- The seat and disk of safety valves shall be of suitable material to resist erosion. The seat of valve shall be fastened to the body of the valve in such a way that there is no possibility of the seat lifting.

D) Hydrant Valve (Outdoor) & Stand Post Assembly

- The general design of hydrant valve shall conform to IS: 5290 type A and shall be suitable for outdoor operation. For further details data sheet shall be referred to.
- The general arrangement of outdoor stand post assembly, consisting of a column pipe and a hydrant valve with a quick coupling end shall be as approved by the Regional Committee of the Tariff Advisory Committee/NFPA.

E) Indoor Hydrant Valves (Internal landing valves)

- The general design of hydrant valve shall conform to IS: 5290 Type- A and shall be suitable for indoor operation. It shall be identical with hydrant valves (outdoor) as outlined above to facilitate interchangeability.

F) Water Monitors

- Fire Water Monitors shall be provided in accordance with the data sheet and shall conform to IS: 8442.

G) Hoses, nozzles, branch pipes and hose boxes

- Branch pipes shall be constructed of Stainless steel (SS-304) and have rings at both the ends. One end of the branch pipe will receive the quick coupling while the nozzle will be fixed to the other end.
- The nozzle sizes shall be of not less than 16mm (or 5/8 inch.) in diameter, nor more than 25 mm (or 1 inch.) in diameters for indoor and outdoor.
- 2 Nos. 15m long Hose pipe fitted with quick coupling ends, branch pipes, nozzles, spanner etc. shall be kept in a hose box, which shall be located near point of use. The furnished design must meet the approval of the Regional Committee of the Traffic Advisory Committee/NFPA. The general

design and construction of instantaneous couplings, branch pipes and nozzles shall comply with IS: 903 (latest revision).

- All instantaneous couplings, shall be of identical design (both male and female designs shall be utilized) so that anyone can be interchanged with another. One male/female combination shall get locked in by mere pushing of the two valves together but will provide leak tightness at a pressure of 21 Kg/sq.cm. Designs employing screwing or turning to have engagement shall not be accepted.

24.4.3 DESIGN PHILOSOPHY FOR SPRAY SYSTEM.

AUTOMATIC HIGH VELOCITY WATER SPRAY SYSTEM.

System Description:-

This system shall automatically detect, control and extinguish any out-break of fire and simultaneously give audible alarm. Water line shall forms a ring around the equipment to be protected with projected outlets at various selected points fitted with the specially designed nozzles. The water supply to the HVW spray system is controlled by deluge valve which shall be operated hydraulically. This valve is normally closed by water pressure in the water piping. The same water pipe forms a ring around the equipment to be protected and frangible bulb type detectors are mounted on this water line at selected places. When the surrounding temperature rises more than the rated temperature of the detector, detector quartzoid bulb collapses releasing water and consequently pressure in water line will fall sharply. This fall of pressure opens the deluge valve and water starts projecting out from the projectors. Local audible alarm shall be produced by water motor alarm gong. The operation of the Deluge Valve shall be annunciated in the Main Fire Alarm Panel situated in Main Control Room as well as in Sub Fire alarm Panel and Repeater Panels located in Fire Station.

The system shall also have a manual over riding facility along with regular testing facility.

Automatic HVW Spray Protection shall be provided for the following equipment:

- All transformers located in transformer yard of Main Plant area.
- All other transformers of rating 10 MVA and above or oil capacity 2000 liter.
- ~~Main and unit turbine oil tanks and purifiers.~~
- ~~Boiler Burner Front~~
- ~~Generator seal oil tank, Cooler and Purifier.~~
- ~~Turbine generator under deck area (Oil Canal)~~
- ~~Emergency DG set~~

- Central Lub Oil Tanks (Clean & Dirty oil tanks) and purifier units.
- Boiler Feed Pump lube oil tanks, coolers, consoles etc.

AUTOMATIC MEDIUM VELOCITY WATER SPRAY SYSTEM (MVWS System)

System Description:-

This system essentially consists of a network of sprayers fitted with a special deflector to give required angle of discharge for the water around the area to be protected. The sprayers discharge a cone of water spray consisting of medium size droplets of water. The droplet size shall be so designed to achieve efficient cooling of the flame zone by evaporation and sufficiently large to penetrate the flame so as to reach and cool surfaces heated by the fire. The operation of the Deluge Valve shall be annunciated in the Main Fire Alarm Panel situated in Main Control Room as well as in Sub Fire alarm Panel (CHP Control room) and Repeater Panels located in Fire Station.

The Medium Velocity Water Spray System shall be provided for the protection of following areas:

a) All coal conveyors, all transfer points, take-up pulleys, and crusher house of the coal handling plant. In this connection, it may be noted that full length of each conveyor both top and bottom belt shall be protected with MVW Spray System.

b) The open conveyors installed shall also be provided with MVW spray system. It may be noted that full length of each conveyor both top and bottom belt shall be protected with MVW Spray System.

c) Cable vault/cable galleries/cable spreader room in Power House, CHP Control room and in other ancillary buildings as applicable and stated elsewhere.

d) HFO/LDO storage tanks, unloading and pressurizing pump house

DESIGN :-

a) Unless specified the HVW and MVW systems shall be as per guideline of TAC. The water for the spray system shall be tapped from the common Header throughout the plant.

b) For HVW Spray System the water pressure at any projector/ spray nozzle shall not be less than 3.5Kg/Cm². For MVW spray system minimum water density and minimum pressure shall be as under:-

Area	Minimum Water Density	Minimum Pressure
Cable Galleries	12.2 LPM/m²	2.8 Kg/Cm²
Coal Conveyors	10.2 LPM/m²	1.4 Kg/Cm²
L.D.O Storage Tanks	10.2 LPM/m²	1.4-3.5 Kg/Cm²

c) ~~The spray system for boiler burner front shall cover all the fuel oil and coal burner elevations, its adjacent piping structure, floors etc.~~

~~e) The spray system for the fuel oil pumping station or fuel oil tank shall also cover the piping near the vicinity.~~

~~f) In conveyor galleries the water spray shall cover the exposed area of both the forward and return conveyors and idlers. In transfer points, crusher house, track hopper, pent house etc the water spray shall cover the drive equipment, pulleys, chutes, other equipments of the floor and at various elevations.~~

g) Wet type fire detection system using quartzoid bulb detector shall be provided for HVW /MVW spray system employed for coal conveyors, transformers etc. In case of fire QB detector shall break due to heat and pressure in wet detector network resulting in fall in pressure which shall actuate the respective deluge valve resulting in water spray on the protected equipment.

h) All spray pipe mains/ pipelines shall be routed underground and provided with coating and wrapping as per TAC. Road, rail, cable trench, cable channels or pipe trench crossing shall be through RCC hume Pipe of appropriate pressure class. Alternatively spray pipes shall be laid overground on separate RCC pedestals or on pipe trestles along with other pipe lines.

i) Each deluge valve shall be suitable for automatic actuation. Each deluge valve shall also be provided with a LCP from which valve may be operated remote manually. In addition, each deluge valve shall also be provided with an operational latch/ handlever. Each deluge valve shall be provided with gate valve on upstream and downstream with limit switches. The valve on the downstream side shall be kept locked open.

j) Each deluge valve shall be provided with a fast acting butterfly valve with limit switch as a byepass.

k) Vendor to consider the close/open annunciation of all the valves using necessary modules in the Main Fire alarm panel in TG building.

L) ~~Cable vaults/cable spreader rooms shall be suitably zoned. Total water requirement for each zone shall be limited to one-third the capacity of spray water pump, three (3) zones (one forward and one backward and the zone under fire) shall be flooded~~

~~M) Conveyor belt shall be suitably zoned. Length of each zone shall be so selected such that water requirement of each zone shall be limited to one-third the capacity of each spray water pump and in case of fire, three (3) zones (one forward and one backward and the zone under fire) shall be flooded.~~

n) Water sprayer shall be placed in such a way so that the "spray cone" overlaps each other. This is applicable for all transformers, cable vaults, conveyor belts and other areas where MVW or HVW spray system has been asked for.

TECHNICAL REQUIREMENT :-

a) The deluge valve (auto resetting type) assembly shall consist of accessories such as pressure gauge (two nos.), water motor gong, alarm test valves, drain valves, strainers for these valves, hydraulic releasing system, etc. Solenoid valve for remote operation shall also be provided.

b) Deluge valves shall be used for automatic HVW spray system, and MVW spray system. In automatic HVW Spray System, deluge valve in spray water line shall be kept closed normally by water pressure. Same water line will form the water circuit of fire detector. When the detector quartzoid bulb collapses in the event of fire, the water pressure in the deluge valve will fall resulting in the opening of deluge valve.

c) But the deluge valves, which will be used in the MVW spray system shall be of solenoid-operated type, will remain normally closed but in the event of fire, the solenoid will be energised to open the valve.

d) Each Deluge Valve assembly shall Consist of Y type Strainer in the Upstream and a By-pass Butterfly Valve with Limit Switch. Upstream and Downstream of Deluge Valves shall be provided with OS&Y Type isolation Valves with Limit switches. Deluge valve along with trims shall be UL/FM or equivalent approved / listed.

For further details of Specification of all valves mentioned above, Data Sheet shall be referred to.

e) A strainer ('Y' type) shall be provided at upstream of deluge valve. Strainer Body shall be constructed of mild steel as per IS: 2062 (tested quality). Strainer wires shall be of stainless steel AISI: 316, 18 BWG, 30 mesh. Blowing arrangement shall be provided with removable plug at the outlet. Screen open area shall be at least 4 times pipe cross-sectional area at inlet.

f) The design features and make of all the projectors/ spray nozzles shall be UL/FM or equivalent approved. Material of construction for projectors / spray nozzles shall be **Stainless Steel.**

g) Pressure switches shall be provided in spray and detector piping to exhibit "FIRE DETECTED" and "SPRAY ON" annunciations and interlock for tripping of respective equipment wherever applicable.

h) Wet type detector network with venting arrangement shall be provided for spray system using quartzoid bulb detectors.

i) Remote manual operation of the deluge valves shall be possible from the respective fire alarm cum control panel through the keyboard operation of Operating Work-station when the system is selected in remote manual mode. The remote manual selection for the operation of spray system on any equipment or any zone shall also be through the monitoring station of the respective panel. Apart from the automatic operation of the deluge valve, the system shall have provision for manual operation of the deluge valve by means of hand operated lever close to the deluge valve assembly. There shall also be a provision to operate deluge valve electrically from a nearby local panel.

j) Each outdoor deluge valve housing shall be provided with brick wall housing on three sides and 4" RCC roof. The fourth side of the enclosure shall be in a direction away from protected equipment. Indoor deluge valve(s) which are within 6 meters of the protected equipment shall also be separated from the latter by a brick wall enclosure.

~~24.4.4 FIXED FOAM PROTECTION SYSTEM~~

~~24.4.4.1 SYSTEM DESCRIPTION:~~

- ~~Water based automatic activated low expansion foam protection systems shall be provided for HFO and LDO storage tanks.~~
- ~~Foam protection systems are based on the principle of blanketing the burning surface of oil stored inside the tanks by pouring foam mixed with water, enabling to cut off the oxygen to the burning fuel thus achieving immediate Extinguishments of fire.~~
- ~~In general the system shall be in line with NFPA 11 regulations.~~

~~24.4.4.2 DESIGN:~~

~~The Fixed Foam System Shall consist of foam concentrate tanks, pumps, balancing line with automatic controlling valves, foam makers, discharge outlets, interconnection piping, valves, foam makers, discharge outlets, interconnection piping, valves, fittings, instrumentation, panel and control system. Semi Fixed system consisting of separate foam solution ring main around the tank with foam hydrant valves at regular intervals shall also be provided in addition to the water Hydrants.~~

~~24.4.4.3 OPERATIONAL PHILOSOPHY~~

~~The operation of fixed foam system shall be automatic with the aid of dedicated fire detection System provided in the tank/equipment. The semi Fixed system shall be operated through the foam hydrants/ monitors. Portable type foam water monitors (wheeled type with in built foam maker), hoses and nozzles for extinguishing spill fire in and around the tank.~~

~~Apart from feeding the individual tank each foam inductor will deliver the foam solution to the piping around the tank dyke, whenever foam injection system is initiated so that spill fire if any may be extinguished by means of foam hydrants through Hoses. The maximum spacing of foam Hydrants around the dyke will be similar to that of water Hydrant System. The minimum foam application rate of 3% foam solution be 6.1 lpm/sqm (Complete surface area) for fixed roof tanks. Manual operation facility will be facilitated locally from the opening of valves and injection of foam to any of the fuel oil tanks will be achieved through selectors switches, push buttons etc. The minimum effective capacity of each foam concentrate tank shall be designed considering the simultaneous protection of any of the oil tank (Largest dia) and operation of at least two Hydrants for 60 minutes. Apart from the primary protection, supplementary protection shall be provided. To achieve this at least 3 (three) nos. of Portable wheeled type foam monitors each minimum solution application rate of at least 189 L/min (50 gpm) shall be provided.~~

24.4.4.4 TECHNICAL REQUIREMENT:

Complete system shall be designed as per NFPA 11 and TAC.

a) Water for the foam system shall be tapped off from the hydrant system.

b) The operation of foam system shall be automatic with the aid of fire detection system provided for the HFO / LDO tanks with a provision for manual operation.

c) Auto/Manual selection switch shall be provided at the local panel.

d) Foam concentrate shall be of 100% AFFF type and shall be provided in 2x100% capacity foam concentrate tanks. It shall be discharged to the foam pumps inductors through 2x100% capacity motor driven foam pumps (1W + 1S) through balancing line, with control valves, flow controllers etc.

e) Foam Pump: The design and material of construction for foam concentrate pumps shall be in accordance with NFPA-20. Special attention shall be paid to type of seal or packing used. Seals or packing used shall be compatible with foam concentrate. To ensure positive injection of concentrates, the discharge pressure rating of pumps shall be in excess of the maximum water pressure available under any condition at the point of concentration injection.

f) The minimum effective capacity of each foam concentrate tank and foam pumps shall be designed considering the following :

- Simultaneous protection of any of the fuel oil tank or LDO tanks and operation of two hydrants for 60 minutes

  or

- Minimum capacity if specified elsewhere.

- A design margin of atleast 10% shall be considered over the calculated foam concentrate capacity, tank capacity and discharge capacity of the foam discharge pumps.

g) Foam concentrate storage tank shall be provided with discharge pipe manifolds, individual isolation valves, tank inlet, drain, overflow connection, level indicators, level switches, etc. All the foam concentrate tanks, pumps, the local panel and other shall be located indoor in a building. Foam concentrate storage tank shall be made of carbon steel as per IS:2062 Grade 'B' and shall be provided with 2 mm thick FRP lining.

h) One number foam proportioner of adequate size shall be provided for each tanks. Besides these, one additional foam proportioner of adequate size shall be provided for foam hydrant rings around dyke area. All the proportioners are interconnected by isolation valves (manually operated), in such a way that any of proportioner may cater to the requirement of others. Further, separate isolation valves (manually operated) shall be provided for each proportioner for maintenance.

i) Automatic solenoid valve shall be provided in foam supply line to each of the HFO and LDO tanks at the upstream of foam proportioner. In the event of detection of fire, the signal (with the help of necessary electronic

~~modules) shall start the foam pump, operate the deluge valve of water inlet valve to the designated foam proportioners of the tank, and as well as open the foam solution inlet valve to foam proportioner and thereby foam is injected to the tank under fire foam makers discharge outlets.~~

~~j) Apart from feeding the individual tank, each set of foam inductors shall deliver foam solution to foam hydrant piping ring around the tank dyke whenever foam injection system is initiated so that spill fires if any may be extinguished by means of foam hydrants, hoses & portable (wheeled type) foam generator/ monitor. Foam monitor shall conform to relevant International standard / manufacturer's standard.~~

~~k) The maximum spacing of the foam hydrants around the dyke area shall be similar to that of water hydrant system.~~

~~l) The minimum foam application rate of 3% foam solution shall be 6.1 lpm/Sq.m (complete surface area) for fixed roof type tanks.~~

~~m) The system shall incorporate features such as non return valves to avoid mixing water with foam concentrate pipelines, strainers in water inlet and in foam concentrate lines, isolation valves of pumps/ flow control valves/ ratio proportioning devices etc.~~

~~n) Foam concentrate piping shall be of Stainless Steel (seamless) as per ASTM A 312, TP 304, Schedule 40s. Fittings shall be of SS forged to ASTM A 182, F 304 for sizes 15NB to 40NB and S.S. seamless to ASTM A 403, WP 304, Schedule 40 for sizes 50NB & above. All the piping shall be laid over ground on RCC pedestals. Further, all valves, strainers, foam proportioners, balancing valves, etc. in foam concentrate line shall be of stainless steel construction.~~

~~o) Manual operation facility shall be facilitated locally from the panel and operation of foam pump, opening of valves and injection of foam to any of the HFO/LDO tanks shall be achieved through selector switches, push button etc.~~

24.4.5 Inert gas flooding system

24.4.5.1 System Desription

One centralized total flooding type clean inert gas extinguishing system shall be provided for the following areas as a protection for fire damage.

a) Main Control rooms under false flooring, above false ceiling, and inside the rooms' voids.

b) Electronic equipment rooms, Computer rooms, UPS rooms battery and battery charger room.

c) Switch yard control room.

The inert gas flooding system for the above areas shall consist of battery of inert gas storage cylinders of adequate capacity. The system shall be designed as per NFPA 2001 (latest edition) considering C class fire hazard. Inert gas Storage cylinder shall be provided with a standby cylinder bank of equal

capacity, which shall be located suitably near the control room. Discharge nozzles shall be provided on the gas distribution pipe network suitably located on the areas to be protected.

In the event of fire, the fire detectors shall initiate an alarm in the local panel, and main fire alarm panel. Simultaneously, the detection signal shall opens the directional valve automatically and so that the protected area is filled up by rapid injection of required quantity of inert gas through the pipe network and discharge nozzles to create a homogenous air/inert gas atmosphere within the protected area.

The pipe network shall be connected to a gas manifold, through a manually operated valve. The manifold shall be connected to a group of inert gas cylinders.

In general the system shall be provided in line with NFPA-2001 regulations. The system shall be for total flooding application with electrical detection using optical detectors.

a) Complete design and all critical components / equipment like cylinder, cylinder valve assembly, hoses, check valve, actuation controls, restrictor / pressure reducer, directional / selector valve, pressure relief device / safety valve, pressure gauge, pressure switch, nozzle, etc. shall be approved and listed by UL / FM / VDS / LPCB or equivalent and the system shall also be approved by TAC / TAC accredited professional(s) before installation.

(b) Basic design parameters of inert gas extinguishing system like type of inert gas agent, extinguishing / design concentration, safety factor, discharge time, etc. shall be considered in strict accordance with NFPA-2001 (latest edition). Piping design / layout, nozzle arrangement / orientation, etc. shall confirm to UL / FM / VDS / LPCB or equivalent.

24.4.5.2 Design philosophy for inert gas system.

i) Complete design shall be approved and listed by UL/FM/VDS/LPCB.
ii) The complete volume of the rooms including the above false ceiling shall be consider for estimation of quantity of gas and containers.
iii) When determining the gas quantity, the leakage losses from the enclosures shall be taken in to account. Further volume of recirculating type air conditioning system and its duct work at least upto the automatic fire dampers of the ducts shall be considred as a part of the total volume so that the design concentration shall be achieved through out the hazard area. Further gas quantity shall be adjusted for ambient pressure and temperature conditions.
iv) Centralized inert gas system along with 100% standby reserve gas quantity and cylinders shall be provided for each of the areas mentioned above.
v) The discharge time period shall be such that the design concentration shall be achieved within 60 second. The flow calculations shall establish this criteria.
vi) Operating devices shall be by mechanical, electrical and pneumatic means conforming to NFPA-2001. The power supply to electrical actuators shall be backed up with reliable battery supply. Such batteries shall be charged automatically by battery chargers.
vii) Facility for manual release of gas through push buttons shall be provided. In addition local manual release through lever operation shall also be provided near the cylinder banks. Further manual abort switches shall be provided for each of the area / zones.

viii) Appropriate warning signs shall be fixed outside of those areas protected by the system and also in areas where the gas may spread indicating and hazard clearly. Apart from written warning signs, audio visual type warning signs i.e hooters and strobe lights shall be provided for pre discharge and post discharge activities.

ix) To prevent the loss/release of gas automatically or manually during maintenance, the system shall have the facility of " LOCK OUT".

24.4.5.3 Operational Philosophy

Inert gas flooding system is provided for the main control room, control equipment room for Unit and computer room & UPS room. The system shall be provided in line with NFPA 2001 regulations. The system proposed is of total flooding application with electrical detection system using optical detectors.

The detectors used in this application shall of analogue addressable type and upon receipt of signal from any detector in the protected enclosure to the MFAP, pre-discharge signal shall be sent to the gas release panel. Upon receipt of signal from second detector from the protected enclosure, discharge signal shall be sent to the gas release panel and in turn the gas release panel shall activate the solenoid valve in the master control head of the inert system cylinder. Manual mechanical actuation of the inert cylinder is also possible using the Manual mechanical actuator in the master control head.

24.4.5.4 Technical Requirement:-

Agent Supply, Design Concentration, Quantity & Discharge time

(a) System shall be designed to meet the minimum requirements of total flooding inert gas extinguishing system as per NFPA 2001. However higher concentration may be used if it is specified by the agent manufacturer/ system supplier for the area protected.

(b) The complete volume of the rooms including the above false ceiling, below false floor & room voids shall be considered for estimation of quantity of gas and containers.

(c) When determining the gas quantity, the leakage losses from the enclosure shall be taken into account by the supplier. Further volume of re-circulating type air conditioning system & its duct work (atleast upto the automatic fire dampers of the ducts) shall be considered as a part of the total volume so that the design concentration is achieved throughout the hazard area. Further gas quantity shall be adjusted for ambient pressure & temperature conditions.

Bidder to provide primary supply of gas & its cylinders, along with 100% (Hundred percent) standby / reserve gas quantity and cylinders for each room / area.

(d) However, if the system design permits provision of a common "ENGINEERED STORAGE SYSTEM" with directional valves for multiple rooms / areas of one unit, such a design is acceptable provided the total primary supply and/or reserve supply is equivalent to the requirement of largest area / room and such rooms /areas are perfectly separated from each other by means of wall / metal cladding or floor of minimum required fire rating. Such common storage system should have been listed & approved by UL/FM/VDS/LPCB or equivalent and bidder should produce

documentary evidences for design and installation of such systems else where in the past by them.

(e) In either of the case mentioned in above two clauses, both the main & reserve supply cylinders shall be permanently connected to the distribution piping through manifold and arranged for easy changeover from the panel. Suitable selector switches be provided for "Normal /Standby "supply selection.

(f) The discharge time period shall be such that the design concentration is achieved within time duration specified in NFPA-2001 (latest edition). Flow calculations shall also establish this criteria.

(g) The quality of gas shall conform to relevant design standard such as NFPA – 2001(latest edition) or as specified by listing authorities.

Storage containers

(a) The storage cylinders offered shall be of seamless type & brand new. Welded cylinders are not permitted.

(b) All the storage containers shall be provided under an enclosure. It shall not be kept open to atmosphere.

(c) The storage containers shall be securely installed as per the listed installation manual with a provision for convenient individual servicing and container weighing. Such servicing or weighing shall be possible without shutting down the system.

(d) Automatic means such as check valves shall be provided to prevent gas loss if the system is operated when any containers are removed for maintenance.

(e) The storage containers shall not be charged to a fill density or super pressurization level different from the manufacturer's listing.

(f) The design pressure for storage cylinders shall be suitable for the maximum pressure developed at 55°C and shall be designed to meet the requirements in NFPA-2001.

(g) All cylinders shall bear the marking as detailed out in NFPA -2001 and shall be duly listed by UL / FM / VDS / LPCB or equivalent in addition to approval by Chief Controller of Explosives - INDIA.

(h) The storage cylinders shall have accessories such as pressure gauges/ switches, liquid level indicators (if applicable), refilling connections, relief devices (if applicable) etc. A reliable means of indication other than weighing shall be provided to determine the pressure in cylinders.

(i) All the pressure gauges / switches, manifold connections etc shall be easily removable for servicing / maintenance without any loss of gas.

DISTRIBUTION

(a) Both main & reserve cylinders shall be permanently connected to the distribution piping through manifold and arranged for easy & auto changeover. Cylinder Manifold, directional valve manifolds, Piping, fittings

& pressure relieving device shall be designed for the maximum design pressure of the system and shall conform to the requirements of NFPA - 2001 (latest edition) or as specified by listing authorities. Material of construction for manifolds shall be as per listed design manual and shall be hydro-tested as per design manual or at 1.5 times the maximum design pressure, whichever is higher.

(b) Discharge nozzles along with deflector shields shall be listed for the intended use including the flow characteristics and area of coverage and quantity & design shall be such that complete quantity of gas is uniformly distributed throughout the hazard volume within the specified discharge time without disturbing the ceilings, lighting fixtures etc.

(c) The fire detection system to be employed shall be as specified elsewhere. Operating devices shall be by mechanical, electrical and pneumatic means conforming to NFPA-2001. The power supply to electrical actuators shall be backed up with reliable battery supply. Such batteries shall be charged automatically by battery chargers. Power supply shall be taken from the Fire detection / alarm system panels of the respective unit/s. Required annunciations such as “Gas released”, “Failure of automatic actuation” etc shall be exhibited in the fire alarm panel.

(d) Where pilot cylinders are employed for actuation of the cylinder banks, the number of pilot cylinders shall be as per the listed design manual.

(e) Facility for manual release of gas through push buttons shall be provided along with selection facility of “Auto/Manual” from the panel.

(f) In addition to this, local manual release through lever operation shall also be provided near the cylinder banks.

(g) All manual-operating devices shall be identified to the hazard they protect by fluorescent paint.

(h) Manual abort switches shall be provided for each of the area/zone and the same shall be provided as per NFPA -2001 or as specified by listing authorities.

(i) The gas releasing devices at cylinder outlets shall be of re-usable type after discharge at any instant.

(j) Supervision of automatic actuation devices, power supply, manual actuation circuits, and complete wiring shall be provided through control system / panel and the healthiness shall be reported or indicated in the panel automatically. Complete control system shall be listed and approved by UL / FM / VDS / LPCB.

~~**24.4.6 Fire Water Pumps & Pump House.**~~

~~i) Three (3) nos. of vertical turbine fire water pumps with drive electrical motors and all other accessories as specified. The quantity and capacity indicated in the specification is only tentative and bidder to work out capacity and quantity based on TAC guidelines / IS 3034.~~

ii) Three (3) nos. of vertical turbine fire water pumps driven with compression ignition diesel engines along with all accessories required for automatic starting of diesel engine, including fuel oil system, lub oil system etc. The quantity and capacity indicated in the specification is only tentative and bidder to work out capacity and quantity based on TAC guidelines.

iii) Two (2) (1W +1S) vertical turbine jockey with drive motors and all other accessories as per TAC as specified elsewhere.

iv) Two (2) nos. of horizontal centrifugal type booster pumps (One motor driven and the other diesel engine driven) for hydrant service for maintaining required pressure on higher elevations of power house and boiler building.

v) The Selection of Spray Pump Capacity & head shall be designed on the basis of the following criteria whichever is higher.

a) Maximum capacity required for the largest risk area/equipment of HVW spray system

OR

Simultaneous operation of three zones of MVW spray system of cable galleries.

OR

Simultaneous operation of three zones of MVW spray system of Coal Conveyors.

vi) Total Dynamic head of pumps shall be 105/110/120 MWC.

vii) The Pumps shall comply with the regulations of BIS/TAC/and shall be approved by TAC accredited agency.

viii) The fire water pump house layout shall have sufficient space for the maintenance of pumps and diesel engines. further the pump house shall be provided with a electrically operated overhead travelling type crane of capacity capable of lifting heaviest component but not less than 5 metric tones capacity.

A) FIRE WATER AND JOCKEY PUMPS:-

A1 Performance Requirement

a) Performance requirement for the pumps shall be guided by the `Data Sheet' enclosed in this section and TAC recommendation.

b) Pumps shall deliver not less than 150% of rated capacity at a head of not less than 65% of total head. The shut-off head shall not exceed 140% of total head of the pump.

c) Pump sets shall be capable of continuously delivering the rated output for the voltage variation of (±) 10% and frequency variation of (±) 5% occurring separately or combined voltage and frequency variation of (±) 10% (absolute sum).

A2 **Constructional Features**

a) The design and Testing Standards of the Pumps shall conform to IS 12469 and TAC recommendation.

b) The pumps shall comply with the regulations of Tariff Advisory Committee (TAC) and National Fire Protection Association (NFPA), USA as applicable.

c) Drive Unit Power rating for the fire water pumps shall be selected such that it is equal to higher of the two conditions :

i) 110% of the duty point power requirement.

ii) Motor input power required at 150% of the duty point capacity of pump.

d) Motor of all pumps shall be rated for continuous duty and shall be generously designed. The continuous motor rating shall be atleast 10% above the load demand of driven equipment at design duty point. The rating shall be such that the motor shall not be overloaded at any operating point of driven equipment from zero to full load. The rating of the drive shall in any case be not less than the power required to drive the pump at 150% of its rated discharge.

B) DIESEL ENGINE :-

B.1 Performance requirement of the diesel engine shall be guided by TAC recommendations.

B.2 The engine shall be capable of operating continuously on full load at the site conditions for a period of at least six (6) hours.

B.3 The engine shall be naturally aspirated, super charged or turbo charged as recommended by the manufacturer. (Ref. Fire Protection Manual by TAC).

B.4 The continuous engine brake horse power rating (after accounting for all auxiliary power consumption) at the site conditions shall be at least 20% greater than the brake horse power required to drive the pump at it's duty point at rated R.P.M. and in no case less than the brake horse power required to drive the pump at 150% of rated discharge or at any condition of operation of pump. Deacrating Factors considered by the manufacturer to arrive at the shaft power of the diesel engine at site, shall not be less than the following for normally aspirated engines only :

B.5 Design and construction of the diesel engine shall be guided by TAC recommendations.

B.6 Starting

a) The engine shall be capable of both automatic and manual start.

b) Automatic cranking shall be effected by a battery driven D.C. motor having high starting torque to overcome full engine compression. Starting power shall be supplied from two (2) sets of storage batteries (2x100%). One (1) set of battery is for automatic starting of the engine and the other provided for manual starting. A selector switch shall be provided at the automatic starting control panel to select any of the two (2) sets of battery for manual/auto starting of the engine. Also the Battery chargers shall be 2x100%.

c) The automatic starting arrangement shall include, as a safeguard, a "Repeat Start" feature so that if the pinion of the starting motor does not engage the flywheel at the first attempt, it is automatically retracted and after a short pause again will advance towards the flywheel. This repeat start cycle will continue until five (5) kicks after which there will be suitable annunciation. The battery capacity shall be adequate for ten (10) consecutive starts without recharging with a cold engine under full compression.

d) Arrangement for both trickle and booster charge of the batteries shall be provided. When the engine starts running, provision should be kept to ensure that the electric charger is automatically disconnected and the battery is charged by engine dynamo.

e) Each diesel engine shall be provided with two (2) battery charger units of air cooled design. Each charger unit shall be capable of charging one (1) set of battery at a time. Provision shall, however, be kept so that any of the charger units of a particular engine can be utilised for charging any one of the two (2) batteries of that engine.

B.7 Governing System

a) The engine shall be fitted with a speed control device which will control the speed under all conditions of load.

b) The governor shall offer following features :

i) Engine should be provided with an adjustable governor capable of regulating engine speed within 10% of it's rated speed under any condition of load up to the full load rating. The governor shall be set to maintain rated pump speed at maximum pump load. (Refer Fire Protection Manual by TAC).

ii) Engine shall be provided with an over speed shut down device. It shall be arranged to shut down the engine at a speed approximately 20% above rated speed and for manual reset, such that the automatic engine controller will continue to show an over speed signal until the device is manually reset to normal operating position. (Refer NFPA).

c) The governor shall be suitable for operation without external power supply.

B.8 Fuel System

a) The diesel engine shall run on High Speed diesel oil.

b) Each engine shall be provided with fuel oil tank having storage capacity sufficient to run the engine at full load for at least six (6) hours.

c) For each compression ignition engine driven pump set, there shall be individual fuel tank and fuel feed pipes.

d) A suitable 1 phase 230 Volt fuel pump (portable) to be provided to fill up diesel oil from Diesel Drum received from supplier of Diesel. This pump should also have facility to be operated by hand, in case electricity fails.

B.9 Lubricating Oil System

Automatic pressure lubrication shall be provided by a crankshaft driven oil pump.

B.10 Cooling Water System

The cooling water system shall conform to any one of the systems specified in Fire Protection Manual of the Regional committee of the Tariff Advisory Committee/NFPA.

B.11 Instrumentation & Control

The diesel engine shall be provided with adequate instrumentation. These shall include but not limited to the following :

a) Temperature indicator (contact type) in cooling water inlet and outlet.

b) Temperature indicator in lubricating oil outlet from the oil cooler.

c) Pressure gauges (contact type) for lubricating oil system.

d) Differential pressure gauges (contact type) across strainers/ filters.

e) Speed indicator.

f) Running hour meter.

g) Dip. stick type lubricating oil sump level indicator.

h) Gauge glass type Fuel Oil Tank level indicator.

i) Voltmeter & Ammeter in dynamo type battery charging circuit

24.4.7 DESIGN PHILOSOPHY FOR FIRE DETECTION, ALARM, PROTECTION AND CONTROL SYSTEM.

24.4.7.1 GENERAL

a) PLC based Fire Water control panel for Fire Water Pumps located in Fire Water pump house for operation of the Fire water pressurizing and pumping system. Separate parallel redundant UPS with battery shall be provided for PLC based control system.

b) Fire Protection, Detection and Alarm Panel shall be located in the Central Control Room. Each of the Panels shall be provided with a Operating work station with colour graphic Software and printer. Fire response programme shall be integrated with the colour graphic software in order to display all the Detector Loops with their Dynamic Status. Summary of Alarm page shall also to be configured. Alarms with Beeper are to be configured in each Monitor Station with facility for acknowledgement.

c) Fire Detection and Alarm Panel in the Central Control Room shall be provided with hardwired contacts for Group Alarms for the fire Protection, detection & Alarm system and to be connected to the DDCMIS.

d) One(1) No Sub Fire alarm shall be located in Coal Handling Control room to take care of alarms etc in Coal handling area.

e) A separate parallel redundant Uninterruptible Power Supply (UPS) unit with Battery Back up shall be provided with the Fire Alarm Panel in CCR, which shall provide Power to the Operating work station & printer with Fire alarm Panel. Technical Requirements and features of the Operating work station, printer and UPS shall be provided as per NIT.

Bidder may also consider redundant UPS feeders in main plant UPS for OWS & printer located in CCR instead of separate UPS.

e) Satellite Fire Alarm Panels wherein all connections from the Fire Detectors and Manual call Points of the respective areas shall be terminated.

f) Repeater Master Fire Alarm Panel to be located in the Fire Station. All annunciations of local Fire Detection and Alarm Panels in CCR including their respective satellite Fire Alarm panels, Fire Alarm Panel in CHP and Grouped Annunciations etc shall also be made available in the Master Fire Alarm Panel.

g) This panel is to be provided with an operating work station with colour graphic software and printer. Fire response programme shall be integrated with the colour graphic software in order to display all the Detector Loops with their Dynamic Status. Summary of Alarm page shall also to be configured. Alarms with Beeper are to be configured in the Monitor Station with facility for acknowledgement.

h) A parallel redundant Uninterruptible Power Supply (UPS) unit with Battery Back up shall be provided with the Master Fire Alarm Panel which shall provide Power to the Operating work station & printer with Fire alarm Panel. Technical Requirements and features of the Operating work station, printer and UPS are provided in the Vol V of the Specification.

i) All Fire protection, Detection and Alarm Panels in CCR, CHP, Satellite Fire Alarm Panels and Repeater Master Fire Alarm Panel in Fire Station shall be integrated through Dual Redundant Optical Fibre Data Highway connected in Ring Main Topology. The technical requirements of such FO based communication cable are elaborated in Volume V of the specification.

j) Two (2) sets (1 working & 1 standby, 100% capacity each) of 24 Volt (2x12V) Automotive type battery with charger for each diesel engine driven fire water pumps primarily for starting the engine.

k) Two (2) sets (1 working & 1 standby, 100% capacity each) of 24 Volt sealed type maintenance free lead-acid battery with charger for each Satellite fire alarm panel, Fire Detection and Alarm panels in CCR, CHP, Satellite Fire Alarm Panels and Repeater Master Fire Alarm Panel in Fire Station.

l) Supply, laying and connection of FRLS power, control and instrumentation cables required for complete fire protection system and Fire survival cables (950°C. for 3 hours) for CHP area.

m) Adequate no. of Back-lit maintained type emergency exit signs as per TAC.

n) Emergency Voice Communication System, adequate number of fireman's telephones and speakers. Speakers shall be provided in strategic locations throughout the Plant. Pre recorded voice messages shall be sounded through these Speakers to alert the people. Telephone set shall be provided in each Fire Alarm Panel. As minimum, Speakers shall be provided in Central Control Room, Coal and Ash Handling Plants, DM Water Plant, CW Pump House.

The Fire Protection, detection and Alarm System shall comply with NFPA - 72/72E and IS: 2189 standards. The Fire protection, detection, alarm and Control System shall consist of various type detectors, Control Cabling, Fire Alarm Panels, Central Monitoring station, repeater Panels, PLC control Panels and Local Panels(For Deluge Valves etc).

a) The fire Alarm, protection and Detection system shall be hot redundant microprocessor based, analogue addressable type.
b) Selection of temperature rating of heat detectors shall be based upon maximum ambient temperature of about 50°C for outdoor equipments (Like Transformers, boiler burner fronts, fuel oil tanks etc) and about 40°C for indoor equipments like Coal conveyors, Cable galleries, Fuel oil Pump House etc.

Fire detection and alarm System shall cover the following area & system :-

a) Multi sensor type Smoke detection System.

- All Switchgear/MCC/Control rooms of Main Plant Building, ESP, switchyard control room building, CHP Control room, APH Control room various auxiliary building like ash handling system, compressed air system, CW/ACW system, condensate polishing plant, water treatment plant, Pump Houses, Service, Admin building, Battery room etc.

- Below false ceiling area of all air conditioned rooms in main plant building, service building, ESP building, various control rooms of auxiliary buildings etc.

b) Multi criteria type smoke detectors for above false ceiling for all air conditioned areas.

c) However combination of both multisensor and photoelectric smoke detectors for above and below false ceiling of inert gas protected areas and various cable galleries protected by MVW Spray System.

d) Linear Heat sensing Cable (Digital type) detection system for coal conveyors, and cable galleries covered under MVW Spray Systems.

e) Quartzoid Bulb heat detection system for equipments protected by HVW Spray system, LDO/HFO, pump House etc protected by MVW Spray System.

f) Probe type heat detectors for Fuel Oil HFO and LDO Tanks.

g) Heat detection system (microprocessor based analogue addressable based heat detector) shall be provided in the following areas in order to avoid spurious operation of the smoke detectors due to fumes, smoke & dust which are present in these areas. The heat detectors shall be suitably mounted on fire water pipes covering an open area.

- Battery and battery charger rooms.
- Oil filled type L.T. Transformers (up to and including 2500 KVA rating) However, no oil filled L.T. Transformer has been envisaged inside power house.
- Dry type L.T. Transformers located anywhere in the plant area.
- Batteries & UPS rooms.
- Pantry & Canteen area.

h) PLC based Local Fire Water control panel for Fire Water Pumps located in F.W pump house for operation of the Fire water pressurizing and pumping system. This shall be connected to DDCIMS in Main Control room thru fiber optic cables.

i) Main Fire Detection, Protection and Alarm Panel for each Unit to be located in the Central Control Room in Power House. Each of the Panels shall be provided with a operating work station with complete Software and A4 sized B/W printer. Fire response programme shall be integrated with the colour graphic software in order to display all the Detector Loops with their Dynamic Status. Summary of Alarm page shall also to be configured. Alarms with Beeper are to be configured in each Monitor Station with facility for acknowledgement.

j) Fire Detection and Alarm Panel in the Central Control Room shall be provided with hardwired contacts for Group Alarms for the fire detection system and to be connected to the DDCMIS of the respective unit.

k) All connections from the Fire Detectors and Manual call Points of the respective areas shall be terminated to their respective Fire Alarm Panel.

l) Repeater Fire Alarm Panel to be located in the Fire Station. All annunciations of local Fire Detection and Alarm Panels in CCR including their respective satellite panels, Fire Alarm Panel in CHP and Grouped Annunciations etc shall also be made available in the Master Fire Alarm Panel as well as in repeater panel.

m) Main/Sub Fire alarm panel is to be provided with a operating work station with colour graphic software and A4 sized B/W printer. Fire response programme shall be integrated with the colour graphic software in order to display all the Detector Loops with their Dynamic Status. Summary of Alarm page shall also to be configured. Alarms with Beeper are to be configured in the Monitor Station with facility for acknowledgement.

n) A parallel redundant Uninterruptible Power Supply (UPS) unit with suitable Battery Back up shall be provided with the Master Fire Alarm Panel which shall provide Power to the operating work station & printer of the Panel. Technical Requirements and features of the OWS, printer and UPS are provided in the Vol V of the Specification.

o) All Fire Detection and Alarm Panels in CCR, CHP, and Repeater Fire Alarm Panel in Fire Station shall be integrated through Dual Redundant Optical Fibre Data Highway connected in Ring Main Topology. The technical requirement of such FO based communication cable are elaborated in Vol. V of the specification.

p) PLC based panel at fire water pump house, electronic based panel at foam and booster pump house shall indicate the status of each pump, system pressure, operation system, failure of starting of pumps, healthiness & failure of batteries/ chargers, main supply, low level of fuel oil of diesel engines, tripping of pumps, low level / very low level of water level in the water supply system, status of batteries & chargers of panels and diesel engines etc. Alarms from these panels shall also be available to operator at fire alarm addressable panels, central monitoring station and DDCMIS.

q) Two (2) sets (1 working & 1 standby, 100% capacity) of 24 Volt (2x12V) Automotive type Ni-Cd battery with charger for each diesel engine driven fire water pumps primarily for starting the engine .

r) Two (2) sets (1 working & 1 standby, 100% capacity) of 24 Volt (12x2V) sealed type maintenance free lead-acid battery with charger for each Satellite fire alarm panel, Fire Detection and Alarm panels in CCR, CHP and Master Fire Alarm Panel in Fire Station.

s) Supply, laying and connection of FRLS power, control and instrumentation cables required for complete fire protection system and Fire survival cables (950°C. for 3 hours) for CHP area.

t) Adequate no. of Back-lit maintained type emergency exit signs as per TAC shall be provided in all staircases of the building coming under plant battery limit.

u) Emergency Voice Communication System, adequate number of fireman's telephones and speakers. Speakers shall be provided in strategic locations throughout the Plant. Pre recorded voice messages shall be sounded through these Speakers to alert the people. Telephone set shall be provided in each Fire Alarm Panel. As minimum, Speakers shall be provided in Central Control Room, Coal and Ash Handling Plants, DM Water Plant, CW Pump House.

v) The panel at coal handling plant control room shall exhibit alarms from detection and protection from coal handling plant and all other auxiliary building/areas. Further, all panels shall also be hooked-up with Fire alarm panel at Central Control room for alarm purpose.

w) The central monitoring station to be located at Central Control Room and coal handling plant control room and shall cover the fire detection and protection system of the complete (all the areas) plant. This shall give audio-visual annunciations for fire in each of the risk area / equipment/ status of the fire protection system as well as system operator open /short circuit status of detector or control cabling etc. Further, this shall activate a hooter/sounder in each of the area provided with fire/smoke detection system.

x) Alarms from all the fire alarm addressable panels shall be repeated simultaneously in repeater panel at Fire station.

y) Dual action type Manual Call Points shall be provided at strategic locations at indoor and outdoor (preferably in Coal handling plant).

z) Sounder cum flashers shall be required at the exit gates along with the hooters/sounders along with Manual Call points. With each Manual Call Point, hooter/Sounder flashers shall be considered. The distance between consecutive MCP and Hooter shall be in such fashion that a person should not travel more than 30 mtr distance from the nearest one.

aa) Response indicators shall be employed for the showing the status of the detectors placing above false ceiling.

ab) Bidder shall refer Vol. V for complete C & I requirments of Fire Detection, protection & Alarm system.

ac) All instruments, detectors, cables and control equipments etc shall ensure high avaiabilty, high reliablility, low down time and ease of maintenance.

ad) Complete Fire protection, detection & Alarm system shall be designed in such a way that any failure in cable, detector or any component used in system, wire break, short circuit etc will not impact on the system and the Fire protection, detection & Alarm system shall be available 100% all the time round the year.

24.4.7.2 DESIGN:-

1.0 Detectors (Microprocessor Based)

a) Detectors shall be intelligent analogue addressable type. Detectors shall be housed or mounted in suitable enclosures in such a way that their performance is in no way affected. Special maintenance procedures, if any, required for the satisfactory operation of the detectors shall be clearly described.

b) In case detectors having electrical contact signal output on sensing fire, it shall be noted that the contact shall be "NC" type so that under fire conditions, this contact will open to initiate fire alarm system (fail safe type).

c) Normally the detectors, which has sensed fire and operated to give fire alarm could be easily located by the numbering scheme both on the detectors and zone-panel, for fire alarm system.

d) The various fire detectors serving a particular area / zone of plant may be wired-up in group and one common signal for each area/zone shall be transmitted to the zone indicating panel. The number of detectors to be installed shall be governed by total area to be protected, type of building construction, air movement, ceiling construction and sensitivity required.

e) The detectors shall be located where the largest combustion gas concentration can be expected.

f) It shall be possible to replace any type of detector head by a different type detector without requiring change in cabling/panel wiring and condition of the zone originally covered by the detector, thereby making it possible for a smoke detector to be replaced by either heat or flame type or vice versa.

g) All detectors shall be provided with built-in response indicating Lamp/LED which shall give local visual indication, in dense smoke condition when it will operate. The failure of lamps shall not prevent the function of detector.

h) The exact location of detectors shall be coordinated with other services like air-conditioning grills, light fittings, cable trays etc. to provide aesthetically pleasing appearance. The return air paths of air conditioning shall be avoided for detector location.

i) In such areas where detectors themselves are not easily accessible, the remote response indicators outside the enclosed areas shall be provided to indicate the fire condition.

j) Make and type of detectors shall be subject to Purchaser's approval.

k) The indigenous detectors shall have the approval of ISI/ISO in addition to the approval of FM/UL/FOC. Detectors and panels shall be preferably from the same manufacturer for compatibility.

l) The detectors shall not be effected by temperature, humidity, air flows.

A. Multi Criteria Smoke Detectors

a) The multi criteria smoke detectors shall be capable of sensing the fire in the incipient or smoldering stage itself, long before the fire matures to a visible flame. For achieving this requirement, the detector shall be capable of sensing visible combustion gases (in the form of smoke) or invisible combustion gases, which are the only clues for a long time in smoldering fires.

b) The detectors shall be sensitive to very low smoke densities of the order of 0.05 gm/cum.

c) The detectors shall be of Multisensor type with a combination of photo electric and heat sensing elements. The multicriteria smoke detector provides photo electric sensing and heat sensing combined in a single

sensor/base assembly. The multisensor base provides two sequentially addressable points, automatically assigned with one address selection.

d) The sensitivity of multicriteria smoke detectors shall be selected depending upon the environmental condition.

e) For further specification of multicriteria smoke detector, data sheet shall be referred to.

f) The design Coverage area for smoke detectors to be considered shall not exceed 25m² for A/C area per each detector and 35-40 m² for non A/C areas.

B. Rate-of-Rise and Fixed Temperature Heat Detector (IC Type)

a) The detector shall be solid thermal detector.

b) It shall operate on electronic-principle to provide precise fire detection.

c) The detector shall be of integrated circuit design enclosed in a robust moulded base.

d) It shall be completely moisture proof and air tight with exposed metal part specially treated to allow the device to be used in particularly corrosive atmospheres.

e) The detector should work on rate-of-rise and fixed temperature modes of operation.

f) It shall have no moving mechanical parts.

g) The detector shall be either surface mounted or with the body concealed above the ceiling and only the detecting element in view.

h) The rate-of-rise detector shall function when the rate of temperature increase exceeds a pre-determined value, around 7 to 8 Deg C per min. This detector shall be designed to compensate with the normal changes in ambient temperature, less than 6.7 Deg C per min., which are expected under non-fire conditions.

i) For further details, data sheet shall be referred to.

j) All the detectors shall comply style-7 fashion as per NFPA-72 standard.

k) Inbuilt indicating lamp shall be provided to indicate operation of the detector.

~~**C. Linear Heat Sensing Cable**~~

~~a) Linear Heat sensing cable shall be SS braided digital type (For Coal conveyors for Cable galleries/ spreader rooms. All cable shal be SS braided.~~

D. Frangible (Quartzoid) Bulb Type Detector

a) In frangible bulb type detectors a small amount of gas along with heat sensitive liquid (coloured) is entrapped and hermatically sealed. This detector shall generally be mounted on the pressurized water line which forms a ring around the equipment to be protected. When the surrounding temperature rises more than the rated temperature of the detector, the gas inside the detector shall expand and as a result the quartzoid bulb shall collapse releasing water and consequently pressure in the water line shall fall sharply. This fall in pressure will give signal/annunciation in the Panel.

b) The frangible bulb shall be capable of withstanding the hydraulic test pressure (19 Kg/Cm2 g) in normal practice.

c) Type and make of frangible bulb shall be of Owner's choice /approval.

d) For further details data sheet shall be referred to.

E. Infra red Spark/Ember Detector

a) The detector must respond satisfactorily even when the lens, through which the detection is sensed are covered with coal dust or oily dust substance.

b) The detectors shall be designed to work satisfactorily in the event of vibration in any axis.

c) To prevent false alarms, the detectors shall be provided with purge air facility to keep the lines clean.

d) Facility for remote response indication shall be envisaged in each detector.

F. Manual Call System of Fire Alarm (Intelligent Addressable Type)

a) The design shall be dual action type with the provision of key resetting.
b) Dual-color LED blinking for annunciation.
c) The MCP shall be made of M.S/ABS body.
d) The manual call points shall be provided at each entry & exit point of control rooms, UPS rooms, battery rooms, and other critical & mandatory locations specified else where in the specification.
e) The manual call point enclosure shall be completely dust, weather and vermin proof. The housing of the electronic circuitry shall have minimum IP 65 protection. The complete unit shall be suitable for wall/column mounting with necessary mounting accessories.
f) Clear inscription reading (in English) "FIRE ALARM - IN CASE OF FIRE PUSH" shall be provided for each manual call point unit, either on the enclosure or on a separate metal plate mounted behind the glass cover. The metal plate for inscription shall not tarnish under the atmospheric conditions
g) Type of manual call point shall be intelligent Addressable Analog type.
h) A red lamp Response Indicator shall be provided which will light up on actuation of manual call point to locate the manual call point station, which is operated.
i) The Manual Pull station shall be addressable type, the address and the location of the same shall be annunciated in the panels on operation.

G. Power Module

a) The Power Module shall be provided with AC to DC conversion circuits and the battery charger circuits. The panel which requires more than 16 Amp, A.C. power supply shall be suitable to receive 415 Volts ±10%, 3-Phase, 50 Hz ±5%, 3-wire power supply through MCB. Other panels having requirement of equal to and less than 16 Amp., A.C. power supply shall be suitable to receive, 240 Volt ±10%,, single phase, 50 Hz ±5%, phase and neutral, through MCB.

b) The panel shall have in-built stabilized power supply unit for its electronic circuitry which rectifies A.C. power supply to D.C. for system operation. Power supply to the detectors, manual call points, external hooters etc. shall be provided in the panel.

c) The automatic with manual over-ride change over inclusive of all metering, control, indication and interlock system shall be provided.

d) Parallel redundant (2 x 100% rating) Regulated power supply modules shall be used for operation of various components / cards. LED indications for system ON and blow fuses shall be provided on the Facia of Power Module.

H. Monitor Module

a) The monitor module shall be provided with all circuits which shall be able to monitor the various conditions / status of power supply section continuously. The monitor module shall be plug-in type.

I. Control Module

a) The Control Module shall be provided for hooking-up with Power Module, Monitor Module and Zone Module and for proper controlling of system of Fire Protection Zonal System. The Control Module shall be plug-in type.

J. Zone Module

a) Zone Module provided shall be of intelligible and addressable type. The zone module shall function as the interface between the various types of intelligent addressable analogue type fire detectors connected in the field and the panel circuits. Zone module shall comprise of necessary circuits for continuously monitoring the detectors, line cabling, the circuit for open, short and fire condition with audio-visual alarm. Facility for testing and isolation through push button shall be provided for zone module to simulate the open and short circuit of the cable connected between detector and the panel and fire condition with audio-visual alarm. Audio-visual alarm for each zone module in case of withdrawal or taking out of zone module from the connected system shall be provided. Zone module shall be designed in such a way that even after detection of fire from one detector located in a zone, the same zone shall be in operation for detecting fire. All the Zonal Fire Panels shall be networked through Fibre Optic Link with the Main Fire Detection and Alarm panel in CCR.

Note : 20% spare wired channel shall be provided in each module.

K) Realy Modules

i) No of contacts per relay shall be 2 SPDT or DPDT.

ii) 20% spare wired relay shall be provided in each relay module.

iii) The relay Module shall be plug-in type.

L) Loop Sounder / Hooter

i) Loop Sounder/Hooters shall be intelligent addressable and electronic type.

ii.) Loop sounder/hooters shall be provided with each Fire alarm panel, section indicating panel, Satellite Fire Alarm Panels & Repeater panel.

iii.) The system shall have provision to annunciate any one or all the loopsounder/hooters on any given condition.

iv.) The sound intensioty/volume shall be more than 85 dB at one meter distance and 5 dB above the back groud noise/sound at one meter distance.

v.) Colour of case shall be red.

vi.) Pitch, tone & volume of sound shall be adjustable.

vii.) Type of tone shall be selectable. (Minimum 4 types of tones shall be provided).

2.0 Fire Panels

A. Satellite Fire Protection, Detection & Alarm Panels

i) Satellite fire panels will be used to cater for the fire detection, deluge valve operation, associated annunciations system and power supply distribution network for the Fire Protection system. These panels shall be based on intelligent addressable Microprocessor based technology. These panels shall be strategically located in different areas of the Power Plant considering zone wise fire detection and fire fighting system.

ii) The system shall be operable from each fire detector network, automatic deluge valve right upto each local zonal fire panels, Manual Call Points provided in the area /equipment shall also be hooked up with such type of Local Fire Panels.

iii) Number of Satellite Fire Panels will be minimum as indicated in Vol V of specification and as finalized during detailed engineering. Any more no. of panels as required shall also be provided.

B) Fire Detection, Alarm & Protection Panels in Central Control Room.

i) The Fire Detection and Alarm Panel for the unit shall be based on intelligent addressable redundant microprocessor based technology and will be used to hook up with each of the Satellite Fire Alarm panels. The Panel with its operating work station, Monitor, printer and Peripheral devices shall

detect, display and annunciate electrical fault (open or short circuit), individual detector wise and Group Zone wise Fire Annunciation Satellite fire panels. in addition to monitoring its own detection system. The Fire Detection and Alarm Panel shall also supervise, monitor and annunciate the condition of the circuitry of the fire detection system through Satellite fire panels.

ii) The monitor of the fire detection and alarm panels in CCR shall be located on the operator's control desk of the respective units in the Central control Room.

iii) One number of Fire Detection and Alarm Panel complete with all accessories as described above and other items to make the installation complete is to be provided for the unit.

iv) Fire Detection and Alarm Panel shall have microprocessor based annunciation system. It will supervise; monitor the detection circuit through the Satellite Fire Panels.

v) Fire Detection and Alarm Panel shall detect and display both Fault and Fire alarm from each Satellite Fire Panels. The Fire Panels shall supervise, monitor and annunciate the condition of the entire circuitry up to the detectors through Satellite Fire Panels.

vi) The Fire Detection and Alarm Panel shall be indoor, air insulated, metal clad, floor/Wall mounting type.

C) Repeater Alarm Panel in Fire Station

i) The Repeater Fire Alarm Panel used to repeat, monitor, supervise and annunciate whatever fire and fault alarms annunciations coming in the fire detection and alarm panel of central control room. This panel shall also monitor supervise the circuitry between the Fire Alarm Panels in CCR, Sub Fire alarm panel in CHP. The repeater panel shall be located in the Plant Fire Station.

ii) One number of Repeater Fire Panel complete with all hardware and accessories and requisite software is to be provided, in the Fire Station.

D) ~~Local Fire Water Control Panel (PLC Based)~~

~~The Local Control Panels shall be provided for the following services:~~

~~i) Auto manual control, interlock, indication supervision and HW annunciation for Fire Fighting Equipment (Fire Pumps, Jockey Pumps etc.) located inside the FW Pump House. Complete operation of the Diesel engine driven pumps shall also be performed from this panel.~~

~~**The following feature shall also be provided in Local Fire Panels, Main Fire Panels and Repeater Panel :**~~

~~i) Actuation of any of above push buttons shall activate the corresponding Audio/Visual indications.~~

~~ii) External audio alarms (if any) shall not come on during the testing period.~~

iii) No relay/contactor shall get energised during TESTING PERIOD to avoid spurious tripping / actuation / simulation of alarms in the associated equipment.

iv) The performance and characteristics of audio visual annunciation system shall conform to BS, NFPA codes.

Local Control Panel for Fire Water System / Diesel Engine Driven Pumps and other Fire Protection Equipment located Fire Water Pump House and a local control panel for electric & diesel engine driven Booster pump.

i) Local Control Panel for the service called for shall be indoor, air insulated, metal clad, floor or wall or column mounting type. Type of mounting shall be determined by the Bidder depending upon layout convenience and size of the panel.

ii) The panel shall be fabricated out of 2 mm thick CRCA sheets. Degree of protection of the panel enclosure shall be IP 54. Lockable front door with proper gasketing shall be provided.

iii) Power module shall be provided with parallel redundant AC to DC conversion circuits and the battery charger circuits. The panel shall have in-built parallel redudant stabilizer power supply unit for its electronic circuits which rectifies AC power supply to 24 volt DC for system operation.

iv) The automatic with manual over ride changeover inclusive of all metering, control, indication and interlock system shall be provided.

vi) All controls, interlocks, indications and annunciation system shall be provided for safe and trouble-free operation of the Plant / equipment supplied.

The Panel shall be provided with the following features as minimum:

- One (1) Auto Start Control Section for auto start of electric driven fire pumps, jockey pumps and one (1) no. auto start control section for diesel engine driven pumps shall be provided inclusive of following gadgets as minimum :
- Auto and Manual Selector Switch for each electrical driven fire pump, jockey pump and air compressor (if applicable).
- Manual Start / Stop Push Button for each drive.
- Indicating Lamp showing power – ON
- Indicating Lamp showing power – ON / OFF
- Engine r.p.m. Indicator
- Lubricating oil pressure indicator

- ~~Engine Cooling Water temperature – "in and out" indicator.~~
- ~~Differential Pressure Indicator across strainer.~~
- ~~Voltmeter / Ammeter in Battery Charging circuit. Ammeter for each Electrical motor.~~
- ~~Hardware for diesel engine driven pump's control system.~~
- ~~Any other instrumentation and control required as per system demand and as per design criteria & guidelines specified in C&I part, Vol. V.~~
- ~~All annunciations as listed elsewhere and as required for safe and trouble free operation of the plant / equipment supplied.~~
- ~~The operation of control panel for Booster Pumps located in the Booster Pump House shall be similar to that of FW pump Panel.~~

Specific Requirements for Local Fire Panels

- Local Fire panels shall be indoor, air insulated, metal clad, floor, wall or column mounted type. Type of mounting shall be determined by the Bidder depending upon layout convenience, type, rating and duty involved in each category of panels.
- Each local fire panel shall be fabricated out of 2 mm thick CRCA sheets. Degree of protection of the panel enclosure shall be IP-54. However the hooter box to be mounted to the top of each panel shall have degree of protection IP-40.
- The front door shall be provided with either toughened glass or acrylic transparent sheet over the lockable full door with proper good quality of gasketing arrangement and with proper lock or equivalent so as to maintain degree of protection of IP-54.
- The components, which are to be fixed inside the cubicle, shall be so located on separate swing compartment in such a way that component and zone modules are clearly visible through glass or acrylic transparent sheet.
- The panel shall be designed in a truly modular concept with each zone represented by a module in order to minimize the wiring inside the panel and to minimize the breakdown time of the system.
- Each intelligent addressable local fire panel shall be capable of operating the intelligent addressable detectors and provided with the following plug-in type modules.
- Panel shall be designed on solid-state circuitry with provision of zone printed circuit cards, which shall be coated, for prevention against corrosion with suitable gold plated connectors for proper contacts. Gold plating shall be in the order of 4 to 6 microns.
- System of fire alarm shall be based on two-wire circuit system. Number of zones per panel shall be provided as per actual system requirement.

Each zone card shall be independent. Repetition of Fire Alarm and "Open and Short Circuit" of cables shall be provided in the panel.

- "Fire Detection Operated" signal shall be generated in the panel and shall be provided in the panel for hook-up with Owner's air-conditioning system, ventilation system, coal conveying system etc. The panel shall have provision for hook-up with external hooter, siren also.
- The panel shall have Ammeter and Voltmeter for 24 V D.C. System.
- UPS 230 Volts Volts Bus System shall be provided in the panel for solenoid operated valve required for Fire Fighting System in Coal Conveyors.
- All the Fire and Fault indications / alarms for the various zones and / or groups of zones shall be made available as electrically potential-free contact of adequate rating at the terminal strips of the Local Fire Panel for repetition of the same at Repeater Panel and Main Fire Panels.
- For each deluge valve, module shall be provided in panel in similar to Fire Detection System with the audio-visual alarm for (a) Detector circuit water pressure low, (b) Deluge valve operated (i.e. FIRE).
- The coal conveyor system shall be equipped with solenoid type Deluge Valve (SDV) to be operated automatically through fire detection system. Each SDV shall be provided with limit switch contacts to indicate actual operation of the solenoid operated valve in the panel. Since these connecting cables are to be run with other cables, the signal interference shall be avoided.

3. Microprocessor based Fire Alarm System

Bidder shall quote for a microprocessor based system to achieve the functional requirements as indicated above.

System Required

A) Panel System

i) The 100% hot standby redundant micro processor based fire detection and fire alarm system shall be designed such as to have built in redundancy to ensure availability at all times.

ii) The system shall basically comprise of the followings:

- Fire alarm panels housing the main processor units and plug in modules.
- Addressable type detectors shall be hooked up to the panel.
- Main and standby power supply units.
- Operating terminals.
- Printer.

iii) The control unit shall be of modular design, by means of plug in cards along with future expansion facility, exact tailoring of detector zones and control outputs to the actuation devices as required.

iv) The control unit shall be micro processor based and controlled by a programme contained in nonvolatile memory (EPROM).

v) Licensed version of Run and Edit mode of Software for the Fire Alarm panels, PLC System and Human Machine Interface System shall be provided.

vi) The control unit shall be suitable for accepting inputs from addressable type detector. It shall also have the facility to monitor the contact inputs.

vii) All the detection circuits shall be monitored against open circuit, short circuit and ground faults. For any malfunction in any detection line the control unit shall initiate a trouble signal for that detection line.

Further, the following criteria shall also be met.

- Fault in one detection line shall not affect the functioning of other detection lines.
- A single open circuit, short circuit or ground fault shall not inhibit the detection capability of the detection circuit. Suitable circuitry / modules shall be provided.
- The control unit shall pin point the location of fault for ease of maintenance.
- The alarm display unit, in the event of fire shall indicate the zone no. and zone description. It shall be possible to define the zones through software.

viii) The control unit shall be capable to process and evaluate incoming signals from addressable devices such as automatic heat/smoke detectors, manual call points etc. via four wire line circuits. The control unit shall be compatible with the detection line impedances.

ix) Each addressable line module shall have its own microprocessor-based circuit, working independently from the central processor unit located in the control unit.

x) In the event of an alarm or a fault condition it shall be possible to determine the exact device address at the control unit by means of numerical display. The device address shall comprise of the line number, device number and zone number.

xi) The detector shall be exchangeable without any change of programme.

xii) It is Bidder's responsibility to include required number of zone modules for the addressable detector.

xiii) Any special type of cable required for the detection system shall be provided by the Bidder.

xiv) Provision for a Remote Electronic Hooter with intelligent Control Module shall be made and the Hooter Unit shall be placed in a convenient location to draw attention to the people in the locality.

B) Detector System

i) Selection of detectors as per the requirements for that area and indicated previously. However some general criteria are elaborated additionally below for Bidder's guidance.

ii) Selection of type and number of detectors shall be based on type of combustible and ignition source, type of environment and type of risks involve. The detector shall determine whether a fire condition exists in the room / area where the detector is located. In case of fire, the audio-visual fire alarm will be generated at Central Control Room as well as initiate signal to operate a Hooter located at convenient place in the Power House Building, along with repeat display at fire alarm panel in Fire Station.

iii) Bidder shall consider area, ceiling height and type of ceiling construction for selection of optimum detector number and their placement. Other factors like ventilation, ambient temperature, radiation etc. are also to be taken into consideration.

iv) Guidelines in various standards such as NFPA-72, IS:2189, AERB standards etc. shall be followed. Detectors shall comply style-7 of NFPA.

v) Multi criteria smoke/heat detectors shall be intelligent analogue addressable type and shall have bi directional communication capability with the control panel. The accessory if required for the programming of the detector's address shall be provided. Further it shall be possible to change the detector sensitivity, calibration and identification from the control panel.

C) Additional Features

Followings are the additional features required :

i) A Operating work station with a keyboard and a A4 sized colored Laser printer. The monitor is essentially a 24 inch LED colour monitor which shall be hooked up to the main fire alarm control panels and shall display the alarm, prewarning, faults, system diagonistics and data logging system. A print of the data logged can be taken on demand.

ii) All the panels shall be standalone floor mounted type and as per design criteria & guidelines specified in C&I part, Vol. V

24.4.7.4 OPERATIONAL PHILOSOPHY & TECHNICAL REQUIREMENT:-

Each of the Addressable Fire Alarm panel shall be able to communicate with one another as well as with repeater annunciation panel and PLC based control panel located IN Fire Water Pump House. The detectors or other devices of any other unit/area shall be addressable only from the respective Addressable Fire Alarm Panel, so that each of the Addressable Fire Alarm Panel is under the control of designated operating personnel at that location. Facility to operate

booster pumps, foam system pumps and fire water pump house shall be provided from OWS based monitoring station.

At least 10% spare loop shall be provided in each of the addressable type fire alarm panel located in unit control room and in CHP control room with complete loop card and all other accessories so that OWNER can expand the system in future. Further, at least 10% of loop capacity be left free in each of the connected loop in all the panels, so that, additional devices may be connected to the system in any of the loop by OWNER in future.

Fire system (as a whole including PLC control systems) shall be provided with necessary interface hardware and software for dual fibre optic connectivity & interconnection with station wide LAN for two–way transfer of signals for the purposed of information sharing. The information shall be made available though on Ethernet link following TCP/IP standard. The system shall be OPC compliant. The exact data structure shall be as decided during detailed engg. All required plant data shall be transferred to /from through the ensuring complete security. The exact number of points to be transferred through the above communication link and the format of the data shall be finalized during detailed engineering.

System Functional Requirement

The fire alarm panel shall evaluate the signals received from the detectors and shall handle the following functions:

1. System self monitoring and fault signaling.

2. Transmission of alarm and fault signals to the respective fire alarm panels and as well as in the repeater panel in fire station. Further, the panel shall activate hooter / sounds in each of the area locally provided with fire/smoke detection system. Further, the system shall enable operation of spray system from the panel through monitoring station when the system operation is selected under remote, manual mode.

3. Initiate control functions like stoppage of conveyor, closure of fire doors, shutdown of draft fans, air-conditioning and ventilation plant/ equipment, opening smoke extraction vents, switching on smoke extraction equipment, emergency lighting etc.

4. Triggering stationary extinguishing systems such as clean agent system.

5. Supervising of unauthorised removal of a detector head from its base and giving a fault alarm on the control panel.

6. Supervising and monitoring the detection cabling, to indicate fault conditions in case of open/short circuit in the wiring.

7. Supervising by a separate annunciation window, changeover from mains supply to battery supply. “Mains On” indication shall be continuously on, as long as the main supply is available.

8. Facilitating simulation of fire conditions to enable the testing of circuits (without creating actual fire) under the test mode from the fire Alarm panel

9. The control unit shall contain all the systems main switches lamps and fuses.Switches and lamps shall be easily identified even in closed casings.

10. All the circuits from the detectors to the panels and the circuits from panels to the actuating/operating devices of the respective extinguishing system shall be of closed loop type and shall be supervised for open-circuiting and shortcircuiting of cables. The cable fault shall be audio-visually annunciated on the panels. Separate hooters with different tones shall be provided for 'fault' alarms and 'fire' alarms.

11. Actuate solenoid valve in spray system in case of fire from respective fire alarm panel. **For achieving this if any additional hardware is required like relays, power supply and cables, the same shall be provided.**

Analog Addressable Fire Detection and Alarm System shall also meet the following functional requirements:

i. Each of the system shall support analog addressable detectors of all types, non-addressable type detectors / devices along with its addressable interface units / modules, Video display units etc.

ii. Each of the devices and/or detectors shall be individually, uniquely and continuously addressable by the panel to which it is connected.

iii. Detectors shall be interrogated for sensitivity settings from the control panel, logged for sensitivity changes indicating the requirement for cleaning and tested by a single technician using the field test routine. Sensitivity of each of the detectors made available in the panel shall be adjustable from the panel.

iv. The system shall be capable of self-adjustment to compensate for the accumulation of contaminants that would change the detector sensitivity in either a more or less sensitive direction to prevent false indications or failure to alarm in the actual fire conditions. The system shall annunciate a trouble condition when any analog addressable smoke detector reaches 80% of its alarm threshold due to gradual contamination, signaling the need for service and eliminating unwanted alarm.

v. Continuous supervision/monitoring of all the circuits and its components shall be made available from the panel for open, short circuits and grounding.

vi. The system shall be able to recognize and indicate and alarm condition in a degraded mode of operation, in the event of processor failure or the loss of system communications to the circuit interface panels.

vii. The system shall be programmable at site and required hardware shall be included in the scope of supply. The system software Programs shall be password protected and shall include full upload and download capability. During program upload or download the system shall retain the capability for alarm reporting. The system shall download to a OWS for program editing. The software shall eligible Owner to add the spare loop provided in the fire alarm panel or addition of additional devices/detectors in and of loop in any of the fire alarm panel.

viii. The system shall support the use of color interactive History Reporting video display terminal for the display of information in an appropriate format.

ix. The system shall include software for system database, historical event log, logic and operating system. The system shall require no manual input to initialize in the event of a complete power down condition. It shall return to an on line state performing all programmed functions upon power restoration.

x. Software logic modules and system database shall be programmable using a windows compatible program on OWS. It shall be possible to program or edit the system database off site after down loading from the panel.

xi. All detectors shall incorporate internal automatic temperature compensation to overcome the effects of either high or low ambient temperatures in the installed environment on the detector sensitivity. The detectors shall be tested at a specified frequency by raising the detector sensitivity level to the alarm threshold, to check the operation of the detector without system alarming automatically by the control panel.

xii. In an alarm or trouble condition the following shall occur on the monitoring station:
1. Sound an audible.
2. Write details of the actuation to a system log file on the OWS.
3. Print the details of the actuation to the system printer.
4. Activate the color graphic display system controls, providing functions such as zooming, scrolling of Alarms, troubles, etc.

xiii. System configuration shall be menu driven and capable of being operated by a person with no previous computer programming experience.

Panel Display Requirements.

System display shall consist of minimum 80 character back lighted alphanumeric LCD display readable at any angle. Thirty-two character customer defined custom messages shall describe the location of the active device. In addition to the above, the following features shall be available.

a. The system shall be capable of programming to allow troubles occurred and restored in the system to be automatically removed from the display queue, eliminating the necessity for individual acknowledging of these events. This feature shall not affect the historical logging of events as programmed.

b. As a minimum an LED display for “Alarm”, “Audible Silenced”, “Supervisory”, “Trouble”, “Security”, “Power On”, And “Partial System Disabled”.

c. Touch activated membrane switches for “Alarm Acknowledge”, “Audible Silence”, “Supervisory Acknowledge”, “Security Acknowledge”, “Reset”, “Display Hold”, And “Display Next”.

d. All membrane switches shall be tactile with audible feedback when pressed.

SYSTEM SOFTWARE REQUIREMENTS

i) The software shall control the operation, function and display of the graphic system and provide for automatic boot up and run from the hard disk drive of the computer.

ii) All project specifics actuating device programming shall be capable of being carried out on site via password access.

iii) The system shall monitor all alarm, supervisory; trouble and security conditions detected by the fire alarm control panel and provide separate disk based files, for each condition. These logs may be enabled, disabled, or cleared with password access. This log information is not to be lost upon power failure or fire alarm control panel reset. A utility file shall be provided to sort the log data by date or by device and display this information either on the screen or the system printer.

iv) Selective memory storage up to 800 events, shall be stored in flash memory and displayed, printed or downloaded by classification for selective event reports.

a. Software shall allow selection of events to be logged, including; inputs as alarms, troubles, supervisors, securities, status changes and device verification; out puts, as audible control and output activation; action, as reset, set sensitivity, arm/disarm, override, password, set time and acknowledge.

b. Audible and visual indications shall be generated when memory is 80% and 90% full to allow downloading of data. The system shall be programmable circular logging, assuring that at least the last 400 events will always be stored in non-volatile memory.

v) Software has driven logic for adjusting the alarm threshold windows on detectors to compensate for accumulating contamination and keep detector response sensitivity constant. The software shall compensate for either oversensitized or desensitized units, raising a system flag when a detector approaches the allowable limits of adjustment, indicating a requirement for cleaning.

a. Values shall be stored in non-volatile memory allowing activation of all tracking functions within 90 sec of system initiation from a "cold boot". During the boot sequence, alarms from detectors programmed with the feature shall be suppressed.

When the full data history is active all devices shall be checked and any active alarms displayed.

b. The control panel shall place each detector in the system in an alarm condition, transparent to the system user, every twenty-four hours as a dynamic check of the accuracy of the alarm threshold setting. Upon reception of the alarm report, the system detector shall be restored to its pretest state.

c. The system shall be capable of monitoring the stage of detectors and displaying a message when a detector is approaching the limits of adjustment as a result of contaminates. A second message

shall be displayed when the detector reaches the limits of adjustment due to these contaminate.

d. The system shall be capable of recognizing that a detector has been cleaned, initiating a series of tests to determine if the cleaning was successful and display a detector cleaned message, readjusting that detectors normal sensitivity setting reference.

vi) When an alarm or trouble is registered at the fire alarm control panel the graphics system shall display the first screen image for the first actuated device. The system shall be capable of zooming in for further information if required. At all times when in the alarm or trouble mode the fire control panel status i.e. number of current alarms and or troubles is to be displayed on the graphics screen.

~~**Detection System for Coal Conveyors**~~

~~a. The LHS cable detector for each conveyor to be provided for both forward and return conveyors and shall be mounted as per the standard practice of the manufacturer/ supplier. The mounting arrangement shall be designed such a way that the same shall not hinder the normal operation and maintenance. Suspension of LHSC through flexible chains is a preferred arrangement. Further, LHS cable shall also be provided for return side of conveyors inside the bunker house.~~

~~b. The detection zone/loop divisions of LHSC system shall match with the MVW spray system.~~

~~c. Wet type QB detection system shall also be employed in addition to LHS Cable.~~

~~d. Upon detection of fire either by QB detector or LHSC detector, the spray system shall be initiated. It shall also initiate spray system for the two adjacent zones after a time delay settable at site.~~

~~e. The LHSC detector shall be provided with suitable interface unit, which shall generate/ make the signal compatible with fire alarm panel.~~

~~f. The infra red type (IR) detectors shall be suitable for detecting moving fires in coal conveyors.~~

~~g. The IR detector shall stop the conveyor upon detection of fire and give audiovisual annunciation locally and in fire alarm panel.~~

~~h. The IR detector shall be outdoor type weather proof and shall be able to function continuously in heavily coal dust prone atmosphere without regular maintenance.~~

~~i. The IR detector shall be designed to reject deceptive phenomenon such as electric arc, heaters, artificial light sources (HPSV/LPSV/incandescent lamps etc.) Sunlight etc. while retaining the inherent detection characteristics.~~

~~j. Each of the IR detectors shall be provided with its own purging arrangement using blowers, hoses, etc and required power supply shall be~~

derived from the fire alarm panel. Alternatively, bidder to each of the IR detector shall be provided by the bidder.

k. The performance of the proposed IR detector model for detecting moving fires shall be demonstrated to Owner as per test procedure acceptable to Owner before supply of the same at site. Such demonstration test shall be conducted in a typical coal conveyor test set up at works or in a plant.

l. Min two (2) Nos Solar Blind Infra red detectors with inbuilt air purging unit as per specification shall be used in each coal conveyor gallery and tunnel for detection of moving fire.

Detection System of Cable Galleries

a. In cable galleries, MVW spray system shall be actuated either by detection of fire by Linear Heat sensing cable detectors or by fire signal from smoke (after cross zoning) detection system. Apart from the automatic operation of spray system in the detected zone the adjacent two zones shall also be sprayed with water automatically after a set time delay simultaneously.

b. LHSC detector shall run in a zig zag fashion (with an included angle of minimum 90 degree atleast) in each of the top tray, bottom tray and in every alternate trays. Mounting arrangement of LHSC detector shall be as per recommendation/proven practice of manufacturer.

c. The detection zone/loop divisions shall match with MVW spray zones.

24.4.8 Control and Instrumentation

For technical features and requirements of the control and instrumentation items including Field instrument, Panels and Panel mounted instruments, annunciators, PLC and other hardware and peripherals under scope of supply for the Fire water system, Bidder shall refer the relevant clauses of the Volume V – Instrumentation & Control Works

24.4.8.1 Battery and Battery Charger

24.4.8.1.1 Battery

a) Battery to be located in FW Pump house shall be suitable to meet starting requirements of Diesel Engine driven pumps. Besides these all controls, indications, annunciations etc. (including multiplication of process interlock relays and auxiliary relays) shall have power supply from 24 V (2 × 12 V-2x100%) & Battery and Battery Charger unit(2x100%)

b) Satellite Fire Panels are located strategically in the power. All controls, interlock, indication, annunciation system etc. for Fire Detection system shall have power supply from 24V (2x12V) Battery and Battery charger Unit. The Battery for each Satellite Fire Panel compatable with UL standared shall be located in the bottom portion of the same panel.

c) All controls, interlocks, indications, annunciation system etc. for each of the Fire Detection and Alarm Panels (located in Central Control room) and the Repeater Panel (located in Fire Station), shall have power supply from 24 V (2x12V) Battery and Battery Charging Units. The Battery of each of the above Panels shall be located in the bottom portion of the same Panel.

The OWS with Printer in the central control room shall be powered up by the respective UPS Power of the Plant Instrumentation and Control System.

d) Diesel Engine Driven Fire Water Pump:
The Battery shall have the capacity to start the Diesel engine at least for eleven starts. Further Battery shall have capacity to meet auxiliaries & other loads of Local Control Panel, if any, for a minimum period of 10 hours. Minimum Ampere-hour capacity of the Battery shall be selected accordingly.

e) The Battery driven Power supply shall be available to local zonal fire panels, main and repeater fire alarm panel shall be designed to provide supply for a minimum period of 10 hours. Minimum ampere hour capacity of the Battery shall be selected accordingly.

f) Bidder shall compute the ampere hour capacity at suitable discharge rate based on above duty and furnish the calculation along with the Bid which shall consider the duty cycle and 25% & 15% compensation for ageing & unforeseen future growth respectively of each battery unit. The maximum and minimum ambient shall be 45°C and 8°C respectively.

The minimum voltage at the end of the load cycle shall not be less than 1.8 volts per cell.

24.4.8.1.2 Battery Charger

For design and construction of Battery Charger refer Volume : V

24.4.8.1.2.1 Layout of Battery & Battery Charger

a) The battery and charger of the respective panels shall be an integral part of each of the local fire protection panel / main fire panel / local fire panel / repeater panel.

b) Bidder shall indicate his own layout of 24 volt Battery and Charger to suit the space available.

24.4.8.1.2.2 Fittings & Accessories

Each battery shall be furnished with necessary accessories required.

24.4.8.2 Contact Rating and Contact Multiplication for Pressure Switch/Limit Switch of Valves

a) Contact rating of 10 Amps. at 240V A.C. or 0.5 Amp. at 220V DC is required to operate different circuits. If the same rating is not available from process switch contacts of the fire protection system, suitable auxiliary contactor/relay shall be included in the offer and provided in the respective panels to get the suitable number of contacts which can meet the current rating stipulated above.

b) Further if the number of the process switch contacts of Fire Protection System are not adequate to meet the requirement for "System of Operation", annunciation and monitoring system, the same shall be included in the offer and provided in the respective Panels to get the

suitable number of contacts which can also meet the current stipulated above.

24.4.8.3 Interlock Between "Fire Protection System" and Coal Handling Plant and Ventilation and Air Conditioning System

a) In case of fire in any Zone of conveying system in coal Handling Plant, fire detector of that particular zone will operate at a preset value and an alarm will be annunciated in the Fire Alarm Panel located in Coal Handling Building. Simultaneously, the conveyor motor of the particular conveying system will be tripped automatically through IR Detector.

b) In order to achieve this, "Detector Operated Digital Signal" will be generated in the Fire Panel by the Bidder (i.e. successful Bidder) with the help of auxiliary contactor/relay for interlock purpose to trip the conveyor motor. This signal shall be provided in the form of potential free (not changeover type) 1NO + 1NC contact combination for trip of each such conveyer motor.
The list of such inputs required shall be developed by the successful Bidder.

c) In case of fire in a zone/area where ventilation fans and/or Air-conditioning Ducts are installed similar "Detector Operated Digital Signal" shall be generated in the nearby Fire Panel. This digital signal shall also be generated in the form of potential free (not change-over type) 1NO + 1NC contact combination with the help of auxiliary contactor/relay for automatic trip or closing of each such ventilation fan-motor, fire damper of ventilation fan/duct, damper motor of Air-conditioning duct, blower motor of corresponding Air handling unit & compressor motor of chiller unit.

d) The list of such inputs required shall be developed by the successful Bidder.

e) The auxiliary contactor/relay required as mentioned in clause nos. a) and b) above shall have 24V D.C. power supply system provided in the respective Fire Protection Zonal Panels.

f) Number of contacts for the auxiliary contactor/relay shall be 4NO + 4NC. The contact rating of each such auxiliary contactor/relay shall be of 10 Amps. at 240V A.C. or 0.5 Amp. at 220V D.C.

g) Since the false ceiling of above area shall act as return duct of Air conditioning and since roof extractor is used without any ducting arrangement for ventilation system, detectors for air conditioning duct and ventilation duct are not envisaged. If Ducts will be decided during detail engineering, the same shall be required.

24.4.8.4 Annunciation System

a) A Board Sequence of Annunciation System shall be as per the following Table :

Status	Visual Display	Audio Signal
NORMAL	OFF	OFF

FAULT	ON WITH BLINKING	ON
ACCEPT	ON (STEADY)	OFF
NORMAL BEFORE ACCEPT	ON WITH BLINKING	ON
FAULT CLEAR BUT NOT RESET (after ACCEPT)	ON (STEADY)	OFF
RESET WHEN FAULT IS CLEARED	OFF	OFF
RESET WHEN FAULT IS NOT CLEARED	ON (STEADY)	OFF

b) The detector zone connections shall be supervised to indicate fault condition in case of removal of one or more fire detectors from the detector base.

c) All cabling between detector and the panel shall be supervised so as to indicate fault condition in case of open/short in detector cabling with a direct fault condition. The tone of this audio-alarm shall be distinct and different from that of zone wise fire alarm.

d) The printed circuit cards provided for individual fire-zone shall be coated for prevention against corrosion. Gold plated connectors shall be provided for proper contacts.

e) Separate set of "Accept", "Test" & "Reset" push buttons shall be provided for "Fault Alarm" and "Fire Alarm" systems.

f) Each panel shall be provided with a hooter/buzzer, which shall have dual toners for differentiating the fire alarm with the fault alarm.

g) Facility shall be provided for connection of external electrical hooter/gong, which shall be energised in case of fire alarm condition within any of the zones provided on the panel. The input for the hooter/gong shall be 24 Volt D.C.

h) Fire Detection and Alarm Panels and Master Fire Alarm Panel shall also have "Fault Alarm" & "Fire Alarm" system. For this purpose potential free contacts shall be provided in the respective Satellite Fire panels for hook-up between Fire Detection and Alarm Panels/ Master Fire Alarm Panels and each Satellite Fire Panel.

i) Each zone module shall have a facility for diagnostic check of all the related circuitry for their operation healthiness. The same shall be accomplished through the following push buttons :

a) Fire, b) Open, c) Short, d) Insulation level.

Fire proof sealing / Fire Stop / Fire Protection Coating System

The fire-proof sealing/fire stop system/fire protection coating system is required to prevent spreading of fire from one place to another (or one zone

to another) through the openings in wall/floor, cables laid in trays / racks and openings below Electrical Switchgear / MCC / Distribution Boards / Cabinets / Panels etc.

~~Fire-proof Sealing System~~

~~The material/components used for fire-proof sealing system shall be provided to meet the following requirements:~~

~~a) Life expectancy should not be less than 30 years from the date of installation.~~

~~b) Free from shrinkage or cracking or asbestos in composition and should achieve smoke and gas tightness during fire and should be modifiable.~~

~~c) Not to generate toxic gas and harmless to the personnel handling the system.~~

~~d) Prohibition of production of acid or alkali during gas generation.~~

~~e) Will not produce suffocating/corrosive gas.~~

~~f) Repellant to pest/ rodent/ termite.~~

~~g) Expansion co efficient - very low, which is to be comparable with masonry concrete.~~

~~h) Not soluble/reactive to acid, water, alkali.~~

~~i) Thermal conductivity - low.~~

~~j) The material in contact with the cables in the fire-proof sealing system shall be compatible with the material used for outer sheath of cables.~~

~~k) It should not have any adverse effect on the cables and should not alter the current carrying capacity of the cables.~~

~~l) Retrofit in design to accommodate not less than 15% more addition of cables depending upon the size of cables, physically and chemically stable.~~

~~m) Capable of withstanding vibrations, drop loads, foot traffics, mechanical loads, etc.~~

~~n) Non-hygroscopic, non-inflammable and shall not get affected over a period of time due to humidity, moisture and ozone etc. and should not contain volatile solvents which may cause a fire hazard during application.~~

~~o) The fire rating shall not be less than three (3) hours and the system shall be stable after application of water jet in the exposed side in order to extinguish fire.~~

~~Fire Protection Coating to be Applied On Installed Cables~~

~~a) The cables shall be coated with fire protection material of 2 mm dry thickness at the strategic locations as follows so as to limit the spread of fire:~~

i) At fire stops in walls and floors on either side upto 500 mm length.

ii) At fire stops below Electrical Switchgears / MCCs / Panels / Cabinets etc. on one side coating of 500 mm length i.e. on the cable vault side/cable trench side.

iii) Length of 500 mm on all sides of the junction/crossing of cabling work in open cable routes/cable trench.

iv) In fire risk areas and where specified at suitable intervals as decided upon site conditions in open cable routes.

v) Where necessary and specified at site at intervals along cable routes in cable trenches.

vi) The coating shall be applied evenly on the cables only.

b) The fire protection coating shall have the following properties / composition:

i) Asbestos free, non-volatile, not eatable by vermin, harmless and non irritant to skin of human.

ii) Not affecting the current carrying capacity of the cables and the properties of the installed cables.

iii) It shall delay fire damage to cables and prevent flame spreading meeting the requirement of IEC 332-1 & IEEE 383.

iv) Coating material shall show no signs of cracking and peeling when the coated cable is bent to the radius of minimum 12 times the diameter of the maximum sized cable at 180°C.

v) The limiting oxygen index of the material shall not be less than 35% as per ASTMD 2863.

vi) Life expectancy equivalent to the cable installations.

The various openings in the cable vault, vertical / horizontal raceways of cables penetrating walls / floors and the bottom of Electrical Switchgears / MCCs / Distribution Boards / Cabinets / Panels shall be provided with fire stop systems. Cables passing through the openings at various locations are laid on various tiers of the cable trays/racks in the bunch formation. In case, for the purpose of installation of seal system, steel frames are required to be fabricated and fixed in the openings, the fabrication of frame and fixing of the same shall have to be done by the Bidder. The necessary steel section for fabrication of frames shall be supplied by the Bidder without any extra cost. Any, civil works required to be done in the openings shall be carried out by the Bidder. Bidder shall also include one set of tools and accessories required for addition or removal of cables after the seal is made. This shall include special tools, compound injection guns, spray guns, etc.

Power and Control Cables

Fire survival Power and Control Cables shall be of following types :

a) Power Cables
750V grade heavy duty mineral insulated copper sheathed copper conductor cable with outer covering of LSF material equivalent to BICC Fire Safe, conforming to BS:6207. The cables shall be rated for 950°C. for three hours and shall meet with requirements of CWZ class as per BS:6387. Minimum cross-section shall be 2.5 Sq.mm.

b) Control Cables (for fire detection)
Survival cables shall be similar to the above except that voltage grade shall be 500V in place of 750V. In addition the cables shall have high degree of immunity from electromagnetic interference. Minimum cross section shall be 1.5 Sq.mm.

FRLS Power and Control Cables

a) Power Cables
1.1 kV grade 85°C. rating heavy duty power cable with stranded Aluminium/Copper conductors, HRPVC insulation, extruded PVC inner sheath, round wire armour and extruded FRLS PVC overall sheath. Minimum cross-section shall be 2.5 Sq.mm. Cu. and 16 Sq.mm. Al.

b) Control Cables
1.1 kV grade, 70°C. rating control cables with stranded copper conductor, PVC insulation, extruded PVC inner sheath round wire armour, overall extruded FRLS PVC sheathed. Minimum cross-section shall be 1.5 Sq.mm. Cu.

Instrumentation Cables

a) Bidder to refer Vol. V, Chapter 9 for details of instrumentation cables. For any binary or Analog signals, instrumentation cables shall be used as per design criteria & guidelines specified in Vol. V, Chapter 9.

b) In Fire Protection & Detection system, Loop wiring & Panel networking shall be designed meeting the NFPA Style 7 requirements.

24.4.8 CIVIL SUPPY

a) ~~Design and construction of Fire Water pump house including foundation of fire water system equipments (viz, pumps & motors, diesel engine, compressor etc.)~~

b) Excavation, preparation of bed and backfilling with compaction for laying underground pipelines and underground cables (where approved by purchaser).

c) Construction of RCC valve chamber as required.

d) Construction of shed for deluge valve, Booster Pump House as per specification. The shed shall be of masonary enclosed structure with minimum four inch (4") RCC Roof.

e) Construction of pylon support including foundation for spray water ring and water circuit for detection of H.T. Transformer, Oil tanks etc.

f) Design & construction of foundation of clarified/ fire water reservoir mentioned above.

g) Adequate no. of staircases as per National Building Code (NBC) and TAC.

24.4.9 ELETRICAL, CONTROL & INSTRUMENTATION

Complete Electrical, Control & Instrumentation system for safe and reliable operation of the system shall be included as per design criteria & guidelines specified in Volume IV & Volume V.

~~n) Fire stops/fire ceiling of two (2) hours rating at 750°C in wall/floors.~~

~~o) Fire stops below switchgear / MCC / Switchboards, junction boxes / panels / cabinets etc. which are floor mounted type.~~

~~p) Fire retardant coating of thirty (30) minutes rating at 750°C to be applied for installed cables.~~

~~n) Fire barrier / baffle wall in transformer yard, fire barriers for compartmentalizing the cable spreader rooms, fire proof door.~~

~~q) Materials for fire barrier walls/baffle wall in Transformer Yard.~~

~~r) Materials for fire barrier for compartmentalizing the cable spreader rooms.~~

~~s) Materials for fire proof doors.~~

~~24.4.10 Fire station & other facilities~~

~~Fire station is to be provided with facilities to park fire tenders, fire control room, fire officer room, store, dormitory for fire staff etc. Repeater Master Fire Alarm panel is provided in the fire station to monitor and control the fire in power station. This panel is provided with audio-visualalarms regarding status of fire in different areas, status of deluge valves, repeat annunciations from main fire detection and alarm panel in unit control room, PLC based panel fire water control cum alarm panel in fire water pump house & in foam pump house.~~

~~Fire station building shall have provisions of all the equipments required for smooth O&M of fire personals as per statutory regulations and norms. Service water, potable water, clarified/fire water line for filling fire tenders,~~

~~compressed air line shall be provided inside fire station along with handling, drainage, lighting, HVAC facilities. Following minimum equipments requirements:~~

~~a. MOBILE FIRE AND FOAM TENDER~~
~~Two (2) No. mobile Fire Tender, One (1) dry chemical tender and One (1) No. mobile Foam Tender shall be provided. The design requirements of mobile water tender shall conform to IS 950 and design requirements of mobile Foam tender shall conform to IS 10460. Supplementary extinguishing agent (dry chemical powder type), (Co2 type) and all accessories as per relevant IS code.~~

~~b. Fire jeep: One no. fire jeep with trailer pumps with al accessories as per IS: 944 and its appendices~~

~~c. Four (4) nos. of fire suits as per relevant IS code.~~

~~d. Ten (10) nos. breathing apparatus (O2 cylinder) as per relevant IS code.~~

~~e. Two (2) sets of first aid kits as per relevant IS code.~~

~~f. Ten (10) sets of fibre glass blankets as per relevant IS code.~~

~~g. Four (4) nos. of multipurpose nozzles.~~

~~h. One (1) no. portable thermal imaging camera.~~

24.4.11 Fire Extinguishers:-

Fire Extinguishers shall be installed in all the buildings within the Plant boundry as per TAC requirement. The Bidder shall supply the required quantities of Fire extinguishers and install the same at all location within the power plant boundary limits. Distribution of these extinguishers in various locations shall be as per TAC guidelines.

Class-A
Fire in ordinary combustibles such as wood, coal dust, vegetable, fibre, paper and the like.

Class-B
Fires in flammable liquids, paints, grease, solvents and the like.

Class-E : Fires in Electrical and Control & Instrumentation Equipments
To encounter the above classes of fires, extinguishers of Gas/Expelled water type, Carbon dioxide type, Dry chemical powder type and Mechanical Foam type shall be provided by the Bidder inside the Power House Building and all other main/auxiliary buildings where the above mentioned classes of fires are envisaged.

The selection of number of extinguishers for each type shall basically follow the guidelines laid down in Cl. No. 4.0 of the latest edition of the Fire Protection Manual Published by TAC.

24.4.11.1 DESIGN, CONSTRUCTION AND SPECIFIC REQUIREMENTS

24.4.11.1.1 Design and manufacture of the extinguishers shall conform to the latest editions of Indian and other equivalent International Standards and shall be suitable for respective design pressure, temperature and service conditions.

24.4.11.1.2 All the extinguishers along with accessories shall be guaranteed for satisfactory and trouble-free operation.

24.4.11.1.3 Portable extinguishers shall be complete with brackets/fittings suitable for mounting on wall and a carrying handle of ample strength.

24.4.11.1.4 Mobile extinguishers shall be provided with a wheeled trolley for movement. Trolley mounted extinguishers shall be provided with 6 or 9 meter long high pressure discharge hose with horn/ telescopic applicator.

24.4.11.1.5 Spanner and other accessories as required shall be supplied with each fire extinguisher.

24.4.11.1.6 Each extinguisher shall be designed, constructed, tested and painted in accordance with respective Indian/International Standard and marked with BIS Certification.

24.4.11.1.7 First charge of chemicals in each extinguisher shall be provided. All chemical charges shall be refilled after testing at site.

24.4.11.1.8 As required by Tariff Advisory Committee (TAC), 20% spare charge of the total no. of extinguishers installed, with a minimum of six recharges, shall be supplied for each type of extinguishers.

24.4.11.1.9 Fire extinguishers shall be fitted with pressure gauges as applicable to indicate whether the extinguisher is charged or in need of a recharge.

24.4.11.1.10 For design and construction standard, capacity and accessories of various portable/mobile extinguishers, datasheet appended shall be referred to.

24.4.11.1.11 The discharge horn of the Carbon-Dioxide Extinguishers shall be made of a material non-conducting to electricity.

24.4.11.1.12 All extinguishers shall be mounted at strategic locations in bunches and/or individually to TAC approval. These extinguisher cylinders shall have the approval of Chief Inspector of Explosive (CIE), Nagpur.

~~24.4.12 Passive Fire Protection System:-~~

~~Passive Fire Protection System for all outdoor transformers, and indoor transformers having rating more than 10 MVA, Cable Vault, Cable Spreader Room & Enclosed Cable Risers (Cable Shafts) shall be provided~~

-Tensile and elongation tests
-Flame retardency as per IEC 332
-Oxygen index test
- FRLS characteristics
- Flammability test as per IEC-332 Part -3 (Category-B) and IEEE-383
- Swedish Chimney test as per SEN-SS 4241475 class F3

9.02.05 Fiber Optic Cable

A	**Fiber:** The optical fiber core shall be of ultra pure fused silica glass coated with UV-cured acrylate suitable to withdraw temperature of about 80 Deg C (continuous). Fiber Optic cables shall be suitable for installation on cable tray, duct bank, cable trench, and direct burial as necessary.		
1	Type	Multiple single mode & Multi-Mode Fiber to avoid usage of any repeaters.	
2	**Core Diameter**	**Multimode Fiber cable**	**Singlemode Fiber cable**
		62.5 ± 2 microns or 50 ± 2 microns depending upon distance between source & destination.	9 ± 1 microns
3	Cladding Diameter	125 ± 2 microns	
4	Fiber Proof test	As per IEC/EIA & other international standard.	
5	Coating Diameter Test	As per IEC/EIA & other international standard.	
6	Number of Fibers/core	Four/Eight/Twelve (Colour Coded) with min. 100% spare core (Fibers)	
B1	**Optical Charactertics – Bandwidth, Attenuation & Numerical Aperture**	**For multimode fiber cable with core diameter 62.5 ± 2 microns:**	**For multimode fiber cable with core diameter 50 ± 2 microns:**
1	Bandwidth @ 850 nm Bandwidth @ 1300 nm	160 MHz-Km min 500 MHz-Km min	500 MHz-Km min 500 MHz-Km min
2	Attenuation @ 850 nm Attenuation@ 1300 nm	3.0 dB/Km max 0.8 dB/Km max	3.0 dB/Km max 0.8 dB/Km max
3	Numerical Aperture	0.275 $\pm$ 0.015	0.200 $\pm$ 0.015
B2	**Optical Charactertics - Attenuation**	**for Singlemode fiber cable outside plant:**	**for Singlemode fiber cable inside plant:**
1	Attenuation@ 1310 nm Attenuation@ 1550	0.35 dB/Km max 0.2 dB/Km max	1 dB/Km max 1 dB/Km max

	nm	
C	**Cable Construction:** Fiber Optic cable shall be of loose tube design. Typically, fibres shall be housed in groups of 4/8/12 (as per requirements) within gel-filled buffer tubes to protect against ingress of moisture and vibration. The tubes shall be manufactured with industry standard material tools & practices. The buffer tubes shall be stranded around the central strength member utilizing reverse oscillating lay (ROL). Blank fillers shall be used as necessary to maintain circular cable structure. Fillers shall be flame retardant and moisture resistant. The cable shall be of dual jacket & armoured. Optic Fibre cable shall be polymer coated, Electrolytically chrome plated corrugated steel taped (ECCST) armoured, fully water blocked with central dielectric material for outdoor/indoor application so as to prevent any physical damage. Two highly visible ripcords are placed under the jacket to aid in sheath removal. A co-polymer coated steel tape is corrugated and wrapped around the inner jacket to provide additional cable compression strength and Termite & rodent protection. A ripcord is also placed underneath the armour for easy outer jacket removal.	
1	Outer Colour	Orange
2	Outer Jacket	Polyethylene minimum 1.5mm thick, Flame retardant & UV resistant.
3	Inner Jacket	Core-locked flame retardant polyethylene
4	Filler / Strength member	As per Manufacturer's standard
5	Central Strength member	FiberGlass reinforced plastic (FRP) and Buckle resistant material to provide both tensile and anti bucking strength to the cable.
6.	Details marked at every meter on outer sheath.	Manufacturer's Name, Month and Year of Manufacturer, Coded description of the cable based on telcordia"s (bellcore) SR-2014 suggested optical cable code (SOCC), Sheath identification Number, Sequential Length marking in meter, A telephone Handset symbol to distinguish communication from power cable as per NESC section-35G.
7.	Life Expectancy	Fiber Optic cable shall provide a long life expectancy of minimum 25 years under continuous operation without degradation to optical or mechanical performance.
8.		Spliced/Repaired cables are not acceptable.
D	**Stripping Ability**	All layers easily removed with Commercially available tools
E	**Installation:**	
1	Minimum bending radius	20 X D (D=core Diameter) - During

		Installation , Short Term , loaded 15 X D (D=core Diameter) – Installed, Long Term , No load
2	Maximum Tensile Load/Strength	During Installation: 2200 N Installed: 1500N
3	Method of laying	Directly laid in cable trays / duct bank / clamped with available structure
4	Pulling	Ordinary cable grips
F	**Storage Temperature**	- 20 ^{0} C to 70 ^{0} C
G	**Operating Temperature & Humidity**	- 20 ^{0} C to 70 ^{0} C & 100%
	Maximum Cable weight	46Kg/1km
	Maximum cable length	1 km
H	**Data Speed performance**	10 Gbps minimum
I	**Test Specification (EIA/TIA – STD455/IEC standard):**	
1	Impact Resistance	2000 Impacts minimum
2	Crush Resistance	4000 N/10cm minimum
3.	Compressive Strength	3000 N minimum
J	**Moisture/Water Resistance as per IEC standard.**	Water blocking layer, Cable shall withstand water penetration when tested with a one meter static head or equivalent continuous pressure applied at one end of a one meter length of filled cable for one hour. No water shall leak through the open cable end.
K.	**Optical time Domain reflectometer**	a. A recording optical time domain reflecto meter (OTDR) will be utilized to test for end-to-end continuity and attenuation of each optical fiber. The OTDR shall be equipped with data storage, printer, help feature, compare trace features and OTDR software. The data storage unit must include a built-in floppy disk drive capable of storing a minimum of 100 test traces. b. Data traces saved to disk shall include the following labels. i. Fiber Identification (ID) with a minimum of 10 characters. ii. Cable ID with a minimum of 10

		characters iii. OTDR location with a minimum of 20 characters iv. Far End location with a minimum of 20 characters. v. Test operator initials with a minimum of 3 characters. c. The printer shall preferable be internal. The printer shall be able to print data traces within 30 seconds or less. The machine setting used to repeat tests at a later time shall include index, range, wavelength, average time, pulse width and scale settings. The test results (on printout) shall provide information including: loss, distance, reflectance, data and time. d. The requirements for the compare trace feature include the ability to recall two historical traces from a diskette and display them simultaneously for analysis and printing. The compare trace must compute and display a single graph representing any differences between two traces. The compare trace must be able to recall historical traces from a discrete and perform the same tests on connected live fibers. The compare trace shall perform a two point loss measurement test for any two particular fibers in a comparison analysis. The losses between the two points on the each fiber shall be displayed, and the differences between the two readings clearly shown. e. The OTDR must be equipped with software to support all of the required functions. The software shall provide for printing of whole set of traces (batch print) with minimal commands eliminating the time spent for printing traces individually. f. Bidder shall provide all mounting

		accessories, cables and connectors required to establish data communication.
L.	Fiber Optic splicer, terminator and tool kit box	Bidder shall provide new unused tools comprise of splicer and fusion jointer and tool kit comprise of cutter, stripper, polishing tool, handheld microscope, heat shrinkable sleeve, scissor, knife etc as required for maintenance and commission.
M.	**Standards**	Optical cable shall be conform to i) IEC 60794/IEC 60793 & EIA/TIA 455. ii) Low smoke (IEC 1034 -light transmittance of 80%). iii) Halogen free (IEC 754: 1&2-maximum acid gas generation shall be 2% by weight and PH >4.3). iv) Fire & flame retarded (IEC 331,IEEE 383). v) Rodent resistant. vi) Crush Resistant (EIA -455-41). vii) Impact Resistant (EIA -455-25). Bidder shall submit Type test report for review, conform to IEC 60794, IEC 60793, IEEE 383, and IEC 754: 1 & 2, IEC 331, IEEE 1034 and EIA/TIA standard. Colour codes shall be as per EIA/TIA 598-A.
N.	**TESTS**	Following minimum test as per any approved standard shall be carried out on the cables for witness of owner: a. Attenuation and Dispersion characteristics tests b. Proof Tests c. Macro-Bend resistance Test d. Mechanical Test e. Low and High Temperature cable Bend Test f. Impact resistance Test g. Compressive strength Test h. Tensile strength Test i. Cable Twist test j. Cable cyclic flexing test k. Environmental characteristics Test l. Temperature cycling test m. Colour permanence Test n. Cable Aging test o. Water penetration test

		p. Lightning Test q. Kink Test r. Crush Test

9.02.06 Data Cable:

Data transmission cables are control & signal cables used in electronics of computer system, electronic control equipment etc. in power plant data processing system. The cable has an overall screening which suppresses external electrical influences and ensures precise pulse transmission. The screen braiding of tinned copper wires is wrapped around the core or inner sheath.

i) Min. bending radius for flexing	:	15x cable diameter.
ii) Temp. Range	:	(-30 to +80) deg. Centigrade
iii) Loop resistance	:	Max.78.4 ohm/km.
iv) Inductance	:	0.65 mH / Km.
v) Coupling	:	200 pF / Km.

Co axial and fibre optic cables are also used as data cables.

9.02.07 All type of Instrumentation & extension cables near high temperature zone shall be high temperature heat resistant cables, which shall be terminated at a junction box in normal temperature zone. Thermocouple extension cables and Instrumentation copper conductor cables for high temperature applications shall be with insulation of individual conductor and outer sheath of extruded FEP (i.e. Teflon) as per VDE 0207 Part 6 and ASTMD 2116. The thickness of insulation shall be 0.5 mm nominal (i.e. 0.4 mm minimum). These cables shall be single / Multipair twisted & shielded. Other parameters/properties shall remain same as specified for Instrumentation and extension cables.

9.02.08 Fire survival instrumentation Cables shall be similar to the Fire survival control cables specified in electrical section (Vol. IV) except that conductor material shall be annealed tinned copper conductor. Size of conductor shall be same as defined at cl. No. 9.01.03.16. In addition the cables shall have high degree of immunity from electromagnetic interference.

Fire survival cables (Power, Control and Instrumentation) shall be provided for the following applications, as these cables can withstand 750°C temperature for three (3) hours:

a) DC emergency lube oil pumps

b) DC seal oil pump

c) DC emergency lighting cables for main plant building.

d) Batteries to battery chargers and DC distribution boards and as well as incoming DC cables to switchgears located in main plant building and firefighting switchgear.

e) Turbine lube oil pumps

f) Jacking oil pumps

g) Emergency turbine trip push buttons in control room.

h) Boiler turbine: Generator inter-trip which includes the inter connecting cables between:-

- Boiler master fuel trip and turbine trip relays
- Generator trip relays and turbine trip relays
- Generator trip relays and 400 kV circuit breaker
- Generator trip relays and generator field breaker
- Generator trip relays and UAT breakers

i) Fire alarm, annunciation and protection system.

j) Any other system like safety critical circuit, trip protection circuit and for drives required for safe shut down operations of the plant.

9.03.00 INSTRUMENTATION CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY

The cable interconnection philosophy to be adopted shall be such that extensive grouping of signals by large scale use of field mounted group Junction Baxes (JBs) at strategic locations is done and consequently cable with higher numbers of pairs are extensively used between field & Marshalling panels. The details of termination to be followed are mentioned in the given table below:-

Application		**Type of Termination**	
FROM (A)	TO (B)	END A	END B
Valves/Dampers Drives (Integral Junction Box)	Marshalling/ Marshalling- cum Termination Cubicle/ Local group JB	Plug in connector	Post mount cage clamp type
Transmitters, Process Actuated switches mounted in LIE/LIR	Integral Junction Box of LIE/LIR	Plug in connector	Cage clamp (Rail mount type)
RTD heads	Local Junction Box	Plug in Connector	Cage clamp (Rail mount type)
Thermocouple	Local Junction	Plug in Connector	Cage clamp (Rail

	Box		mount type)
Other Field mounted Instruments	Local JB/ Group JB	Plug in Connector	Cage clamp (Rail mount type)
RTD heads	Temperature transmitter	Plug in Connector	Screwed Cage Clamp Type
Thermocouple	Temperature Transmitter	Plug in Connector	Screwed Cage Clamp Type
Local Junction box, Temperature Transmitter, Int. Junction box of LIE/LIR/Group JBs.	Group JB	Cage clamp (Rail mount type)	Cage clamp (Rail mount type)
Local Junction box, Temperature Transmitter, Int. Junction box of LIE/LIR/Group JB/ MCC/SWGR	Marshalling/ Marshalling – cum Termination Cubicles.	Cage clamp (Rail mount type)	Cage clamp (Post mounted type)
Marshalling cubicle/Termination Cabinets	Electronic system Cabinet	Cage clamp (Post mounted type)	Plug-in connector/other system as per Mfr's standard
Marshalling/ Termination System Cabinets	UCD mounted equipments	Cage clamp (Post mounted type)	Plug in Connector/ Cage clamp Type (rail mounted)
DDCMIS/PLC cabinets	OWS, Printer etc.	Plug in connector	Plug in Connector

Notes

1. For Analog signals, individual pair shieldiing & overall shielding & for Binary signals, only overall shielding of iinstrumentation cables shall be provided.

2. Signal and Electrical connection shall be screwed connection with double compression type Nickel-plated brass/SS316 cable glands for Explosion proof area, Flame proof area and high vibration prone area.

3. All screwed connections shall be provided with double compression type Nickel-plated brass/SS316 cable glands.

9.04.00 TERMINAL BLOCKS

For all inputs to the system emanating from the field or other systems, the bidder shall furnish terminals suitable for correct size of field cables.

9.04.01 All outputs going to MCC/SWGR terminal blocks, shall be rated 600 volts minimum and shall have strap screw less terminals suitable for connection of wires with ring tongue type lugs. Standard terminal blocks shall be rail mounted screw less spring loaded cage clamps type.

The terminal blocks for DDCMIS/DCS/PLC input/output connections from/to SWGR/MCC, Actuators with Integral Starter (for Coupling relays and check back signals of 11 kV and 3.3 kV auxiliaries, LT drives/valves & dampers/solenoids, CT&VT, etc.) shall be provided with built in test and disconnect facilities complete with plug, slide clamp, test socket etc. The exact type of terminal blocks to be provided by the bidder and the technical details of the same including width etc. shall be subject to owner's approval.

Terminal blocks shall be approximately sized for larger wire size of higher voltage insulated incoming conductors as necessary. All the TBs used shall be high quality non-flammable insulating material of melamine suitable for working temperature of 105 deg C and 6.6 polymide to withstand corrosion and the metallic portion shall be coated against rust /corrosion. All metal parts should be non –ferrous in nature.

9.04.02 All the Terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, partions, small partions, test plug bolts and test plug (as specified above for SWGR connections) transparent covers, support brackets, distance sleeves, warning label, marking etc.
The marking on terminal strips shall correspond to the terminal numbering on wiring diagrams.

9.04.03 Fuses shall not be mounted on terminal blocks. Neither step type terminal blocks nor angle mounting of terminal blocks will be acceptable.The terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks and between terminal blocks and junction box walls.

9.04.04 At least 20 per cent spare unused wired terminals shall be provided on each terminal block for circuit modifications and for termination of all conductors in a multi-conductor control cable with each panel, enclosure, cubicle, Junction Boxes, SOV Boxes, instrument racks/enclosures, termination/marshalling cabinets, etc.

All terminal blocks shall be numbered for identification and grouped according to the function. Engraved labels shall be provided on the terminal blocks.

For terminating each process actuated switches, drive actuators, control valves, thermocouples, RTD, etc. in local junction boxes etc. refer NIT's interfacing & wiring drawings.

9.04.05 For ensuring proper connections, Bidder shall provide suitable accessories, along with insulation sleeves. The exact connecting accessory shall be finalised as per application during detail engineering stage subject to owner's approval without any cost repurcussions.

DATA SHEET FOR FIRE WATER PUMPS

DATASHEETS

A. FIRE WATER HYDRANT & SPRAY PUMPS

Sl. No.	Description	Electrical Motor Driven Pump	Diesel Engine Driven Pumps
1.0	**GENERAL INFORMATION**		
1.1	Service Liquid	Water	Water
1.2	Duty	Intermittent	Intermittent
1.3	Location	In-door	In-door
1.4	Type	Vertical Centrifugal Type	Vertical Centrifugal Type
1.5	Quantity of Hydrant Pumps	2	2
1.6	Quantity of Spray Pumps	1	1
1.7	Rated capacity (m^3/hr)/ Nos.	410m3/hr	410m3/hr
1.8	Rated speed (RPM)	1500 (max)	1500 (max)
1.9	Total dynamic head MWC	105/110/120 MWC	105/110/120 MWC
2.0	**MATERIAL OF CONSTRUCTION**		
2.1	Base Plate	MS, IS:2062 Gr B	
2.2	Discharge elbow / Casing / Bowl / Suction Bell	CI, IS 210 Gr Fg 260	
2.3	Column Pipe	MS, IS:2062 Gr B	
2.2	Impeller	SS 304	
2.3	Shaft	SS410	
2.4	Shaft Coupling	SS 410	
2.5	Line Bearing	Cutless nitrile rubber in SS shell	
2.6	Shaft Sleeve	SS 410	
2.7	Impeller Wearing rings	CF8	
2.8	Stuffing Box	CI, IS210 Gr Fg 260	
3.0	Design standard	HIS/IS 6595 Part 2/Equivalent Standard	
4.0	Type	Vertical Turbine	
5.0	Impeller type	Closed	
6.0	Type of gland lubrication and sealing	By Bidder	
7.0	Shaft sealing arrangement	Gland	
8.0	Axial thrust balancing device to be designed for pump shut off operation	Yes	
9. 0	Type of pump-motor connection	Direct	
10. 0	Type of coupling	Flexible Coupling	
11. 0	Mode of pump starting	Discharge valve fully open	
12.0	Supply of accessories & services		
	a) Base plate	Yes	
	b) Foundation bolts, nuts, sleeves etc.	Yes	
	c) Suction & Discharge companion flanges with bolts, nuts & gaskets		
	d) Priming connection with 3 way SS isolating valve	Yes	

	c) Suction & Discharge pressure indicator	Yes
	f) Vent with 3 way SS isolating valve	Yes
	g) Pump motor coupling and guard	Yes
	h) Drain connection with valve	Yes
	i) Eye bolts, lifting tackle etc.	Yes

B. FIRE WATER BOOSTER PUMPS

Sl. No.	Description	Electrical Motor Driven Pump	Diesel Engine Driven Pumps
1.0	GENERAL INFORMATION		
1.1	Service	Water	Water
1.2	Duty	Intermittent	Intermittent
1.3	Location	In door	In door
1.4	Type	Horizontal Centrifugal Type	Horizontal Centrifugal Type
1.5	Quantity	1	1
1.6	Rated capacity (m^3/hr)/ Nos.	137m^3/hr	137m^3/hr
1.7	Rated speed (RPM)	1500	1500
1.8	Total dynamic head MWC	50	50
1.9	Sealing	Mechanical Seal	Mechanical Seal
2.0	MATERIAL OF CONSTRUCTION		
2.1	Casing	CAST STEEL	
2.2	Diffuser	Fabricated CS as per IS 2062	Fabricated CS as per IS 2062
2.3	Impeller	AISI 410	AISI 410
	Wearing rings	AISI 410	AISI 410
2.4	Shaft	AISI 410	AISI 410
2.5	Shaft sleeve	AISI 410 (Hardened)	AISI 410(Hardened)
2.6	Base plate	MS to IS: 2062	MS to IS: 2062
2.7	Shaft Sealing	Mechanical Seal	Mechanical Seal
2.8	Shaft Coupler	Forged/Cast Steel	Forged/Cast Steel
2.9	Wetted Fasteners	SS 316	SS 316

C. FIRE WATER JOCKEY PUMPS

Sl. No.	Description	Electrical Motor Driven Pump
1.0	GENERAL INFORMATION	
1.1	Service	Water
1.2	Duty	Intermittent
1.3	Location	In door
1.4	Type	Vertical Centrifugal Type
1.5	Quantity	2
1.6	Rated capacity (m^3/hr)/ Nos.	40 m^3/hr

1.7	Rated speed (RPM)	1500
1.8	Total dynamic head MWC	105/110/120 MWC
1.9	Sealing	Mechanical Seal
2.0	**MATERIAL OF CONSTRUCTION**	
2.1	Casing	2.5% Ni CI: IS 210 Gr.FG.260
2.2	Casing Liner	2.5% Ni CI: IS 210 Gr.FG.260
2.3	Diffuser	Fabricated CS as per IS 2062
2.2	Impeller	AISI 410
	Wearing rings	AISI 410
2.3	Shaft	AISI 410
2.4	Shaft sleeve	AISI 410 (Hardened)
2.5	Base plate	MS to IS: 2062
2.6	Shaft Sealing	Mechanical Seal
2.7	Shaft Coupler	Forged/Cast Steel
2.8	Wetted Fasteners	SS 316

D. DIESEL ENGINE

	GENERAL INFORMATION	
	Service	Fire Water Pumps (Hydrant, Spray and Booster)
	Type	Compression ignition, mechanical (airless) Direct injection, multi cylinder and four stroke cycle and cold starting type.
	Duty	Intermittent.
	ENGINE PARAMETERS	
	Nominal output of engine at site operating under ambient conditions	Bidder to indicate during detailed engineering
	Speed of the engine	Not more than 2300 rpm
	Brake horse power rating at rated speed	As per TAC / Factory Mutual
	Speed of the engine	As per TAC / Factory Mutual
	Oil Lubrication System	As per TAC / Factory Mutual
	Fuel Oil System	As per TAC / Factory Mutual
	Governing system	As per TAC / Factory Mutual
	Starting System	As per TAC / Factory Mutual
	Cooling System	As per TAC / Factory Mutual
	Manufacturer	As Per approved Vendor List
	IS Standard Applicable	IS:3046
	No. of cylinders	4 Inline
	No of stroke	4 stroke
	Cooling	Heat Exchanger
	Battery Type and Volts	Ni- Cd(12 V) 2x100%
	Battery Charger	2x100%
	Fuel Tank Capacity	Min 4 Hrs(As Per TAC)
	Spare Parts	As per TAC Clause 7.4.5.11

E. PIPING AND FITTINGS AND SPECIALTIES

1.00.00	**Type**	**Buried pipes**	**Over ground pipes normally full of water**	**Over ground Pipes normally empty but periodically charge with water & foam system applications**	**Over ground compressed air pipes**
		(i)	(ii)	(iii)	(iv)
2.00.00	Material	M. S. ERW pipes as per IS-1239, Part – 1 heavy grade (for pipes of sizes 150 mm NB or below) and IS-3589 Gr.410 ERW (for sizes 200 mm NB and above) or equivalent and galvanized as per IS 4736 for pipes normally empty and periodically charged with water and foam system application.			
3.00.00	Piping Thickness	AS per IS Standards			
4.00.00	Pipe Protection	Refer Volume II			
5.00.00	Size	As per final design and engineering by Bidder and approved by Owner. However Bidder shall consider velocity of fluid in the pipeline & other criteria as indicated elsewhere for selection of pipe size			
6.00.00	Construction	---------- ERW ----------			
7.00.00	Joints	Butt-welded for size 65 mm NB & higher as per ANSI B 16.9 and socket welded for sizes up to 50 m NB as per ANSI B16.11		Screwed flange as required for dismantling purposes for sizes 65 mm NB & above as per ANSI B 16.5 and screwed socket for sizes 50 mm NB & below. Welding on GI Pipes/fittings would be permitted provided the same is carried out by means of special electrodes suitable for the above application and the same shall be approved by the Owner. After welding, welded portions shall be applied with three coats of zinc silicate treatment/rich paint over one coat of suitable primer. Further the Bidder shall provide proper zinc paint at the point of welding.	

6.00.00	Fittings Ratings/Wall thickness Material	Minimum thickness to match with that of pipe for pipe size 65 mm NB and above. For pipe size above 150 mm NB, minimum thickness shall be 6 mm. For pipe size 50 mm NB & below rating shall be 3000 lbs or wall thickness matching with that of corresponding pipe. The material shall conform to ASTM A234 Gr. WPB or ASTM A 105 or equivalent.
Notes :	1. All fittings and flanges for galvanized pipes shall be galvanized. 2. Unless otherwise specified, all elbows/bends shall be long radius type. 3. The fittings shall be galvanized as per IS:4736 for galvanized pipe application. In case of branching connections from GI mains for spray piping network socket may be welded for more than two pipe reduction instead of standard tees. 4. Fabricated fittings shall not be acceptable up to pipe size of 300 NB. For sizes 350 NB & above, fittings may be fabricated as per BS:2633/BS:534.	

E. VALVES AND SPECIALTIES

Cl. No.	Description	Specification Requirement
1.0	**C.I. Gate Valves**	
1.1	Type	Rising spindle type (For Above ground Piping and Non Rising Spindle type for Underground piping)
1.2	Code / Standard	IS-14846 for sizes 65 mm NB to 300 mm NB. IS-2906 for sizes 350mm NB and above.
1.3	Material of construction	
	Body	CI IS: 210 Gr FG 260
	Bonnet	CI IS: 210 Gr FG 260
	Stem	Gun metal IS: 315 CTB2 or IS: 320 HT2
	Wedge disc	CI IS: 210 Gr. FG 260
	Body seating ring	Renewable, gun metal to IS: 315 LTB2 or IS: 318 LTB2
	Back sheet	Renewable, gun metal to IS: 315 LTB2
	Stem packing	Renewable, expanded PTFE
	Hand wheel	CI IS: 210 Gr. 260
	Bonnet bolts & nuts	CS IS: 1367
	Bonnet gasket	Neoprene or Teflon
1.4	Testing	As per IS: 14846
1.5	Approval	ISI marked / TAC approved
2.0	**Gun Metal Globe Valves**	
2.1	Type	Rising spindle
2.2	Code / Standard	IS: 778 / BS 13789
2.3	Material of construction	
	Body	GM, IS: 318 Gr. 2, Casting
	Bonnet	GM, IS: 318 Gr. 2
	Disc	GM, IS: 318 Gr. 2, Guided
	Stem	HT brass, IS: 320, OS & Y, Forged
	Seat ring	GM, IS: 318, Gr. 2, Renewable
	Gasket (Bonnet)	CAF, IS: 2712

	Packing	Renewable with valve open, graphite asbestos to IS: 4687
	Hand wheel / lever	CI IS 210 Gr. 200
2.4	Testing	As per IS: 778
2.5	Approval	ISI marked / TAC approved
3.0	**C-I Check Valves**	
3.1	Type	Swinging disc type
3.2	Code / Standard	As per latest BS 1868 / IS code
3.3	Material of construction	
	Body	CI IS: 210 Gr. FG 260
	Cover	CI IS: 210 Gr. FG 260
	Disc	CI IS: 210 Gr. FG 260
	Hinge bracket	CI IS: 210 Gr. FG 260
	Body seat ring	Leaded tin bronze IS: 310 LTB-2
	Flap seat ring	Leaded tin bronze IS: 310 LTB-2
	Hinge pin	H.T. brass IS: 320 HT-2
	Gasket	CAF IS 2712
	Bolt, nut & studs	CS IS 1367
3.4	Testing	As per latest BS / IS code
3.5	Approval	ISI marked and TAC approved
4.0	**Butterfly Valves**	
4.1	Type	Wafer up to 300 NB, lug type up to 500 NB & shot flanged for 600 NB and above. Valve above 150 NB will be gear operated
4.5	Code / Standard	IS: 13095
4.6	Material of construction	
	Body	SA 216 Gr. WCB, casting
	Shaft	SS 40, stub shaft
	Disc	SA 216 Gr. WCB, casting
	Disc retaining ring	SS 316
	Body seat “O” ring	Nitrile rubber
	Bush	PTFE
	Hand wheel / lever	CS
	Studs	SA 193 Gr. B7
	Nuts	SA 194 Gr. 2H
4.7	Testing	AWWA-C 504
4.8	Test pressure	Body – 24 Kg/cm^2 Seat – 16 Kg/cm^2
4.9	Approval	ISI marked / TAC approved
Note:	Gate, globe and check valve of size 50 mm NB & below shall be of forged CS body as per API 602(Gate valve), BS 1868(Check valve) and BS 1873(Globe valve). These valves shall have socket welded ends. Valves will be provided with locking arrangements.	
5.0	**Hydrant**	
5.1	Type	Single / Double headed, female oblique type
5.2	Code / Standard	IS: 5290
5.3	End connection Inlet Outlet	Flanged and drilled to ANSI 150# B 16.5 Female instantaneous coupling with spring lock type coupling with blank cap & chain.
5.4	Size	63 mm

5.5	Flow	900 LPM at 7 Kg/cm^2 for type-A 1800 LPM at 7 Kg/cm^2 for type-B Or as per TAC
5.6	Testing	As per IS: 5290
5.8	Working pressure	9 Kg/cm^2
5.9	Material of Construction	
	Body	SS to IS: 3444
	Female outlet	SS to IS: 3444
	Stop valve	SS to IS: 3444
	Blank cap	SS to IS: 3444
	Bonnet	SS to IS: 3444
	Gland	As per IS: 5290
	Gland packing	Non-asbestos
	Gland nut	As per IS: 5290
	Check nut	SS to IS: 3444
	Seat	SS to IS: 3444
	Spindle	Brass to IS – 319
	Hand wheel	CI IS 210 Gr. 200
	Spring	SS to IS: 6603
	Washer & rubber seat	Rubber to IS: 937
5.10	Approval	ISI marked / TAC approval
6.0	**Water Monitor**	
6.1	Type	Horizontal and vertical swivel type
6.2	Code /Standard	IS: 8442
6.3	Rotation Horizontal Vertical	 360^0 +90° above horizontal, -45° below horizontal
6.4	Material of construction	
	Water barrel	IS: 1239 (Part-I)
	Wire braided hose	PVC
	Nozzle	SS to IS: 3444
	Handle	MS to IS 2062
	Base flange	MS IS 2062. Drilled to ANSI 150# B 16.5
	Reducer & 90^0 Elbow	Seamless ANSI B 16.9 / IS: 1239 (Part-II) / IS 4310
	Swivel joints (horizontal & vertical)	SS to IS: 6603
	(Horizontal / vertical rotation lock)	SS to IS: 6603
	Grease nipple	Brass
	Drain cock	Bronze IS 318 LTB-2
6.12	Approval	ISI marked & TAC approved
7.0	**Branch Pipe & Nozzle**	
7.1	Size	63 NB with 20 NB nozzle
7.2	Nozzle Type	Hexagonal, detachable
7.3	Code /standard	IS: 903-1995
7.4	Material of construction	
	Branch pipe / nozzle	SS to IS: 3444
	Spanner	Steel of grade C-40 to IS: 1570 (Part 5) chromium or zinc plated.
7.5	Testing	As per IS: 903
7.6	Approval	ISI marked / TAC approved

8.0	**Hose coupling**	
8.1	Type	Instantaneous male and female
8.2	Size	63 NB
8.3	Code /standard	IS: 903
8.4	Material of construction	
	Female half coupling	SS to IS: 3444
	Male half coupling	SS to IS: 3444
	Seal washer	Rubber
	Outer disc	Brass IS: 3189
	Self locking nut	Steel
	Locking latch	Brass IS: 319
	Spring	Phosphor bronze
	Guide disc	Brass IS: 319
	Knob	GM IS: 318 LTB-2
8.5	Testing	As per IS: 903
8.6	Approval	ISI marked/TAC approved
9.0	**Fire Hose**	
9.1	Type	RRL
9.2	Size	63 mm
9.3	Code / Standard	IS: 636 Type B
9.4	Length	15 m for external & internal hydrant
9.5	End fittings	Instantaneous spring lock type coupling at both ends
9.6	Testing	As per IS: 636
9.7	Hose weight (gm/m)	IS: 636
9.8	Bursting pressure	IS: 636
9.9	Proof pressure	IS: 636
9.10	Kink test pressure	IS: 636
9.11	Change in length test pressure	IS: 636
9.12	Change in diameter test pressure	IS: 636
9.13	Approval	IS: 636
10.0	**Hose Cabinet**	
10.1	Type	FRP (3 mm Thickness)
10.2	Size	Approx. 750x600x250
10.3	Mounting	Wall/column mounted for internal hydrant pedestal mounted for external hydrant.
10.4	Special requirement	(i) Each Cabinet will accommodate 2 nos. of 15 m long hoses and 1 no. branch pipe & nozzle. (ii) Cabinet to have double door having toughened glass panel (3mm) with rubber lining and marked Fire on it in 80 mm size letter. (iii) Approved lock with duplicate keys kept wired in a break glass key cabinet in the hose box itself. (iv) A spanner and a set of spare rubber rings packed in fresh chalk to be kept inside

		the hose box. (v) Clamp for holding branch pipe to be provided.
10.5	Accessories	- Fastening nuts, bolts and hardware - Hammer for breaking the glass to take out the keys.
11.0	**Deluge Valve**	
11.1	Type	Quick release, diaphragm type
11.2	Size	80 NB, 100 NB & 150 NB
11.3	Design data	Normal working pressure: 7 kg/cm^2 Design pressure: 10.5 kg/cm^2 Test Pressures: Body: 24 kg/cm^2 Seat: 16 kg/cm^2
11.4	End connection	Flanged, Flat Faced to ANSI B 16.5 # 150
11.5	Type of operation	Hydraulic (wet pilot)
11.6	Trim description	(1) Wet pilot trim (2) Electrical release trim (3) Test & Alarm trim (4) Drain valve (5) Priming connection (6) Drip check valve (7) Emergency release valve
11.7	Accessories	(1) Pressure gauges (2) Pressure switches (3) Solenoid valves(UL Listed only) (4) Water motor and gong (5) Globe valves (including instrument globe valves) (6) Ball valves (7) Check valve (8) Drain valve / Drip valve (9) Positive drain actuators (10) Emergency release (11) Y-strainer (12) GI piping
11.8	Material of construction	
	For Diaphragm type	
	Housing	CI IS 210 Gr. 260
	Cover	CI IS 210 Gr. 260
	Clapper	Cast bronze IS 318 LTB-2
	Clamp ring	Cast bronze IS 318 LTB-2
	Seat	Cast bronze IS 318 LTB-2
	Diaphragm	Neoprene
	Seat rubber	Neoprene
	Listing	UL listed for complete valve and trims assembly.
11.10	Approval	TAC approval
12.0	**Spray Nozzles (high velocity**	

	Water Spray System	
12.1	Type	Open type, solid cone
12.2	Working pressure	3-5 bar
12.3	Material	SS
12.4	K FACTOR / Orifice size (mm)	During detail engineering
12.5	Spray angle	During detail engineering
12.6	Approval	TAC approved
12.7	End connector	Screwed, ¾" BSP
12.8	Marking	K-factor to be marked on hexagonal face.
13.0	**Spray Nozzles (Medium velocity Water Spray System**	
13.1	Type	Open type
13.2	Working pressure	2.8 – 6 bar
13.3	Material Body, deflector & deflector pin	 SS
13.4	K factor / orifice size	During detail engineering
13.5	Spray angle	During detail engineering
13.6	Approval	TAC approved
13.7	End connector	½" BSP, Screwed
13.8	Marking	K-factor to be marked on hexagonal face.
14.0	**Quartzoid Bulb Detector**	
14.1	Material	SS
14.2	Sensitive element	Heat sensitive bulb
14.3	Set temperature	79^0C
14.4	Response time	During detail engineering
14.5	End connector	½" BSP, Screwed
14.6	Approval	TAC approved
15.0	**Y-Strainers**	
15.1	Manufacture	As per approved vendor list
15.2	Sizes	80 NB to 300 NB
15.3	End connector	Flanged and drilled to ANSI 150 # B 16.5
15.4	Screen open area to pipe room sectional area ratio	4:1
15.5	Material of construction Body Screen	 MS to IS: 2062 AISI: 316, 18 BWG
15.6	Screen mesh	30 mesh
15.7	Testing pressure	Two times working pressure or 1.5 times design pressure whichever is higher.
16. Extinguishers		
1	Applicable Standard for all Extinguishers	IS:15683
2	Type of Extinguishers	Co2, Foam, DCP type, both Mobile and portable type.
17. Mobile Tenders		
Foam Type		
1	Applicable Standards	10460
2	Quantity	1 Nos.
WATER TYPE		
1	Applicable Standards	950
2	Quantity	2 Nos.
DCP TYPE		

1	Applicable Standards	10993
2	Quantity	1 Nos.
~~18. SHED FOR DELUGE VALVE, BOOSTER PUMP~~		
~~1.~~	~~Service~~	~~To accommodate deluge valves coming under spray system~~
~~2.~~	~~Location~~	~~Outdoor. Bidder to select the Suitable locations based on piping layout~~
~~3.~~	~~Number~~	~~Bidder to indicate~~
~~4.~~	~~Material of Construction~~	~~Brick Masonary with minimum 4" RCC Roof~~
19. STRAINERS		
1.	Type	Y type
2.	Material of construction	
a)	Body	MS fabricated IS:2062 tested quality
b)	Internal	SS (AISI 316), 30 mesh suitably reinforced

F. FIRE ALARM AND DETECTION SYSTEM

1. Main/Sub Fire Alarm Panel		
1	Make	
2	Type	Intelligent Analog addressable type
3	No. of addressable Devices per loop	As per Manufacturer Standard
4	**Features of Main Fire Alarm Panel-:**	
i	Five Programmable Function Switches	yes
ii	Point Status Control Keys	yes
iii	Event Time and History Back up.	yes
iv	LCD Navigation Control	yes
v	Numeric KeyPad	yes
vi	Inbuilt Regulated DC Power Supply	yes
vii	Inbuilt Battery Charger	yes
viii	Redundancy in CPU(Hot)	yes
ix	Redundancy in Power Supply	yes
x	Accessories required	
	Graphics software	Yes
	OWS + Printer(Laser type)	Yes

A.	**MULTI CRITERIA SMOKE DETECTORS**	
1.	Manufacturer :	As per approved make.
2.	Type :	Combination of Photo electric sensing and heat sensing, intelligent Analogue Addressable.
3.	Code/Specification :	NFPA-72E/BS-5839/IS.
4.	Sensitivity :	Preset at factory/Adjustable at site (as per UL-268).
5.	Temperature range :	0.0 Deg.C to + 38 Deg.C
6.	Humidity range :	10% to 90% RH.
7.	Air velocity :	0 to 300 ± 25 feet/minute.
8.	Plug in type detector to be provided :	Yes
9.	No. of terminals on detector on mounting base :	Bidder to indicate.

10.	Area covered by single detector :	Bidder to indicate.
11.	Operating voltage :	24 volt D.C.
12.	Inbuilt indicating lamp : to indicate operation of the detector provided	Yes [Separate response indicators mounted on false ceiling to be provided for smoke detectors mounted above false ceiling].
13.	Material of detector body :	Metallic/Plastic.
14.	Detector is approved by UL/FOC/FM/TAC :	Yes.
15.	Detector Base :	Mounting box (if applicable) Double Compression gland.
16.	Coverage area	Considering maximum spacing as per IS:2189.
B	**PhotoElectric Smoke Detectors**	
1	Make	DDE
2	Type	Intelligent Analog.
3	Model No	DDE
4	Remote LED Indicator Alarm Current	1mA, no impact to alarm current.
5	Temperature Range within which detector operates	0-38 degree C
6	Humidity Range	10-95% RH
7	Smoke sensor ambient rating	Air Velocity-0-4000ft/min
B.	**HEAT DETECTORS**	
1.	Manufacturer :	As per approved make.
2.	Type :	Fixed temperature cum rate of rise type, intelligent Addressable Analog.
3.	Sensitivity :	Preset at factory/Adjustable at site.
4.	Operating temperature range :	54°C. to 60°C.
5.	Humidity range :	5% to 90% RH.
6.	Detector automatically resets after actuation:	Yes.
7.	Area covered by single detector :	Bidder to indicate.
8.	Operating voltage :	24V DC.
9.	Type of contacts :	Silver.
10.	Principle of operation :	As per Specification.
11.	Detector approved by FOC/FM/UL/TAC :	Yes.
12.	Detector Base :	Mounting box (if applicable) Double Compression gland.
13.	Coverage area :	As per NFPA-72.
14.	Special cable :	To be provided.
C.	**QUARTZOID BULB DETECTORS**	
1.	Manufacturer :	As per approved make.
2.	Type :	Frangible bulb type.
3.	Operating temperature :	79°C.
4.	Material of Construction	
a)	Frame :	Bronze (ASTM B 145) Class-5A Leaded gun metal, Chrome plated.

b)	Bulb :	Glass filled with heat sensitivity liquid (coloured).	
c)	Deflector :	Brass.	
d)	Cap :	Copper.	
e)	Seal :	Teflon/Rubber.	
5.	Working pressure :	3.5 Kg/Sq. cm (g) minimum.	
6.	Detector approved by : TAC/FOC/UL/FAS/NFPA	Yes.	
D.	**LINEAR HEAT SENSING CABLE**		
1.	Manufacturer :	As per approved make	
2.	Type :	SS Braided Digital type	
3.	Operating voltage	24 Volt D.C.	
4.	Ambient temperature	-20 to 79 degreeC	
5.	Operating temperature	Programmable type, with combination of fixed temperature and Rate of Rise in temperature	
6.	Cable Jacket :	Steel Type(for conveyor)	
	i) Nominal Cable Diameter :	3.2mm	4mm
	ii) Maximum weight :	33kg/km	23 kg/km
	iii) Minimum Bending Radius :	75mm	63mm
8.	Typical Performance :		
	i) Sampling Resolution :	1.0 meter	
	ii) Measurement Time :	10 sec for 4 kms	
	iii) Measurement Range :	-20o C to 150oC	
11	All accessories such as fittings, fastenings, sleeves, straps, staples, clips (mounting) rings, test terminals, Junction Box etc. as may be required for interconnection of linear heat detector cables as well as interconnection to Control and Power Cable :	Yes	
12.	Linear Heat Detector approval	FM / UL / TAC / NFPA / VDS / LPCB	
	Fire Detection	Unit should be able to detect abnormal/hot spot within 1 mtrs.	
E	**INFRARED DETECTORS**		
1	Manufacturer :	As per approved make.	
2	Type	Air Purging type with inbuilt blower	
3	Operating Voltage	24V DC	
4	Temperature Range :	- 40°C to 60°C	
5	Nominal Response Time :	75 milli sec. (Max.)	
6	Sensitivity :	1.0 to 5.0 Microwatt shall be Field Adjustable.	
7	Dimensions :	As per manufacturer's standard.	
8	Enclosure :	Dust and Water proof.	
9	Mounting :	To be mounted in protective sheet metal housing above conveyor.	
10	Quiesent Current :	10 mA/As per manufacturer standard.	
11	Alarm Current :	20 mA/As per manufacturer standard.	
12	Acceptance Angle :	120°/As per manufacturer standard	
13	Spectral Response :	0.8 to 2.0 Micron/As per manufacturer standard.	
14	Spectral Range	3000-14000Nm	

15	Half Power Cone Vision :	90°/As per manufacturer standard.
16	All accessories such as air purging facilities for cleaning lens, protective housing mounting hinge & latch, J. Box Glands etc. as required. :	Yes
17	Detector shall be solar blind :	Yes
F.	**Manual Pull Stations**	
1	Make	Approved amke
2	Type	Manual Pull type
3	Temperature Range	0-40 degree C
4	Humidity Range	0-93% RH
G.	**Fixed/ROR type Heat Detectors**	
1	Make	Approved make
2	Type	Fixed/ROR type
3	Maximum Operating Temperature	68 degree C
4	Operating Range in case Rate of Rise	8.3-11.1 deg C per minute.

DATASHEET - PORTABLE FIRE EXTINGUISHERS

SL. NO.	DESCRIPTION	CARBON-DIOXIDE TYPE	MECHANICAL FOAM TYPE	DRY CHEMICAL POWDER TYPE	GAS/EXPELLED WATER TYPE
1.0	APPLICATION	Equipment Control Rooms, Control equipment room [housing DDCMIS, UPS etc.], MCC/ Battery charger room/ Switchgear Rooms. Dry Type L. T. Trans-former etc.	The areas where class B fires are liable to occur.	Boiler & Auxiliaries area, Turbine and Aux. area, CW/Ash water and Ash slurry pump house, fuel oil pressurizing pump houses, Intake Pumhpouse and other areas of the plant, Raw water Intake Pumphouse. Chlorination building near Raw water intake pumphouse, service building, and administration building.	Stores & other Building in the proposed. Plant.
2.	MINIMUM QUANTITY REQUIRED	22.5 Kg - 20 nos. 9 Kg – 30 nos. 4.5 Kg – 110 Nos.	45/50 litre - 15 nos. 9 litre - 50 nos.	75 Kg - 4nos. 10 Kg - 15 nos. 5 Kg - 65 nos.	9 litres - 85 nos.
		However, bidder shall establish the requirement of Portable Fire Extinguishers based on the fire hazard in the entire plant. The final requirement shall be subjected to approval by the TAC and by the Purchaser.			

SL. NO.	DESCRIPTION	CARBON-DIOXIDE TYPE	MECHANICAL FOAM TYPE	DRY CHEMICAL POWDER TYPE	GAS/EXPELLED WATER TYPE
3.	DESIGN, FABRICATION AND TESTING CODE	IS-2878/ Equivalent standard	IS-10204/ Equivalent stan-dard (for 9 litres). For 45/50 litres capacity, extinquisher shall be made of mild steel coated with lead tin alloy. It shall be tested to 30 Kg/Sq.cm for 5 minutes & fitted with 3 mtr. long Nylon braided PVC hose with foam making branch pipe. The appliance shall be supplied with litres of AFFF concentrate and 1Kg. CO2 cylinder. The jet range shall be 8 litres, discharge time 75 seconds and discharge 95% (minimum).	IS-2171/IS-10658/ Equivalent standard	IS-940/ equivalent for gas pressure type, IS-6234/ equivalent for constant air pressure type.
4.	ACCESSORIES TO BE SUPPLIED	Control valve, one (1) metre rubber hose, discharge horn, mounting bracket with screws	As required	Nozzle, mounting bracket, carrying handle, screws etc. and all other accessories as perapplicable design standard.	Nozzle, mounting bracket, screws etc. as required as per relevant standard

SECTION - 3

PROJECT DETAILS GENERAL TECHNICAL REQUIREMENTS

3.0 GENERAL

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipment and services covered under other sections of tender documents and are not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall prevail.

3.1 PROJECT DETAILS

	Particular	**Details**
a)	Customer	Uttar Pradesh Rajya Vidyut Utpadan Nigam Ltd.
b)	Engineer Consultant	DCPL
c)	Engineer Review Consultant/ Inspector	NTPC Ltd.
d)	Project Title	Panki Thermal Power Project (3x660 MW): 400kV Switchyard
e)	Project Location	Place: Panki District: Kanpur State: Uttar Pradesh
f)	Latitude & Longitude	North N26028'20" East E 80014'32"
g)	Nearest Railway Station	Panki
h)	Distance of project location from the Railway station	5 Km
i)	Nearest Major Town	Kanpur
j)	Distance of the town from the project site	16 Km.
k)	Nearest Highway from the project site	National Highway - 25
l)	Nearest airport	Kanpur – 25 Km Lucknow – 80 Km
m)	Nearest commercial airport	440 Km
n)		
	SITE CONDITIONS (for design purposes)	
a)	Design ambient temperature	50°C
b)	Maximum Relative humidity	85 %
c)	Height above mean sea level	Less than 1000 meters
d)	Pollution Severity	Heavily polluted (With Coal dust & Fly ash) and Highly Corrosive environment.
e)	Criteria for Wind Resistant design	Standard Applicable - IS 875 (Part 3) 1987

	of structures and equipment	
f)	Basic Wind speed "Vb" at ten meters above the mean ground level.	47 m/ sec
g)	Siesmic data	Zone-III as per IS: 1893

3.1.1 SYSTEM PARAMETERS:

Sl.No.	Parameters	400 kV
1	Highest system voltage	420 kV rms
2	Lightning Impulse voltage	±1425kVp
3	Switching impulse voltage	±1050kVp
4	Power frequency withstand for 1 min (rms)	630 kV(rms)
5	Max. fault level (1 sec.)	50 kA
6	Minimum creepage distance	13020 mm

3.1.2 AUXILIARY POWER:

Sl.No.	Nominal Connection Voltage	Variations in Voltage	Frequency	Phase	Neutral
1	415V	±10%	50 (+5% -5%)	3Phase , 4 Wire	Solidly Earthed
2	240V	±10%	50 (+5% -5%)	1 phase	Solidly Earthed

Combined variation of voltage and frequency shall be + 10%. Design fault level of 415V system shall be restricted to 50kA rms for 1 second & for 25kA for 1 sec. for 220V DC system.

The operational limits for variation of DC voltage are (+) 10% to (-) 15%.

3.1.3 The various minimum heights of the switchyard shall be as given below from plinth level:

Voltage	Equipment /1st Level	Main Bus Level	Jack Bus Level	Peak
400kV	8000mm	15000mm	23000mm	7500mm

The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or support insulators to the bottom of the equipment structure, where it rests on the foundation pad shall be 2550mm.

3.1.4 The minimum clearances for 400kV switchyard shall be as given below:

Phase to earth clearance	3500 mm
Phase to phase clearance	4200 mm
Section clearance	6500 mm

3.2 INSTRUCTION TO BIDDERS

The bidders shall submit the technical requirements, data and information as per the technical data sheets, provided in Section-4.

The bidders shall furnish catalogues, engineering data, technical information, design documents, drawings etc fully in conformity with the technical specification.

It is recognized that the bidders may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to the Purchaser. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously. All deviations from the specification shall be clearly brought out in the respective schedule of deviations. Any discrepancy between the specification and the catalogues or the bid, if not clearly brought out in the schedule, will not be considered as valid deviation.

Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/ or needed for erection, completion and safe operation of the equipment as required by applicable codes, though they may not have been specifically detailed in the Technical Specifications unless included in the list of exclusions. Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the switchyard unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/parts of similar standard equipment under supply shall be inter-changeable with one another.

'Make' of brought-out items are subject to Owner/Purchaser's approval.

The bidder shall furnish relevant details to the Owner/Purchaser for his concurrence before procurement. Makes approved by owner shall only be acceptable.

The bidder shall supply type tested (including special tests as per tech. specification) equipment and materials. The test reports shall be furnished by the bidder along with equipment/ material drawings. In the event of any discrepancy in the test reports, (i.e., if any test report is not acceptable due to any design/ manufacturing changes or due to non-compliance with the Technical Specification and/ or applicable standard), the tests shall be carried out without any additional cost implication to the BHEL. BHEL reserves the right to get any or all type/tests conducted/repeated.

3.3 CODES AND STANDARDS

The Design, manufacture, erection, testing and performance of items and services provided under this specification shall comply with the latest edition including all applicable official amendments and revisions as on date of award of the following standards. In case of conflict between this specification and code (IS Code, standards, etc.) referred herein, the more stringent of both shall prevail. All work shall be carried out as per the codes and standards listed out in the

description of each equipment/item.

Indian Electricity Act and Indian Electricity Rules can be obtained from bureau of Indian Standards.

Equipment complying with other internationally accepted standards such as IEC, BS, USA, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision amendments and revision in force on date of opening of bid and shall clearly bring out the salient features for comparison.

The supplier is required to follow local statutory regulations stipulated in the latest amended Electricity Supply Act 1948 and Indian Electricity Rules 1956 (latest), and other local rules and regulations.

3.4 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

The 400 kV system is being designed to limit the power frequency over voltage of 1.5 p.u. and the switching surge over voltage to 2.5 p.u. In 400 kV system the initial value of temporary over voltage could be 2.0 p.u. for 1-2 cycles. All the equipment/materials covered in this specification shall perform all its function satisfactorily without undue strain, restrike etc. under such over voltage conditions. All equipment shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation. All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow, (not applicable for this project) short circuit etc for the equipment .

The equipment shall also comply with the following:

a) All equipments shall be suitable for hot line washing.
b) To facilitate erection of equipment, all items to be assembled at site shall be "match marked".
c) Piping, if any, between equipment control cabinet or operating mechanism to marshalling box of the equipment shall bear proper identification to facilitate the connection at site.
d) All equipment shall be supplied with necessary inter-pole cabling, and its cost shall be included in the cost of equipment.

3.5 ENGINEERING DATA

3.5.1 Drawings

All drawings submitted by the supplier including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing

arrangement required. The dimensions required for installation and interconnections with other equipment and materials, clearances and spaces required for installation and interconnections between various portions of equipment and any other information specifically requested in the specifications.

Each drawing submitted by the Contractor (including those of sub-vendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

After the approval of the drawings, further work by the Contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Purchaser, if so required.

The review of these data by the purchaser will cover only general conformance of the data to the specification and documents, interfaces with the equipment provided under specification, external connections and of the dimensions which might affect plan layout. This review by the purchaser may not indicate a thorough review of the dimensions, quantities and details of the equipment, material, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the purchaser shall not be considered by the contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Purchaser. Approval of Contractor’s drawing or work by the Purchaser shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

All engineering data submitted by the contractor after final process including review and approval by the purchaser shall form part of the contract document and the entire work performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the purchaser in writing.

3.5.2 Approval Procedure

The following procedure for submission and review/approval of the drawings, data, reports, information, etc. shall be followed by Contractor:

a. All data/information furnished by Vendor in the form of drawings, documents, Catalogues or in any other form for NTPC’s information/interface and/or review and approval are referred by the general term “drawings”.
b. The ‘Master drawings list’ indicating titles, Drawing Number, Date of submission and approval etc. shall be finalised mutually between Contractor and Employer before the award of contract. This list shall be updated if required at suitable interval during detailed engineering.

c. All drawings (including those of subvendor's) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The Contractor shall furnish this format to his subvendor along with his purchase order for subvendor's compliance.

d. Contractor shall submit all the drawings in five (5) copies for review of Employer.Employer shall forward their comments within four (4) weeks of receipt of drawings.

e. Upon review of each drawings, depending on the correctness and completeness of the drawings, the same will be categorised and approval accorded in one of the following categories:

CATEGORY I	Approved
CATEGORY II	Approved subject to incorporation of comments/modification as noted. Resubmit revised drawing incorporating the comments
CATEGORY III	Not approved. Resubmit revised drawings for Approval after incorporating comments/modifications as noted
CATEGORY IV	For information and records

f. Contractor shall resubmit the drawings approved under Category II, III within one (1) week of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision number enclosed in a triangle (e.g 1.2.3. etc.).

g. In case Contractor does not agree with any specific comment, he shall furnish the explanation for the same to Employer consideration. In all such cases Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.

h. It is the responsibility of the Contractor to get all the drawings approved in the Category I or IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.

i. Contractor shall not make any changes in the portion of the drawing other than those commented. If changes are required to be made in the portions already approved, the Contractor shall resubmit the drawings identifying the changes (along with reasons for changes) for Employer's review and approval. Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents.

j. Approval of drawings will not in any way relieve the Contractor of his obligations of furnishing the equipment in accordance with the specification and shall not prevent subsequent rejection if such equipment is later found to be defective.

3.5.3 Erection Drawings.

a. Contractor shall furnish erection drawings for the guidance or commencement of erection or the first shipment, whichever is earlier. These shall generally comprise of fabrication/assembly

drawings, various component/part details drawing, assembly, clearance data requirements, etc. The drawings shall contain details of components/ equipment with identification number, match marks, bill of materials, assembly procedures etc.

b. For all major equipment apart from above details, assembly sequence and instructions with check-lists shall be furnished in the form of erection manuals.

3.5.4 Instruction Manual

a. The Contractor shall submit to the Employer preliminary instruction manuals for all the equipments for review. The final instructions manuals incorporating Employer's comments and complete in all respect shall be submitted at least sixty (60) days before the first shipment of the equipment. The instruction manuals shall contain full details and drawings of all the equipments, the transportation, storage, installation, testing, operation and maintenance procedures, etc. separately for each component/equipment along with log record format. These instruction manuals shall be submitted in five (5) copies for approval.

b. If after commissioning and initial operation of the plant, the instruction manuals require any modifications/additions/changes, the same shall being corporate and the updated final instruction manuals shall be submitted.

c. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall have sufficient details to enable the Employer to maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant/equipment, including erection, testing, commissioning, operation, maintenance dismantling and repair. Each manual shall also include a complete set of approved drawings together with performance/rating curves of the equipment and test certificates, wherever applicable. The contract shall not be considered completed for purpose of taking over until such instructions and drawings have been supplied to the Employer.

d. A separate section of the manual shall be for each size/type of equipment and shall contain a detailed description of construction and operation, together will all relevant pamphlets.

e. The manuals shall include the following

a) List of spare parts along with their drawing and catalogues and procedure for ordering spares.

b) Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation.

f. A collection of the manufacturer's standard leaflets will not accepted to be taken as a compliance of this clause. The manual shall be specifically compiled for the concerned project.

3.5.5 Operation & Maintenance Manuals

The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All

written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side.

3.5.6 As Built Drawings

After final acceptance of individual equipment/system by the Owner, the Bidder will update all original drawings and documents for the equipment/ system to "as built" conditions in requisite number.

Drawings must be checked by the Bidder in terms of its completeness, data adequacy and relevance with respect to engineering schedule prior to submission to the Owner. In case drawings are found to be submitted without proper endorsement for checking by the Bidder, the same shall not be reviewed and returned to the Bidder for re-submission. The Bidder shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data/drawings at site which are needed as an input to the engineering. The Bidder shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Owner's scope and submit all necessary drawings/ documents for the same.

3.5.7 Final Submission of drawings and documents:

The Contractor shall furnish the following after approval of all drawings /documents and test reports:

a. List of drawings bearing the Employer's and Contractor's drawing number.
b. Two (2) bound sets alongwith 4 CD-ROMs of all drawing.
c. All documents/designs in two (2) copies as noted above.
d. Contractor shall also furnish six (6) bound sets of all as-built drawings including the list of all as-built drawings bearing drawing numbers. The Contractor shall also furnish two (2) sets of CD-ROMs/ DVD/Portable hard disk of all as-built drawings as decided by the Employer.
e. The Contractor shall also furnish four (4) copies of instruction/ operations & maintenance manuals (after approval) for all the equipments.

3.5.8 TEST REPORTS

Four (4) copies of preliminary test results shall be supplied for approval prior to despatch of the equipment. Bound copies of complete test results shall be furnished later, in number of copies as per attached Distribution Schedule. These shall incorporate all tests carried out on the equipment and its auxiliaries as well as characteristic curves of current transformers including reports on the official test waves, failure detection data and copies of final test oscillograms of both voltage and current with calibration.

3.5.9 MATERIAL /WORKMANSHIP

Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the

purpose for which they are intended and shall ensure satisfactory performance throughout the service life.

In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard the purchaser shall decide upon the question of similarity. When required by the specification or when required by the purchaser the contractor shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the Contractor.

The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Purchaser.

Whenever possible, all similar part of the works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the equipment supplied under the specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

The equipment offered in the bid only shall be accepted for supply, with the minimum modifications as agreed/accepted.

3.6 TROPICAL PROTECTION

All electrical equipment, accessories and wiring shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

Fine mesh screen of corrosion resistant material shall be furnished on all ventilating openings to prevent entry of insects.

3.7 SPACE HEATERS

The heaters shall be suitable for continuous operation at 230 V as supply voltage. On –off switch and fuse shall be provided.

One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the compartment and electrical connections shall be made sufficiently away from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

The heaters shall be suitably designed to prevent any contact between the heater wire and the air and shall consist of coiled resistance wire centered in a metal sheath and completely encased

in a highly compacted powder of magnesium oxide or other material having equal heat conducting and electrical insulation properties or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air. Alternatively, they shall consist of a resistance wire mounted into a tubular ceramic body built into an envelope of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in vitreous glaze. The surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments.

3.8 FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistance varnish shall be applied on parts which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

3.9 VENTILATION OPENING

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

3.10 DEGREE OF PROTECTION

Degree of protection for various enclosures as per IS: 13947 shall be as follows:

1.	**LT Switchgear/MCC/DBs/Fuse Boards**		
	i. Compartments and busbar chambers upto 1600A	:	IP52
	ii. Compartments and busbar chambers above 1600A	:	IP42
	iii. Switchgear located outdoor	:	IP55
2.	**Motors**		
	i. Indoor motors	:	IP55
	ii. Outdoor motors	:	IP55 with canopy
3.	**Transformers**		
	i. Indoor Transformer	:	IP22
	ii. Cable box-indoor area	:	IP52
	iii. Cable box-outdoor area	:	IP54
	iv. Indoor kiosks and marshalling boxes	:	IP54
	v. Outdoor kiosks and marshalling boxes	:	IP55
4.	**Push Button Stations and any other kiosk/box/panel/ enclosure**		
	i. Indoor	:	IP54
	ii. Outdoor	:	IP55
	iii. In dusty areas, e.g. conveyor galleries, transfer points, crusher house, bunker floor etc.	:	IP65
5.	Junction boxes for cables/wires	:	IP55
6.	Outdoor lighting fixtures	:	IP55

The degree of protection shall be in accordance with IS: 13947 (Part –I) / IEC-947 (Part-I) / IS 12063/IEC 529. Type test report for degree of protection test, on each type of the box shall be

submitted for approval.

3.11 PRESERVATIVE SHOP COATING

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer.

Transformers and other electrical equipment if included shall be shop finished with one or more coats of primer and two coats of high grade epoxy. The finished colours shall be as per manufacturer's standards, to be selected and specified by the Owner at a later date.

Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer.

All other steel surfaces which are not to be painted shall be coated with suitable rust preventive compound subject to the approval of the Owner.

3.12 RATING PLATES, NAME PLATES AND LABELS

1. Each equipment shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.
2. Such nameplates or labels shall be of white non hygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back.
3. The rated current, extended current rating and rated thermal current shall be clearly indicated in the name plate in case of current transformer.
4. Rated voltage, voltage factor and intermediate voltage shall be clearly indicated on the nameplate in case of capacitor voltage transformer.
5. Each switch shall a clear inscription identifying its function. Switches shall also have a clear inscription of each position indication.
6. All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.
7. All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

3.13 GALVANISING

i. The galvanised surface shall consist of a continuous film adhering to the steel. The finished surface shall be clean and smooth, and shall be free from defects like dissolved patches, base, spot, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surfaces, flaking or peeling off, etc. The presence of any of these defects shall render the material liable to rejection.

ii. All exposed ferrous parts shall be hot dip galvanised as per IS:2629 & IS:2633, Galvanising shall be uniform, smooth continuous and free from acid spots. Should the galvanising of the sample be found defective, the entire batch of steel shall have to be re-galvanised at Contractor's cost. The amount of zinc deposit shall be not less than 610 gms. per sq.m. of surface area and in addition, the thickness of zinc at any spot shall not be less than 85 microns. The Employer reserves the right to measure the thickness of zinc deposit by Elkometer or any other instrument acceptable to Employer and reject any component which shows thickness of zinc at any location less than 85 microns. The testing on the galvanised materials shall be carried out as per IS:2633.

iii. The amount of zinc deposit over threaded portion of the bolts, nuts and screws shall not be less than 300 gms. per sq. meter of surface area. The amount of zinc deposit on washers shall not be less than 340 gms. per sq. meter of surface area. The threads having extra deposit of zinc shall be removed by die cutting after the completion of galvanising. The removal of extra zinc shall be carefully done so that threads shall have minimum deposits of zinc on them as specified.

3.14 PAINTING

3.15.1 All surfaces to be painted including interior and exteriors of enclosures and other metal parts shall be shot or sand blasted or chemically treated to remove all rust, scale, grease and other adhering foreign matters. If not specified or approved otherwise later, colour of finishing paint shall be RAL 7032 with glossy finish except for panels which shall have matt finish. The paints used shall be epoxy-based or of suitable type to withstand the salty atmosphere prevalent in the coastal areas.

3.15.2 All metal parts not accessible for painting shall be made of corrosion resistant materials. All machine finished or bright surfaces shall be coated with a suitable rust preventive compound and wrapped or otherwise protected.

3.15.3 Paints shall be carefully selected to withstand tropical heat and extremes of weather specified herein. It shall not scale-off or crinkle or be removed by abrasion due to normal handling.

3.15.4 Should finished paint chip-off or crinkle during transit or installation, the Contractor shall arrange for re-painting the equipment at site at his own cost.

3.15 QUALITY ASSURANCE

The Contractor shall follow his standard procedures for quality assurance and control. This shall be in standard format indicating test witness and customer hold point shall be submitted for approval by the successful bidder. A copy of the said standard procedures shall be submitted to the Owner/Purchaser for his reference. However, Owner/Purchaser reserves the

right to review the same and give his observations, if any, for compliance.

The procedures shall be in such a form as to clearly delineate the manufacturing sequence, inspection points, tests and test procedures, acceptable ranges/values, reference drawings etc.

Test shall be performed in presence of Owner/Purchaser's representative so desired by the Owner/Purchaser. The Contractor shall give at least fifteen (15) days advance notice of the date when the tests are to be carried out.

Manufacturing and quality control procedures shall be available for audit to the Owner/Purchaser and/or its representative at the place of manufacture.
The Owner/Purchaser reserves the right to inspect the equipment at the point of manufacture and witness factory and other such tests as may be necessary to ensure conformance to the specification.

The Owner/Purchaser may inspect the Contractor's facilities prior to award of contract.

The Owner/Purchaser may witness any or all of the tests stipulated in the relevant standards and this specification.

The Owner/Purchaser may conduct surveillance of the Contractor's facilities for compliance to his standard procedures of Quality Assurance and Quality Control while work on the specified equipment is in progress.

3.16 QUALITY ASSURANCE PROGRAMME

To ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance program to control such activities at all points, as necessary. Such programs shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA program shall be generally in line with ISO-9001/IS-14001. A quality assurance program of the contractor shall generally cover the following:

i. His organisation structure for the management and implementation of the proposed quality assurance programme
ii. Quality System Manual
iii. Design Control System
iv. Documentation Data Control System
v. Qualification data for Bidder's key Personnel.

vi. The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.

vii. System for shop manufacturing and site erection controls including process, fabrication and assembly.

viii. Control of non-conforming items and system for corrective actions and resolution of deviations.

ix. Inspection and test procedure both for manufacture and field activities.

x. Control of calibration and testing of measuring testing equipments.

xi. System for Quality Audits.

xii. System for identification and appraisal of inspection status.

xiii. System for authorising release of manufactured product to the Employer.

xiv. System for handling storage and delivery.

xv. System for maintenance of records, and

xvi. Furnishing quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per format enclosed as Annexure-I.

3.17 GENERAL REQUIREMENTS - QUALITY ASSURANCE

i. All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award.

ii. Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. floppy or E-mail in addition to hard copy, for review. Once the same is finalised, hard copies shall be submitted for approval. After approval the same shall be submitted in compiled form on CD ROM.

iii. Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's site Quality Control Organisation, during various stages of site activities starting from receipt of materials/equipment at site.

iv. The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed.

v. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer/Authorised representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.

vi. No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of MDCC.

vii. All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.

viii. All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer.

ix. All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.

x. All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.

xi. Test results or qualification tests and specimen testing shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorised representative.

xii. For all pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. Similarly, any other statutory requirements for the equipments/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding.

xiii. All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.

xiv. No welding shall be carried out on cast iron components for repair.

xv. Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.

xvi. All non-destructive examination shall be performed in accordance with written procedures as per International Standards. The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.

xvii. In general all plates of thickness greater than 40mm & for pressure parts plates of thickness equal to or greater than 25mm shall be ultrasonically tested otherwise as specified in respective equipment specification. All bar stock/Forging of diameter equal to or greater than 50mm shall be ultrasonically tested.

xviii. The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the subcontractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval. The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified subcontractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.

xix. For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the subcontractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc.

xx. Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub vendor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.

xxi. The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractors and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipments conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.

xxii. Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply

with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.

xxiii. For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.

xxiv. Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.

3.18 Environmental Stress Screening

All solid state electronic system / equipment / sub assembly shall be free from infant mortile components. For establishing the compliance to this requirement, the contractor / sub – contractor should meet the following.

1. The Contractor / Sub – contractor shall furnish the established procedure being followed for eliminating infant mortile components. The procedure followed by the Contractor / Sub – contractor should be substantiated along with the statistical figures to validate the procedure being followed. The necessary details as required under this clause shall be furnished at the stage of QP finalization.

Or

2. In case the Contractor / Sub – contractor do not have any established procedure to eliminate infant mortile components then two or 10% whichever is less, most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure.

<u>Elevated Temperature Test Cycle</u>

During the elevated temperature test which shall be for 48 hours, the ambient temperature shall be maintained at 50° C. The equipment shall be interconnected with devices and kept under energized conditions so as to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service.

During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature at 50° C.

In case of any failure during the test cycle, the further course of action should be mutually discussed for demonstrating the intent of the above requirement.

<u>Burn In Test Cycle</u>

The test shall be conducted on all the panels fully assembled and wired including the panels having undergone the above mentioned elevated temperature test.

The period of Burn in Test Cycle shall be 120 hrs and process shall be similar to the elevated temperature test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control systems, the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable.

During the Burn in Test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature.

The Contractor / Sub-contractor shall carry out routine test on 100% item at contractor / sub-contractor's works. The quantum of check / test for routine & acceptance test by employer shall be generally as per criteria / sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check / test for routine / acceptance test shall be as agreed during detailed engineering stage.

3.19 QUALITY ASSURANCE DOCUMENTS

The Contractor shall be required to submit two hard copies and two sets on CDROM of the following Quality Assurance Documents as identified in respective quality plan with tick (√) mark.

Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing.

The final quality document will be compiled and issued at the final assembly place of equipment before dispatch. However CD-Rom may be issued not later than three weeks.

3.19.1 Typical contents of Quality Assurance Document are as below:-

i) Quality Plan,

ii) Material mill test reports on components as specified by the specification and approved Quality Plans.

iii) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.

iv) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.

v) Heat Treatment Certificate/Record (Time- temperature Chart)

vi) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure).

vii) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.

viii) Certificate of Conformance (COC) whoever applicable.

ix) MDCC

x) Similarly, the contractor shall be required to submit two hard copies and two sets on CD ROM of Quality Assurance Documents (in line with above) pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.

xi) Before dispatch/ commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

xii) If the result of the review carried out by the Inspector of the Quality document (or applicable section) is satisfactory. The Inspector shall stamp the quality document (or applicable section) for release.

xiii) If the quality document is unsatisfactory, the Supplier shall endeavour to correct the incompleteness, thus allowing finalizing the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.

xiv) If a decision is made for dispatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the dispatch of equipment.

3.20 TRANSMISSION OF QUALITY DOCUMENTS

As a general rule, two hard copies of the quality document and Two CD ROMs shall be issued to the Employer after the delivery date for the corresponding equipment. One set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Site.

For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 1 month after the date of the last delivery similarly as stated above.

3.21 INSPECTION, TESTING & INSPECTION CERTIFICATE

i. The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.

ii. The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.

iii. The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.

iv. The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.

v. When the factory tests have been completed at the Contractor's or subcontractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.

vi. In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide

free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.

vii. The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.

viii. To facilitate advance planning of inspection in addition to giving inspection notice, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

ix. All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by cutomer/consultant. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.

3.22 PACKAGING & TRANSPORTATION

3.24.1 Packing, Marking and shipping

The packing and shipping shall be carried out in accordance with the standard practice of Contractor and with the following additional requirements:

a) The equipment shall be prepared in such a manner as to protect the equipment from damage or deterioration during shipping or storage. The shipments can be exposed to heavy rains, hot sun, high humidity and sudden extreme changes of temperature. The equipment shall be packed and shipped so as to protect it from all such conditions and any other abnormal conditions, generally expected during shipping & storage. **Packing shall be done by high quality material suitable for at least 1 year storage at site.**

b) The metallic containers, if any, shall be considered as the property of the Contractor and he will be allowed to remove them from site once the contents are unpacked, inspected, documented and placed in temporary storage or in final position.

c) The equipment shall be shipped in such a manner as to facilitate unloading, handling and storage enroute and at the site. The Contractor shall provide lifting lugs and special lifting devices for proper handling and erection.

d) The Contractor shall be liable for any damage or loss resulting due to careless, improper, poor or insufficient packing and handling.

e) Spare parts and spare equipment shall be packed separately in containers adequate for long term storage, plainly marked “Spare Parts Only”. They shall be crated individually or in kits to be

used in one single renewal or overhaul operation. Other spare part kits shall not be disturbed when using one set or kit.

f) The Contractor shall at all times protect and preserve from damage, loss, corrosion and all other forms of damage, all parts of the works.

3.24.2 Transportation

a) The Contractor shall make a careful examination of access rail/roadways to the site in order to confirm the practical maximum transport weight and dimensions as well as a careful examination of the ports of disembarkation particularly with respect to the capacity of the cranes installed and access roads.

b) All instruments and computer/microprocessor based equipment imported into India from overseas for the purpose of this contract shall be air freighted to the nearest possible point and further by rail/road taking due precautions as per manufacturer's recommendations. Employer shall have the right to decide the items that should be air freighted and Employer's decision shall be binding on Contractor.

3.24.3 Insurance

a) The Contractor shall insure all shipments and works at his own expense for not less than the full replacement cost plus any additional cost for accelerated manufacturing of the replacement parts.

b) Loss or the damage to equipment during shipping or transportation to the site(s) or otherwise shall not constitute groups for claims for extension in time or for extra payment.

3.22.1 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

3.24.1 The material of clamps and connectors shall be Aluminium alloy casting conforming to designation A6 of IS: 617 for connecting to equipment terminals and conductors of aluminium. In case the terminals are of copper, the same clamps/connectors shall be used with 2mm thick bimetallic liner.

3.24.2 The material of clamps and connectors shall be Galvanised mild steel for connecting to shield wire.

3.24.3 Bolts, nuts and plain washers shall be hot dip galvanised mild steel for sizes M12 and above. For sizes below M12, they shall be electro-galvanised mild steel. The spring washers shall be electro-galvanised mild steel.

3.24.4 All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be rounded off to meet specified corona and radio interference requirements.

3.24.5 They shall have same current rating as that of the connected equipment. All current carrying parts shall be at least 10 mm thick. The connectors shall be manufactured to have minimum contact resistance.

3.24.6 Flexible connectors, braids or laminated strips shall be made up of copper/aluminium.

3.24.7 Current rating and size of terminal/conductor for which connector is suitable shall be put on a suitable sticker on each component which should last atleast till erection time.

3.22.1 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS, AND DISC INSULATORS

3.25.1 Bushings shall be manufactured and tested in accordance with IS: 2099 & IEC: 137 while hollow column insulators shall be manufactured and tested in accordance with IEC 233/IS 5284. The support insulators shall be manufactured and tested as per IS: / IEC 168/IEC 273. The insulators shall also conform to IEC 815 as applicable.

3.25.2 Support insulators/ bushings/ hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

3.25.3 Porcelain used shall be homogenous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture. Hollow porcelain should be in one integral piece in green & fired stage.

3.25.4 Glazing of the porcelain shall be uniform brown in colour, free form blisters, burns and other similar defects.

3.25.5 When operating at normal rated voltage there shall be no electric discharge between conductor and insulators which would cause corrosion or injury to conductors or when operating at normal rated voltage.

3.25.6 The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall be lead to deterioration. All ferrous parts shall be hot dip galvanised.

3.25.7 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps, the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

3.25.8 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued, porcelain parts by grinding and metal parts by machining. Insulator/ bushing design shall be such as to ensure a uniform compressive pressure on the joints.

3.25.9 Insulator shall also meet requirement of IEC - 815 as applicable, having alternate long & short sheds.

3.23 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT.

3.26.1 All types of control cabinets, junction boxes, marshaling boxes, lighting panels, terminal boxes, operating mechanism boxes, Kiosks etc. shall generally conform to IS:5039, IS:8623 and IEC:439 as applicable.

3.26.2 Mechanism Box/ Control Cabinet/ Kiosks: A sheet steel (atleast 2.5 mm thick), dust and vermin proof M.Box/CCC/CMB shall be provided with proper lighting and thermostatically controlled space heaters. The degree of protection shall be IP 55. One dummy terminal block in between each trip wire terminal shall be provided. At least 20% spare terminals shall be provided on each panel. The gasket used shall be of neoprene rubber.

3.26.3 Junction Boxes: The junction boxes shall be made of minimum 2 mm thick sheet steel. Gland plates shall be removable type and made of 3 mm thick sheet steel. The boxes shall be provided with detachable cover or hinged door with captive screws. Top of the box shall be arranged to slope towards the rear of the box. The box shall be hot dip galvanised and shall be provided with suitable neoprene gaskets to achieve requisite degree of protection. Adequate spacing shall be provided to terminate the external cables. The boxes shall be suitable for mounting on various types of steel structures. The terminal blocks provided shall be of 650 V grade, rated for 10 A for control cables. Suitable numbering for terminal blocks shall be done. In case of junction box for power cable, the box shall be rated for maximum current carrying capacity. Terminal blocks shall be of one piece, Klippon RSF-1 or ELMEX CSLT-1 type with insulating barriers.

3.26.4 The cabinets/boxes/kiosks/panels shall be free standing or wall mounting or pedestal mounting type. They shall have hinged doors with padlocking arrangement. All doors, removable covers and plates shall be gasketed all around with neoprene gaskets.

3.26.5 The degree of protection of of all the outdoor boxes shall not be less than IP 55 as per IS 2147.

3.26.6 The cable entry shall be from bottom, for which removable gasketed cable gland plates shall be provided.

3.26.7 Suitable 240V, single phase, 50Hz ac heaters with thermostats controlled by switch and fuse shall be provided to maintain inside temperature 10deg. above the ambient.

3.26.8 The size of enclosure and the layout of equipment inside shall provide generous clearances. Each cabinet/box/kiosk/panel shall be provided with a 15A, 240V ac, 2 pole, 3 pin industrial grade receptacle with switch. For incoming supply, MCB of suitable rating shall be provided. Illumination of each compartment shall be with door operated incandescent lamp. All control switches shall be of rotary switch type.

3.26.9 Each cabinet/box/kiosk/panel shall be provided with two earthing pads to receive 75mm x 12mm GS flat. The connection shall be bolted type with two bolts per pad. The hinged door shall be connected to body using flexible wire. The cabinets/ boxes/ kiosks/ panels

shall also be provided with danger plate, and internal wiring diagram pasted on inside of the door. The front label shall be on a 3mm thick plastic plate with white letters engraved on black background.

3.24 TERMINAL BLOCKS

3.27.1 They shall be non-disconnecting stud type of extensible design equivalent to Elmex type CAT-M4.

3.27.2 The terminal blocks shall be of 650 V grade, and rated to continuously carry maximum expected current. The conducting part shall be tinned or silver plated.

3.27.3 They shall be of moulded, non-inflammable thermosetting plastic. The material shall not deteriorate with varied conditions of temperature and humidity. The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating plastic material. Insulating barriers shall be provided between the terminal blocks so that the barriers do not hinder the wiring operation without removing the barriers.

3.27.4 The terminals shall be provided with marking tags for wiring identification.

3.27.5 Unless otherwise required (expected current rating) or specified, terminal blocks shall be suitable for connecting the following conductors on each side:

All CT & VT circuits - Min. four 2.5 sq.mm. copper flexible conductor

AC & DC power supply -Two 16 sq.mm. Aluminium conductor

Other control circuits - Min. two 2.5 sq.mm. copper flexible conductor.

3.27.6 The terminal blocks for CT and VT secondary leads shall be provided with test links and isolating facilities. CT secondary leads shall also be provided with short circuiting and earthing facilities.

3.25 Wiring

3.28.1 All wiring shall be carried out with 1100 V grade stranded copper wires. The minimum size of the stranded conductor used for internal wiring shall be as follows:

a) All circuits except CT circuits 2.5 sq.mm

b) CT circuits 4 sq. mm (minimum number of strands shall be 3 per conductor).

3.28.2 All internal wiring shall be securely supported, neatly arranged readily accessible and connected to equipment terminals and terminal blocks.

3.28.3 Wire terminations shall be made with solderless crimping type of tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with the wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires shall not fall off when the wires and shall not fall off when the wire is disconnected from terminal blocks.

3.28.4 All wires directly connected to trip circuit breaker shall be distinguished by the addition of a red coloured unlettered ferrule. Number 6 & 9 shall not be included for ferrules purposes.

3.28.5 All terminals including spare terminals of auxiliary equipment shall be wired upto terminal blocks. Each equipment shall have its own central control cabinet in which all contacts including spare contacts from all poles shall be wired out. Interpole cabling for all equipment's shall be carried out by the Contractor.

3.26 CABLE GLANDS AND LUGS

3.29.1 Cable glands shall be Double compression type, tinned/Nicked plated (coating thickness not less than 20 microns in case of tin and 10 to 15 microns in case of nickel) brass cable glands for all power and control cables. They shall provide dust and weather proof terminations. They shall comprise of heavy duty brass casting, machine finished and tinned to avoid corrosion and oxidation. Rubber components used in cable glands shall be neoprene and off tested quality. Required number of packing glands to close unused openings in gland plates shall also be provided.

3.29.2 The cable glands shall be tested as per BS: 6121. The cable glands shall also be duly tested for dust proof and weather proof termination.

3.29.3 Cables lugs for power cables shall be tinned copper solder less crimping type conforming to IS:8309 and 8394 suitable for aluminum or copper conductor (as applicable). Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipment. The cable lugs shall suit the type of terminals provided. The cable lugs shall be of Dowell make or equivalent.

3.27 CONDUITS, PIPES AND ACCESSORIES

3.30.1 The bidder shall supply and install all rigid conduits, mild steel pipes, flexible conduits, hume pipes, etc. including all necessary sundry materials, such as tees, elbows, check nuts, bushing reduces, enlargers, wooden plugs, coupling caps, nipples, gland sealing fittings, pull boxes, etc.

3.30.2 Rigid conduits shall be flow-coat metal conduits of Nagarjuna Coated Tubes or equivalent make. The outer surface of the conduits shall be coated with hot-dip zinc and chromate conversion coatings. The inner surface shall have silicone epoxy ester coating for easy cable pulling. Mild steel pipes shall be hot-dip galvanised. All rigid conduits/ pipes shall be of a reputed make.

3.30.3 Flexible conduits shall be heat-resistant lead coated steel, water-leak, fire and rust proof, and be of PLICA make or equivalent.

3.28 AUXILIARY SWITCH

The auxiliary switch shall conform of following type tests:

a) Electrical endurance test - A minimum of 1000 operations for 2A. D.C. with a time constant greater than or equal to 20 milliseconds with a subsequent examination of mV drop/ visual defects/ temperature rise test.
b) Mechanical endurance test - A minimum of 5000 operations with a subsequent checking of contact pressure test/ visual examination
c) Heat run test on contacts
d) IR/HV test, etc.

3.29 LAMPS AND SOCKETS

3.32.1 Lamps:

All incandescent lamps shall use a socket base as per IS-1258, except in the case of signal lamps.

3.32.2 Sockets

All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

3.32.3 Hand Lamp:

A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF Switch for connection of hand lamps.

3.30 SWITCHES & FUSES:

Each control panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with switch-fuse units. Selection of the main and sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

All fuses shall be of HRC cartridge type conforming to IS 9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal Protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage.

All control switches shall be of rotary type. Toggle/piano switches shall not be accepted.

TESTS

3.31 General

During manufacture, the Owner/Purchaser's representative(s) shall have the right to expedite and/or inspect design, materials, workmanship and progress of manufacture of the Contractor's and their Sub-Contractor's equipment and may reject defective materials considered unsuitable for the intended purpose or which do not comply with the intent of the tender specification. The Contractor, upon any such rejection by the Purchaser or his representative(s), shall replace the defective or unsuitable materials. The Contractor shall

provide every reasonable inspection facility to the Purchaser's Inspector(s) or representative(s) at his own and his Sub-Contractor's works.

The Contractor shall give thirty (30) day notice of readiness for inspection of component parts and/or before final assembly and test, so that the Purchaser's representative(s) may inspect the materials and witness such tests before shipment. The Purchaser's representative(s) may, at any time, inspect and request copies of any or all test data of raw materials and finished components which shall be immediately furnished.

Material being furnished against this order shall only be shipped when factory inspection, satisfactory to the Purchaser and/or their representative(s) has been conducted. Such inspection and acceptance for shipment shall not, however, relieve the Contractor from his entire responsibility for furnishing equipment conforming to the requirement of the tender specification nor shall prejudice any claim, right or privilege which the Purchaser may have because of the use or supply of defective or unsatisfactory materials or equipment. Should the inspection be waived by the purchaser, such waival shall not also relieve the Contractor, in any way, from his entire obligations under the
Contract.

The equipment shall, at the factory or after installation, be demonstrated capable of performing satisfactorily upto the Contractor's guaranteed performance. All tests required by the tender specification including retests and inspection that may be necessary owing the failure to meet any tests specified, shall be made at the Contractor's expenses. Additional tests, as necessary, shall be made to locate such failure(s) and after determining the causes of failure(s) and rectifying it, specified tests shall be repeated to establish that the rebuilt equipment meets the tender specification requirements in every respect.

Should the equipment ultimately fail to pass the specified tests, the Purchaser will have the option to reject the unit.

Tests during Manufacture

During the manufacture of equipment, tests specified in Standard Specification(s) shall be performed on each unit in addition to any of manufacturer’s standard tests and requisite number of copies of tests certificates as per Distribution Schedule shall be furnished.

Routine Tests

After completion of manufacture routine tests as specified in relevant Standards and in Standard Specification(s) shall be performed on equipment and requisite number of copies of test certificates as per Distribution Schedule shall be furnished.

All tests shall be conducted in accordance with Indian Standards in effect at the time of testing and in presence of representative(s) of the Purchaser/ Consulting Engineer.

Tests on Associated Components

Cast epoxy resin insulators, surge absorbers, current transformers, voltage transformers, control devices and other associated components as applicable, shall be tested in accordance with the relevant Indian standards and/or Manufacturer's Standards.

Type Tests

Contractor will have to submit Type test reports for all equipment for review. The test reports shall be of same or higher rating. In case the test reports are **older than 5 years from the date of techno commercial bid opening i.e. 02.11.15** or related to equipment of lower rating then fresh type tests have to be conducted without any implication.

Site Tests

The Bidder shall indicate tests recommended to be carried out at site during installation and commissioning to ensure satisfactory performance of all the equipment supplied.

Testing Facility

The Bidder shall state in the Proposal the testing facilities available at his works. Should full capacity testing equipment be not available, the Bidder shall state the method proposed to be adopted with detailed computations and justification for adopting such a method to reliably ascertain the equipment characteristics corresponding to full capacity testing.

3.4 Enclosures:

1. ANNEXURE- I – MQP (Customer format)
2. ANNEXURE- II – QUALITY ASSURANCE FOR SWITCHYARD

SECTION 4
LIST OF DOCUMENTS

1.0 LIST OF TECHNICAL DATASHEETS

In this section Technical Datasheets (TDS) of various equipment/items and system drawings that are required to be generated is furnished herewith. List of datasheets/drawings and numbers to be accorded is also given below.

The list furnished here is tentative and additional documents may be required during detailed engineering.

List of Data Sheets		
Sl. No.	**Item Description**	**NTPC Doc. No.**
01.	D.S. For Water based Fire Protection System	9962-001-TB-572-PVM-Y-236
02.	D.S. For Portable extinguisher	9962-001-TB-572-PVM-Y-237
03.	D.S. For Fire Detection items	9962-001-TB-572-PVM-Y-238
04.	BOQ - FPS switchyard	9962-001-TB-572-PVM-Y-239
05.	D.S. For Solenoid Valve	9962-001-TB-572-PVM-Y-240
06.	D.S. of Fiber Optic Cable for Fire Detection system	9962-001-TB-572-PVM-Y-244
07.	D.S. of Cable	9962-001-TB-572-PVM-Y-245
08.	D.S. of Instruments	9962-001-TB-572-PVM-Y-246
List of Drawings		
09.	Schematic Diagram for Fire Protection system of Switchyard	9962-001-TB-572-PVM-C-228
10.	Fire Water Piping Layout for Switchyard	9962-001-TB-572-PVM-Y-229
11.	HVW Spray system of 80MVar Reactor- Side View, Isometric View (with Hydraulic Calc)	9962-001-TB-572-PVM-Y-230
12.	Distribution of Extinguisher inside Switchyard control room	9962-001-TB-572-PVM-Y-231
13.	Schematic, GA and Layout Drawing for Inert Gas flooding System for Switchyard Control Room	9962-001-TB-572-PVM-Y-232
14.	Schematic of Fire detection system for Switchyard Control building	9962-001-TB-572-PVM-Y-233
15.	Fire Alarm & Detection system inside Switchyard control room building	9962-001-TB-572-PVM-Y-234
16.	LCPDV Drawing	9962-001-TB-572-PVM-Y-235

SCHEDULES AND ENCLOSURES

SECTION- 5

ENCLOSURES TO SPECIFICATION

SCHEDULES TO BE FILLED UP BY THE BIDDER

Schedule 1 **Schedule of makes of Equipments**

Schedule 2 **Schedules of Deviations**

Schedule 3 **Schedule of past experience and qualifying requirements**

Schedule 4 **Schedule of performance certificates**

Schedule 5 **Schedule of type test and special tests**

Schedule 6 **Details of contact persons (technical & commercial)**

Schedule 7 **Enclosures to Specification**

ANNEXURE-A Drawings

SCHEDULE - 1

MAKES OF IMPORTANT ITEMS / COMPONENTS OF EQUIPMENTS AND THEIR DETAILS

ITEM NAME	NAME OF MANUFACTURER	PLACE OF MANUFACTURE OF ITEM	PLACE OF TESTING AND INSPECTION	COMPLIANCE WITH ISO 9001 (YES/NO)

Place

Date

Bidder

Signature of the authorized representative of

Name ----------

Designation----------

Company seal----------

SCHEDULE - 2

SCHEDULE OF TECHNICAL DEVIATION

The following are the deviations / variations / exceptions from the specification:

Section	Clause No. / Page No.	Statement of deviation/ Variations/Exceptions

1) In case, this schedule is not submitted, it will be presumed that the equipment /material to be supplied under this contract are deemed to be in compliance with the specification.

2) If there is NIL deviation, even then the format to be filled as **NIL DEVIATION**

3) Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.

Place — Signature of the authorized representative of Bidder

Name ----------

Date — Designation----------

Company seal----------

SCHEDULE – 3

SCHEDULE OF PAST EXPERIENCE AND QUALIFYING REQUIREMENT

Following is the list of earlier orders executed by us for supply of equipment / material of similar nature over the last past five years:

S.No.	Item	Brief rating	Qty	customer	Date Of order	Date of supply	Order value

Place

Date

Signature of the authorized representative of Bidder

Name----------

Designation----------

Company seal ----------

Note: Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.

SCHEDULE – 4

SCHEDULE OF PERFORMANCE CERTIFICATE

Bidder shall furnish the performance certificate of the similar equipment having
The following details:

S.No.	Item	Brief rating	Qty	Customer	Date Of supply

Place

Date

Signature of the authorized representative of Bidder

Name----------

Designation----------

Company seal ----------

Note: Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.

SCHEDULE - 5

SCHEDULE OF TYPE TESTS AND SPECIAL TESTS

The following type tests and special tests as called for in the Specification shall be conducted (all type tests / special tests as mentioned in the relevant clauses of the Specification shall be listed here):

Sl no.	Clause no/ page no of Specification	Details of test	Lab in which to be conducted	Whether test to be conducted free or on chargeable basis. Mention 'FREE' or 'CHARGEABLE'	If charges per test have been quoted for in the price bid. YES / NO
		A. Type Tests			
		1.			
		2.			
		B. Routine Tests			**DO NOT**
		1.			**MENTION**
		2.			**ANY PRICE**
		C. Site Tests			**IN THIS**
		1.			**COLUMN**
		2.			
		D. Special Tests (specified)			
		1.			
		2.			
		E. Other tests at works / site recommended by the Bidder			
		1.			
		2.			

NOTE:

1) Details have to be furnished on cables as well as accessories, each separately.

2) NO PRICE SHALL BE FURNISHED IN THIS FORMAT.

Place

Date

Signature of the authorized representative of Bidder

Name----------

Designation----------

Company seal----------

SCHEDULE - 6

DETAILS OF CONTACT PERSON BOTH TECHNICAL AND COMMERCIAL

Name

Address for correspondence

Phone No.

Fax No.

Email

Place

Date

Signature of the authorized representative of Bidder

Name----------

Designation----------

Company seal ----------

Note: Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.

SCHEDULE –7

ENCLOSURES TO SPECIFICATION

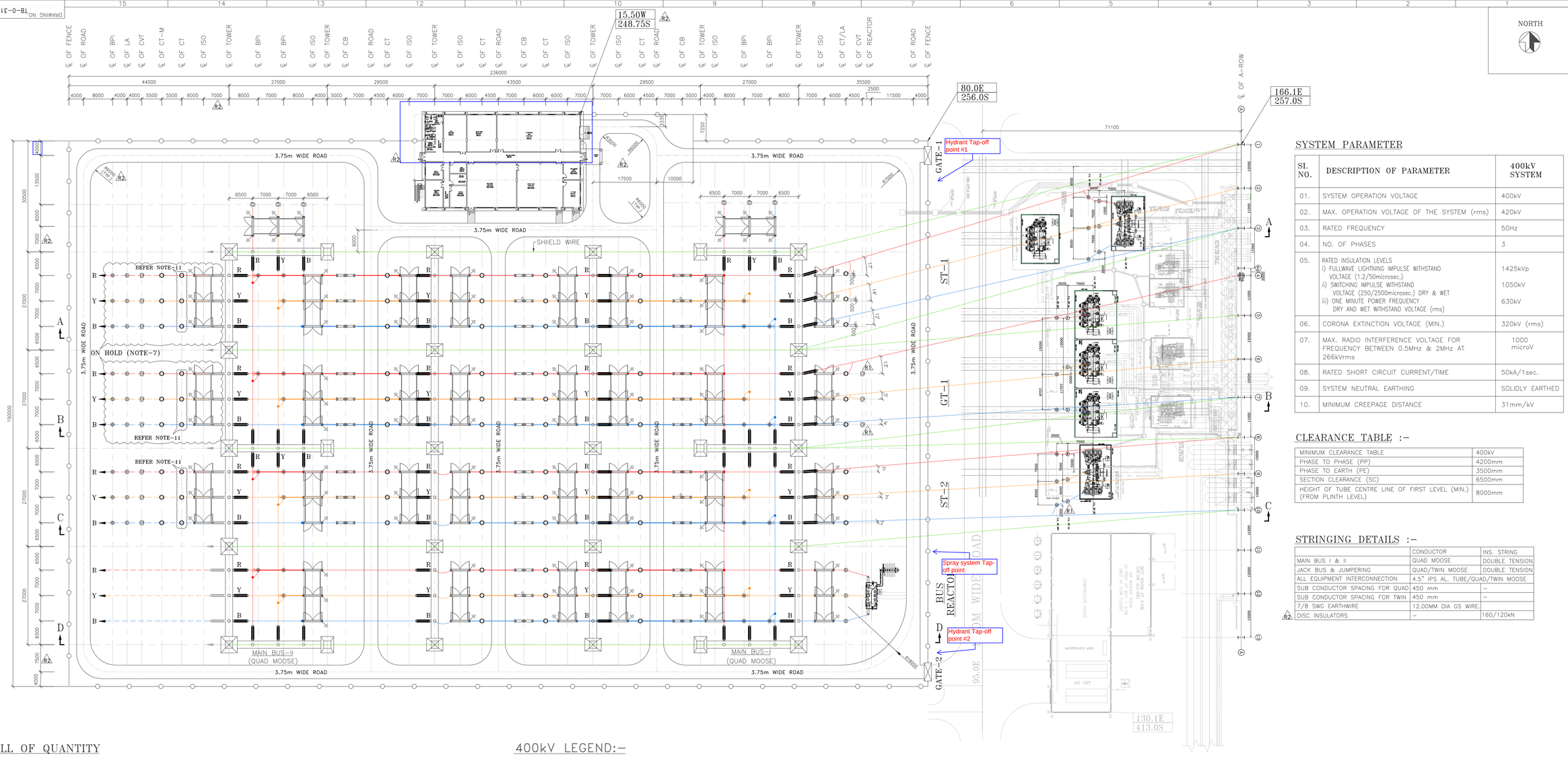
DRAWINGS (ANNEXURE-A)

1. 400 KV SWITCHYARD PLAN
   DRG. NO. 9962-001-TB-572-PVE-F-184 REV.05 (2 SHEETS)
2. ARCHITECTURAL DRG. FOR SWITCHYARD CONTROL BUILDING LAYOUT
   DRG. NO. 9962-001-TB-572-PVC-C-121 (4 SHEETS)
3. CABLE TRENCH LAYOUT FOR 400 KV SWITCHYARD.
   DRG. NO. TB-0-380-510-004 REV.00 (1 SHEET)
4. OGA OF 80 MVAR REACTOR.
   DRG. NO. 34690002055 REV.00 (6 SHEETS)
5. P & ID OF FF PUMP HOUSE OF MAIN PLANT (*ONLY FOR REF. OF CONTRACTOR*)
   DRG. NO. PYDP1M01866102 REV.00 (1 SHEET)

DRAWING NO. TB-0-316-401-002

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM



SYSTEM PARAMETER

SI. NO.	DESCRIPTION OF PARAMETER	400kV SYSTEM
01.	SYSTEM OPERATION VOLTAGE	400kV
02.	MAX. OPERATION VOLTAGE OF THE SYSTEM (rms)	420kV
03.	RATED FREQUENCY	50Hz
04.	NO. OF PHASES	3
05.	RATED INSULATION LEVELS i) FULLWAVE LIGHTNING IMPULSE WITHSTAND VOLTAGE (1.2/50microsec.) ii) SWITCHING IMPULSE WITHSTAND VOLTAGE (250/2500microsec.) DRY & WET iii) ONE MINUTE POWER FREQUENCY DRY AND WET WITHSTAND VOLTAGE (rms)	1425kVp 1050kV 630kV
06.	CORONA EXTINCTION VOLTAGE (MIN.)	320kV (rms)
07.	MAX. RADIO INTERFERENCE VOLTAGE FOR FREQUENCY BETWEEN 0.5MHz & 2MHz AT 266kVrms	1000 microV
08.	RATED SHORT CIRCUIT CURRENT/TIME	50kA/1sec.
09.	SYSTEM NEUTRAL EARTHING	SOLIDLY EARTHED
10.	MINIMUM CREEPAGE DISTANCE	31mm/kV

CLEARANCE TABLE :–

MINIMUM CLEARANCE TABLE	400kV
PHASE TO PHASE (PP)	4200mm
PHASE TO EARTH (PE)	3500mm
SECTION CLEARANCE (SC)	6500mm
HEIGHT OF TUBE CENTRE LINE OF FIRST LEVEL (MIN.) (FROM PLINTH LEVEL)	8000mm

STRINGING DETAILS :–

	CONDUCTOR	INS. STRING
MAIN BUS I & II	QUAD MOOSE	DOUBLE TENSION
JACK BUS & JUMPERING	QUAD/TWIN MOOSE	DOUBLE TENSION
ALL EQUIPMENT INTERCONNECTION	4.5" IPS AL. TUBE/QUAD/TWIN MOOSE	
SUB CONDUCTOR SPACING FOR QUAD	450 mm	–
SUB CONDUCTOR SPACING FOR TWIN	450 mm	–
7/8 SWG EARTHWIRE	12.00MM DIA GS WIRE.	
R2 DISC INSULATORS	–	160/120kN

BILL OF QUANTITY

ITEM NO.	EQUIPMENT SYMBOL	DESCRIPTION	QUANTITY (NOS.)	
01.		400kV, 3150A, 50kA FOR 1sec.,3–PH. SF6 CIRCUIT BREAKER	05	R2
02.		400kV, 3150A, 50kA FOR 1sec.,3–PH. SF6 CIRCUIT BREAKER WITH CONTROL SWITCHING DEVICE	06	R2
03.		400kV, 3150A, 50kA FOR 1sec, 3–PHASE HORIZONTAL CENTER BREAK (ELECTRICALLY GANGED) ISOLATOR WITH TWO EARTH SWITCH (MOTOR OPERATED – MECHANICALLY GANGED)	02	
04.		400kV, 3150A, 50kA FOR 1sec, 3–PHASE HORIZONTAL CENTER BREAK (ELECTRICALLY GANGED) ISOLATOR WITH ONE EARTH SWITCH (MOTOR OPERATED – MECHANICALLY GANGED)	30	
05.		400kV, 3000A, 50kA FOR 1sec., 1–PH. CURRENT TRANSFORMER (5 CORE)	54	R2
06.		400kV, 3000A, 50kA FOR 1sec., 1–PH. CURRENT TRANSFORMER (2 CORE)	18	
07.		400kV, 4400pF, 1PH. CVT $\left(\frac{400}{\sqrt{3}} / \frac{0.11}{\sqrt{3}} - \frac{0.11}{\sqrt{3}} - \frac{0.11}{\sqrt{3}} - \frac{0.11}{\sqrt{3}}\right)$	16	
08.		360kV, 20kA, 50kA FOR 1sec., 1–PH., CLASS–4 LIGHTNING ARRESTER	21	
09.		80MVAR, 3–PH, BUS REACTOR	01	
10.		420kV, 8kN, 31mm/kV CREEPAGE POST INSULATOR	42	

400kV LEGEND:–

	TOWER WITH PEAK
	TOWER WITHOUT PEAK
	SUSPENSION INSULATOR STRING (1X31 DISCS)
	DOUBLE TENSION INSULATOR STRING (2X31 DISCS)
	AL. TUBE
	R–PHASE ACSR MOOSE CONDUCTOR
	Y–PHASE ACSR MOOSE CONDUCTOR
	B–PHASE ACSR MOOSE CONDUCTOR
	END CAP/CORONA BELL
	SHIELD WIRE (12.0MMØ)

NOTES:–

1. ALL DIMENSIONS ARE IN MM.
2. ALL STRUCTURE/CONDUCTOR HEIGHTS ARE ABOVE PLINTH LEVEL. PLINTH LEVEL IS 300 MM ABOVE F.G.L.
3. TYPE OF GANTRY STRUCTURES SHALL BE AS PER APPROVED STRUCTURAL LAYOUT DRAWING.
4. SA PRESSURE RELIEF VALVE SHALL NOT BE TOWARDS TRANSFORMER SIDE / ANY EQUIPMENT KEPT NEAR LIGHTING ARRESTER AND BHEL SHALL ENSURE THE SAME DURING ERECTION AT SITE.
5. FOR SECTION DETAILS REFER SHEET No. 02.
6. SIZE OF CONTROL ROOM BUILDING IS TENTATIVE & WILL BE FINALIZED IN A SEPARATE DRAWING OF CONTROL ROOM BUILDING LAYOUT PLAN.
7. LINE SIDE EQUIPMENT FOUNDATIONS WILL BE ON HOLD TILL THE LOCATION OF DEAD END TOWERS IS CONFIRMED BY CUSTOMER. PHASE SEQUENCE AT DEAD END TOWER IS ASSUMED & WILL BE CONFIRMED BY CUSTOMER.
8. SUPPLY AND STRINGING OF 400kV LINE CONDUCTOR, SHIELD WIRE, INSULATOR AND HARDWARE BETWEEN 400kV DEAD END TOWER AND SWITCHYARD TERMINAL GANTRY ARE NOT IN BHEL SCOPE. HOWEVER, JUMPERING FOR THE RESPECTIVE EQUIPMENT, JUMPERS & HARDWARE REQUIRED FOR JUMPERS ARE IN SCOPE OF BHEL.
9. R2 LINE SIDE CONDUCTOR FOR LINE–1 & LINE–2 AS PER MOM WITH UPPTCL & UPRVUNL DATED 22.02.19 IS TWIN MOOSE ACSR.
10. LAs COMING BETWEEN RAIL TRACK IN TRANSFORMER YARD SHALL HAVE REMOVABLE TYPE STEEL STRUCTURE SO THAT THESE CAN BE REMOVED WHEN TRANSFORMER HAS TO BE TAKEN OUT FOR REPAIR / REPLACEMENT.
11. R2 09 Nos. SINGLE PHASE CT (5–CORE) ARE ADDITIONAL TO CONTRACT SPECIFICATION & WILL BE SUPPLIED SUBJECT TO COMMERCIAL SETTLEMENT.

REFERENCE DWG :–

DWG. NO.	TITLE
9962–001–TB–572–PVE–P–052	SINGLE LINE DIAGRAM OF 400kV SWITCHYARD
PE–DG–426–100–M001	PLOT PLAN

NTPC DRG. No. 9962–001–TB–572–PVE–F–184 REV. 02

PROJECT: PANKI THERMAL POWER STATION (1X660MW)

OWNER: UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LTD.

REVIEW CONSULTANT: NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE)

CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD. KOLKATA

EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD.

BHARAT HEAVY ELECTRICALS LTD
TRANSMISSION BUSINESS GROUP
NOIDA

REV.	DATE	ALTD	CHD	APPD
02	18.03.19	PK	AK	VK
01	23.01.19	PK	AK/DK	AG

02: DRAWING REVISED TO INCORPORATE: 1. NTPC COMMENTS DATED 06.02.19 2. ARCHITECTURAL DRAWING OF CRB. 3. CR BUILDING CO–ORDINATES REVISED. 4. ADDITIONAL LINE CT INCORPORATED. 5. ROAD ARRANGEMENT NEAR CRB REVISED AS PER DISCUSSION WITH NTPC.

01: DRAWING REVISED TO INCORPORATE: 1. NTPC COMMENTS DATED 09.11.18 2. REVISED LOCATION OF ST–2 BPI 3. CR BUILDING DRG. 4. SWITCHYARD CO–ORDINATES. 5. REVISED QTY OF CB WITH CSD AS PER LATEST SLD.

DEPT	NAME	SIGN	DATE
DRN	PK		01.09.18
DESN	AK		12.09.18
CHD	DKM		
APPD	AG		

JOB NO.
STATUS
DISTRIBUTION

TITLE: ELECTRICAL LAYOUT PLAN & SECTIONAL ELEVATION OF 400kV SWITCHYARD

DEPT. | SCALE 1: 100 | SIGN | DRAWING NO. TB–0–316–401–002

SHEET 01 OF 02 REV. 02

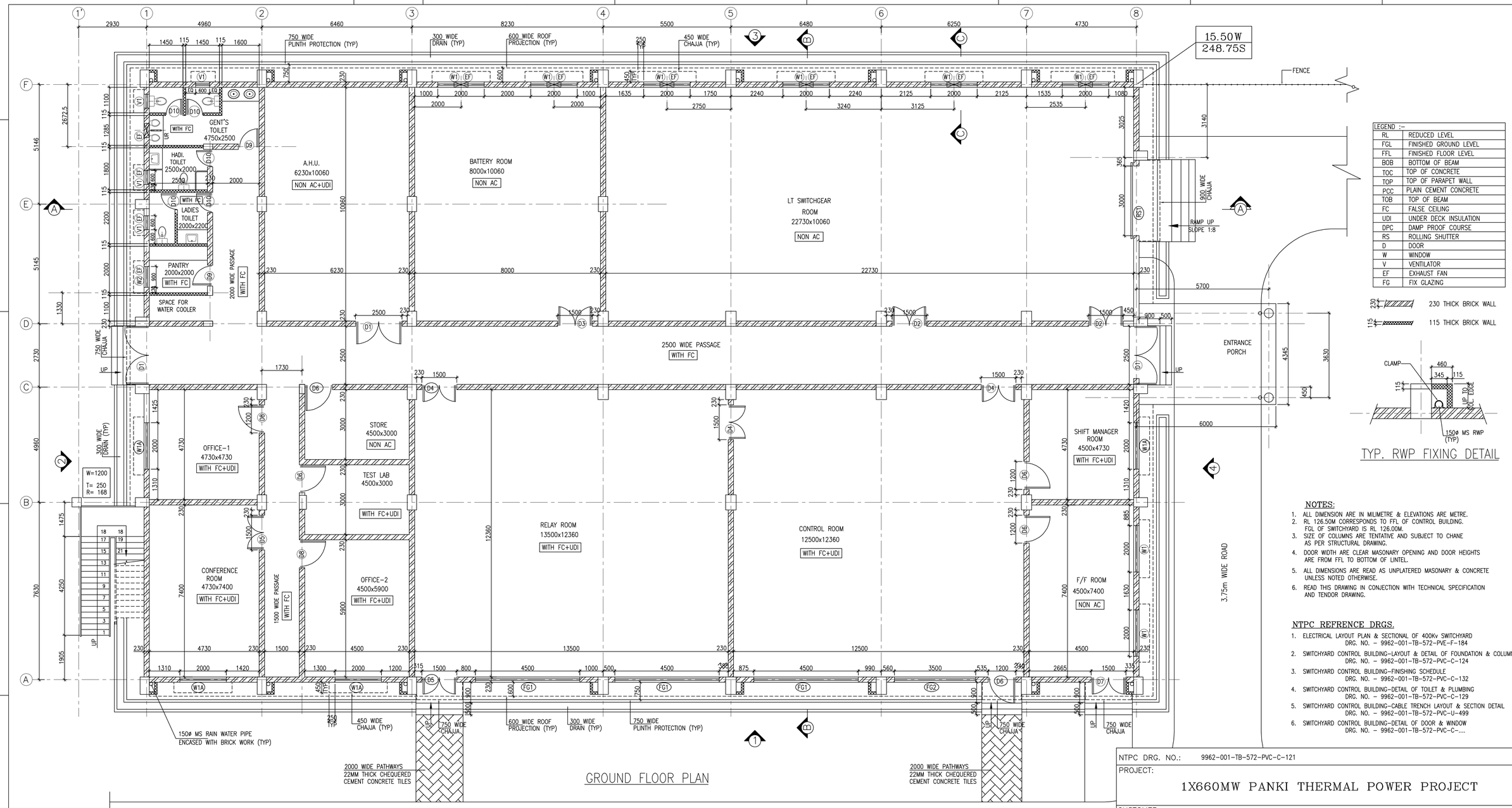
SIZE–A0

ELECTRONIC FILE NAME:

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. TB-3-316-401-061



GROUND FLOOR PLAN

LEGEND :-	
RL	REDUCED LEVEL
FGL	FINISHED GROUND LEVEL
FFL	FINISHED FLOOR LEVEL
BOB	BOTTOM OF BEAM
TOC	TOP OF CONCRETE
TOP	TOP OF PARAPET WALL
PCC	PLAIN CEMENT CONCRETE
TOB	TOP OF BEAM
FC	FALSE CEILING
UDI	UNDER DECK INSULATION
DPC	DAMP PROOF COURSE
RS	ROLLING SHUTTER
D	DOOR
W	WINDOW
V	VENTILATOR
EF	EXHAUST FAN
FG	FIX GLAZING

230 THICK BRICK WALL

115 THICK BRICK WALL

TYP. RWP FIXING DETAIL

NOTES:

1. ALL DIMENSION ARE IN MILIMETRE & ELEVATIONS ARE METRE.
2. RL 126.50M CORRESPONDS TO FFL OF CONTROL BUILDING. FGL OF SWITCHYARD IS RL 126.00M.
3. SIZE OF COLUMNS ARE TENTATIVE AND SUBJECT TO CHANE AS PER STRUCTURAL DRAWING.
4. DOOR WIDTH ARE CLEAR MASONARY OPENING AND DOOR HEIGHTS ARE FROM FFL TO BOTTOM OF LINTEL.
5. ALL DIMENSIONS ARE READ AS UNPLATERED MASONARY & CONCRETE UNLESS NOTED OTHERWISE.
6. READ THIS DRAWING IN CONJECTION WITH TECHNICAL SPECIFICATION AND TENDOR DRAWING.

NTPC REFRENCE DRGS.

1. ELECTRICAL LAYOUT PLAN & SECTIONAL OF 400Kv SWITCHYARD DRG. NO. – 9962-001-TB-572-PVE-F-184
2. SWITCHYARD CONTROL BUILDING-LAYOUT & DETAIL OF FOUNDATION & COLUMN DRG. NO. – 9962-001-TB-572-PVC-C-124
3. SWITCHYARD CONTROL BUILDING-FINISHING SCHEDULE DRG. NO. – 9962-001-TB-572-PVC-C-132
4. SWITCHYARD CONTROL BUILDING-DETAIL OF TOILET & PLUMBING DRG. NO. – 9962-001-TB-572-PVC-C-129
5. SWITCHYARD CONTROL BUILDING-CABLE TRENCH LAYOUT & SECTION DETAIL DRG. NO. – 9962-001-TB-572-PVC-U-499
6. SWITCHYARD CONTROL BUILDING-DETAIL OF DOOR & WINDOW DRG. NO. – 9962-001-TB-572-PVC-C-....

NTPC DRG. NO.: 9962-001-TB-572-PVC-C-121

PROJECT: 1X660MW PANKI THERMAL POWER PROJECT

CUSTOMER: UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP
NOIDA

STRUCTURAL CONSULTANTS:-
RDA CIVIL ENGINEERING SYSTEM PVT. LTD.
N-43, SRINIWASPURI NEW DELHI -65
PH. 011 26845128, FAX 011 26313478

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	TKR	–sd–	06.03.19	N.A.
CHD.	AK	–sd–		
APPD.	DKM	–sd–		

DEPT. TBG / CODE	UNTOL. DIMS. GR. C/M/F	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
		N.T.S	N.A.	N.A.	N.A.	N.A.

TITLE: CONTROOL ROOM BUILDING LAYOUT FOR 400kV ARCHITECTURAL GROUND FLOOR PLAN

CARD CODE: NA

DRG.NO. TB-3-316-401-061

REV. 01

SHT. No 01 NO. OF SHT. 04

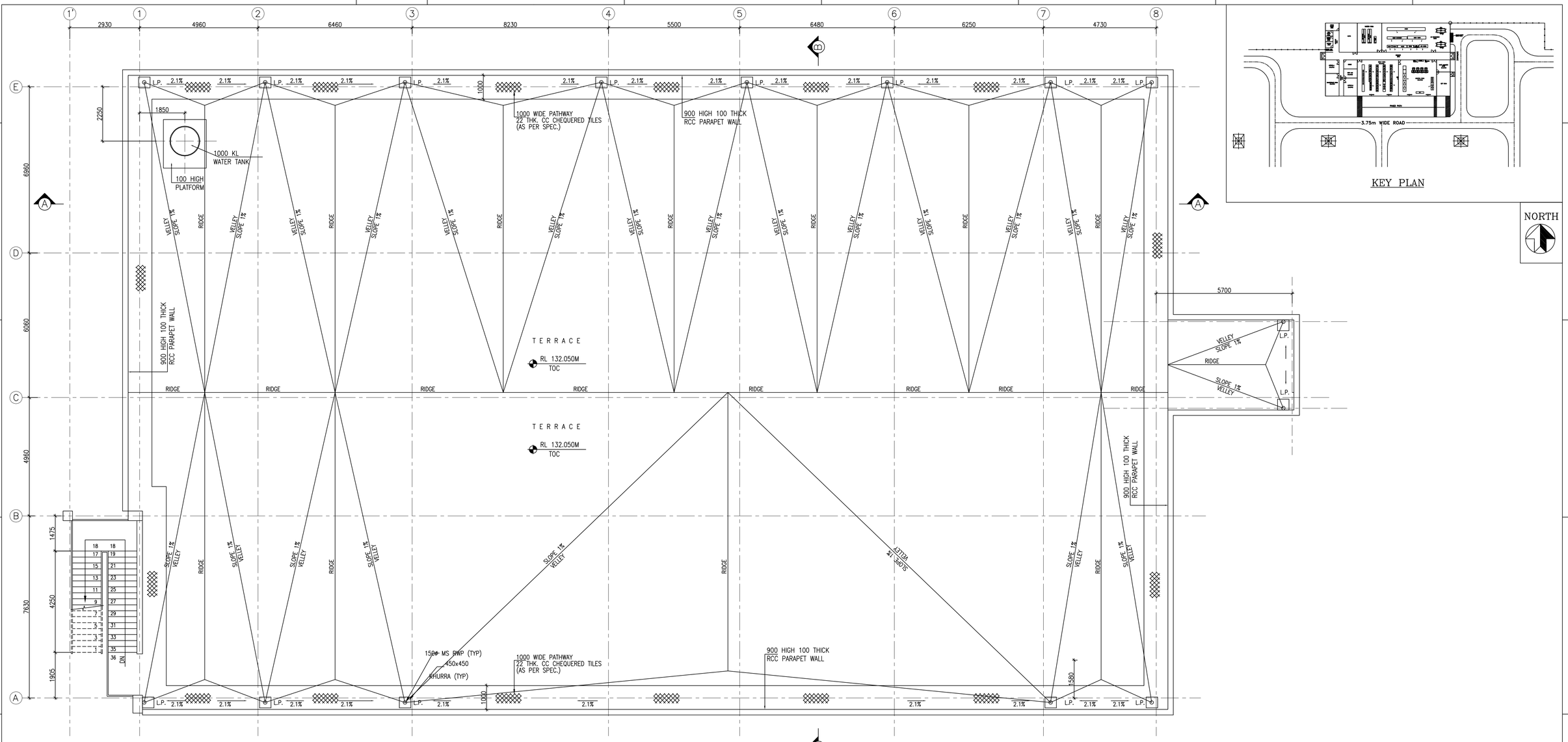
REV.	DATE	ALTERED	CHD/APPD
R1	30-04-19	REVISED AS PER COMMENTS	TKR / AK

SIZE-A1

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. TB-3-316-401-061



TERRACE PLAN

WATER PROOFING ON ROOF:

HIGH SOLID CONTENT LIQUID APPLIED ELASTOMERIC WATER PROOFING MEMBRANE WITH SEPARATE WEARING COURSE AS PER ASTM C -898. THICKNESS OF THE MEMBRANE SHALL BE 1.5 MM. THIS TREATMENT SHALL INCLUDE APPLICATION OF POLYMERISED MASTIC OVER THE ROOF TO ACHIEVE SMOOTH SURFACE AND PRIMER COAT. WEARING COURSE ON THE TOP OF MEMBRANE SHALL CONSIST OF 40MM. THICK PCC (1:2:4) CAST IN PANELS OF MAX. 1200x1200 SIZE AND REINFORCED WITH 0.56 MM. DIA. GALVANIZED CHICKEN WIRE MESH AND SEALING OF JOINTS USING SEALING COMPOUND/ ELASTOMETRIC WATER PROOFING MEMBRANE.

NTPC REFRENCE DRGS.

1. ELECTRICAL LAYOUT PLAN & SECTIONAL OF 400Kv SWITCHYARD DRG. NO. - 9962-001-TB-572-PVE-F-184
2. SWITCHYARD CONTROL BUILDING-LAYOUT & DETAIL OF FOUNDATION & COLUMN DRG. NO. - 9962-001-TB-572-PVC-C-124
3. SWITCHYARD CONTROL BUILDING-FINISHING SCHEDULE DRG. NO. - 9962-001-TB-572-PVC-C-132
4. SWITCHYARD CONTROL BUILDING-DETAIL OF TOILET & PLUMBING DRG. NO. - 9962-001-TB-572-PVC-C-129
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6. SWITCHYARD CONTROL BUILDING-DETAIL OF DOOR & WINDOW DRG. NO. - 9962-001-TB-572-PVC-C-....

NOTES:

1. ALL DIMENSION ARE IN MILIMETRE & ELEVATIONS ARE METRE.
2. RL 126.50M CORRESPONDS TO FFL OF CONTROL BUILDING. FGL OF SWITCHYARD IS RL 126.00M.
3. SIZE OF COLUMNS ARE TENTATIVE AND SUBJECT TO CHANE AS PER STRUCTURAL DRAWING.
4. DOOR WIDTH ARE CLEAR MASONARY OPENING AND DOOR HEIGHTS ARE FROM FFL TO BOTTOM OF LINTEL.
5. ALL DIMENSIONS ARE READ AS UNPLATERED MASONARY & CONCRETE UNLESS NOTED OTHERWISE.
6. READ THIS DRAWING IN CONJECTION WITH TECHNICAL SPECIFICATION AND TENDOR DRAWING.

REV.	DATE	ALTERED	CHD/APPD
ZONE			

REV.	DATE	ALTERED	CHD/APPD
ZONE			

REV.	DATE	ALTERED	CHD/APPD
ZONE			

REV.	DATE	ALTERED	CHD/APPD
R1	30-04-19	TKR	AK
ZONE		REVISED AS PER COMMENTS	

NTPC DRG. NO.: 9962-001-TB-572-PVC-C-121

PROJECT: 1X660MW PANKI THERMAL POWER PROJECT

CUSTOMER: UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

BHARAT HEAVY ELECTRICALS LTD.
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N-43, SRINIWASPURI NEW DELHI -65
PH. 011 26845128, FAX 011 26313478

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	TKR	-sd-	06.03.19	N.A.
CHD.	AK	-sd-		
APPD.	DKM	-sd-		

DEPT. TBG	UNTOL. DIMS. GR.		SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
CODE	C/M/F		N.T.S	N.A.	N.A.	N.A.	N.A.

TITLE: CONTROOL ROOM BUILDING LAYOUT FOR 400kV ARCHITECTURAL TERRACE PLAN

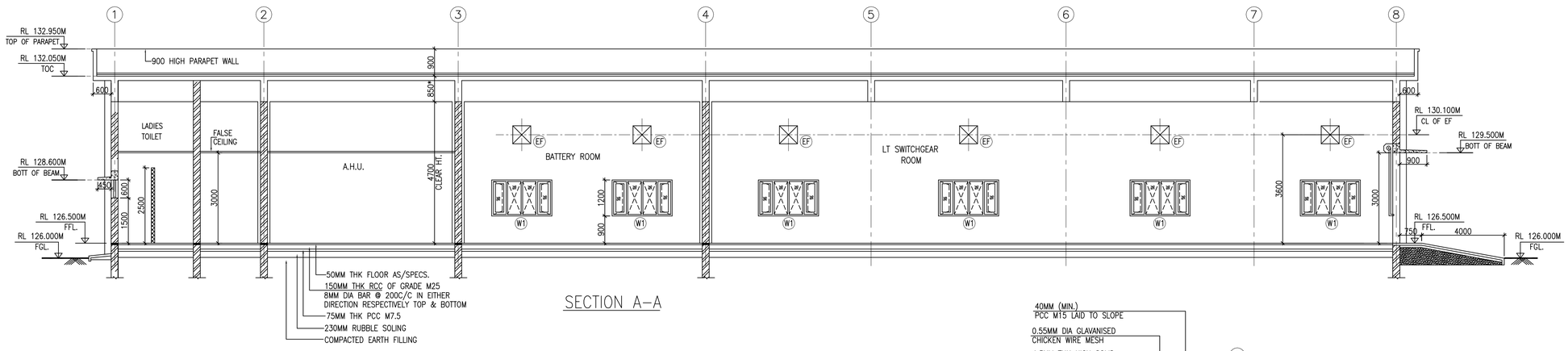
CARD CODE: NA

DRG.NO. TB-3-316-401-061

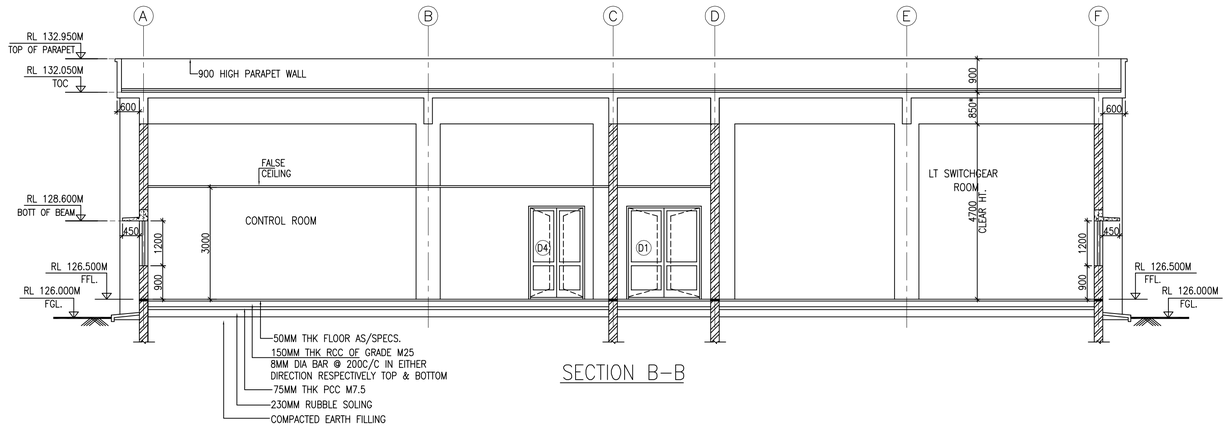
REV. 01

SHT. No 02 NO. OF SHT. 04

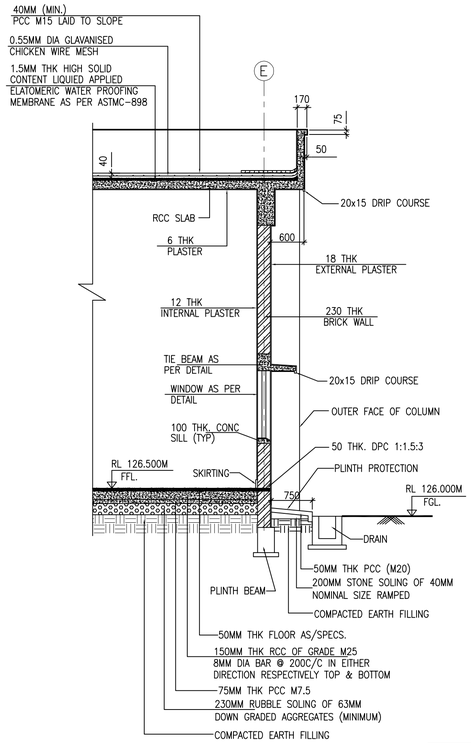
SIZE-A1



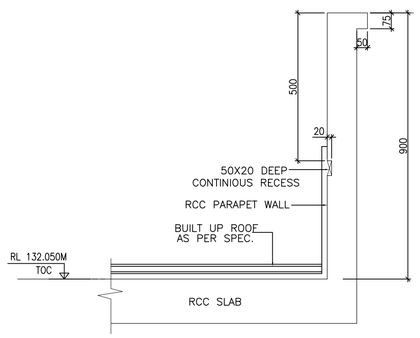
SECTION A–A



SECTION B–B



SECTION C–C



TYP. RCC DETAIL OF PARAPET WALL

SCHEDULE OF DOORS & WINDOWS

TYPE	OPENING SIZE	CILL LEVEL	LINTEL LEVEL	NOS.	DESCRIPTION	REMARKS
RS1	3000x3000	–	3000	1	STEEL ROLLING SHUTTER	LT SWITCHGEAR RM
D1	2500x2500	–	2500	3	DOUBLE SHUTTER ALUMINIUM GLAZED DOOR AS PER SPECS.	MAIN ENTRACE,AHU
D2	1500x2500	–	2500	2	DOUBLE SHUTTER FIRE PROOF STEEL FRAME DOOR AS PER SPECS.	LT SWITCHGEAR RM
D3	1500x2500	–	2500	1	DOUBLE SHUTTER STEEL FRAME DOOR AS PER SPECS.	BATTERY RM
D4	1500x2500	–	2500	3	DOUBLE SHUTTER ALUMINIUM GLAZED DOOR AS PER SPECS.	RELAY RM/ CONTROL RM
D5	1500x2100	–	2100	2	DOUBLE SHUTTER ALUMINIUM GLAZED DOOR AS PER SPECS.	RELAY RM/ CONFERENCE RM
D6	1200x2100	–	2100	5	SINGLE SHUTTER ALUMINIUM GLAZED DOOR AS PER SPECS.	CONTROL RM/FF RM SHIFT RM/STORE/LAB
D7	1500x2100	–	2100	1	DOUBLE SHUTTER STEEL FRAME DOOR AS PER SPECS.	FF RM
D8	1200x2100	–	2100	2	SINGLE SHUTTER STEEL FRAME WITH WOODEN FLUSH DOOR AS PER SPECS.	OFFICE-1/OFFICE-2
D9	900x2100	–	2100	3	SINGLE SHUTTER PVC DOOR FRAME AS PER SPECS.	TOILET/PANTRY
D10	750x2100	–	2100	4	SINGLE SHUTTER PVC DOOR FRAME AS PER SPECS.	TOILET/PANTRY
W1	2000x1200	900	2100	8	PARTLY FIXED & PARTLY OPENABLE ALUMINIUM FRAME GLAZED SHUTTER WINDOW AS PER SPECS.	
W1A	2000x1200	900	2100	4	ALUMINIUM FRAME GLAZED SHUTTER FIXED WINDOW (HERMETICALLY SEALED DOUBLE GAZING)	
W2	900x1200	900	2100	1	PARTLY FIXED & PARTLY OPENABLE ALUMINIUM FRAME GLAZED SHUTTER WINDOW AS PER SPECS.	
V1	600x600	1500	2100	4	PARTLY FIXED & PARTLY OPENABLE ALUMINIUM FRAME GLAZED SHUTTER VENTILATOR AS PER SPECS.	
FG1	4500x1200	900	2100	3	ALUMINIUM FRAME GLAZED SHUTTER FIXED WINDOW (HERMETICALLY SEALED DOUBLE GAZING)	
FG2	3500x1200	900	2100	1	ALUMINIUM FRAME GLAZED SHUTTER FIXED WINDOW (HERMETICALLY SEALED DOUBLE GAZING)	
EF	SIZE AS PER VENTI. DWG.	–	–	10	EXHAUST FAN	

NOTES:

1. ALL DIMENSION ARE IN MILIMETRE & ELEVATIONS ARE METRE.
2. RL 126.50M CORRESPONDS TO FFL OF CONTROL BUILDING. FGL OF SWITCHYARD IS RL 126.00M.
3. SIZE OF COLUMNS ARE TENTATIVE AND SUBJECT TO CHANE AS PER STRUCTURAL DRAWING.
4. DOOR WIDTH ARE CLEAR MASONARY OPENING AND DOOR HEIGHTS ARE FROM FFL TO BOTTOM OF LINTEL.
5. ALL DIMENSIONS ARE READ AS UNPLATERED MASONARY & CONCRETE UNLESS NOTED OTHERWISE.
6. READ THIS DRAWING IN CONJECTION WITH TECHNICAL SPECIFICATION AND TENDOR DRAWING.

NTPC REFRENCE DRGS.

1. ELECTRICAL LAYOUT PLAN & SECTIONAL OF 400Kv SWITCHYARD DRG. NO. – 9962-001-TB-572-PVE-F-184
2. SWITCHYARD CONTROL BUILDING-LAYOUT & DETAIL OF FOUNDATION & COLUMN DRG. NO. – 9962-001-TB-572-PVC-C-124
3. SWITCHYARD CONTROL BUILDING-FINISHING SCHEDULE DRG. NO. – 9962-001-TB-572-PVC-C-132
4. SWITCHYARD CONTROL BUILDING-DETAIL OF TOILET & PLUMBING DRG. NO. – 9962-001-TB-572-PVC-C-129
5. SWITCHYARD CONTROL BUILDING-CABLE TRENCH LAYOUT & SECTION DETAIL DRG. NO. – 9962-001-TB-572-PVC-U-499
6. SWITCHYARD CONTROL BUILDING-DETAIL OF DOOR & WINDOW DRG. NO. – 9962-001-TB-572-PVC-C-....

NTPC DRG. NO.: 9962-001-TB-572-PVC-C-121

PROJECT:
1X660MW PANKI THERMAL POWER PROJECT

CUSTOMER:
UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

CONSULTANT:
DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP
NOIDA

STRUCTURAL CONSULTANTS:–
RDA CIVIL ENGINEERING SYSTEM PVT. LTD.
N-43, SRINIWASPURI NEW DELHI -65
☎PH. 011 26845128, FAX 011 26313478

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	TKR	–sd–	06.03.19	N.A.
CHD.	AK	–sd–		
APPD.	DKM	–sd–		

DEPT. TBG	UNTOL. DIMS. GR.		SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
CODE	G/M/F		N.T.S	N.A.	N.A.	N.A.	N.A.

TITLE: CONTROOL ROOM BUILDING LAYOUT FOR 400kV ARCHITECTURAL SECTIONS

CARD CODE: NA

DRG.NO. TB-3-316-401-061 REV. 01

SHT. No 03 NO. OF SHT. 04

SIZE-A1

REV.	DATE	ALTERED	CHD/APPD
ZONE			

REV.	DATE	ALTERED	CHD/APPD
ZONE			

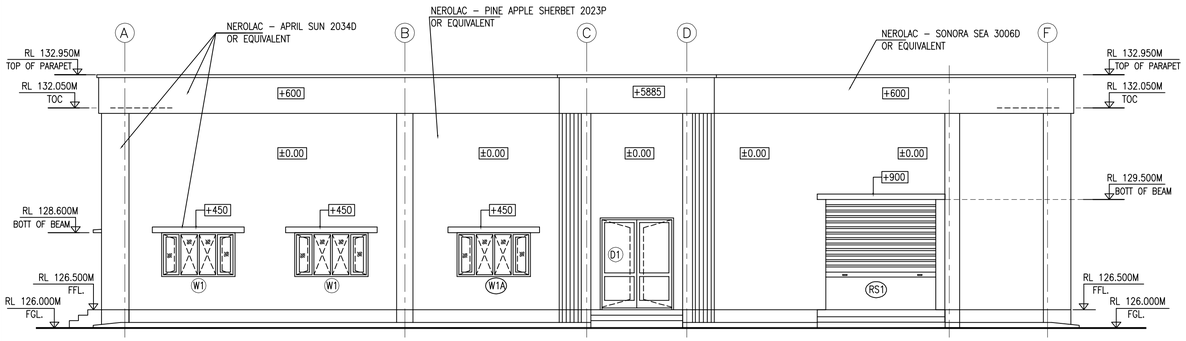
REV.	DATE	ALTERED	CHD/APPD
ZONE			

REV.	DATE	ALTERED	CHD/APPD
R1	30-04-19	TKR	AK
ZONE		REVISED AS PER COMMENTS	

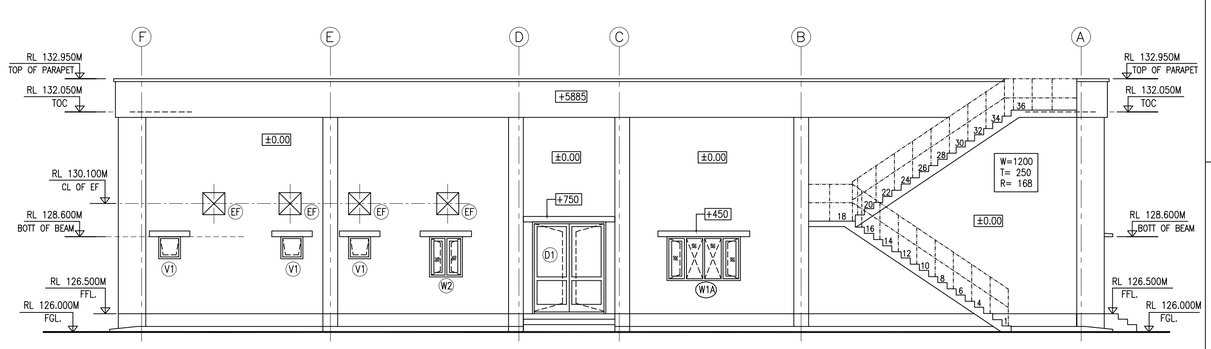
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

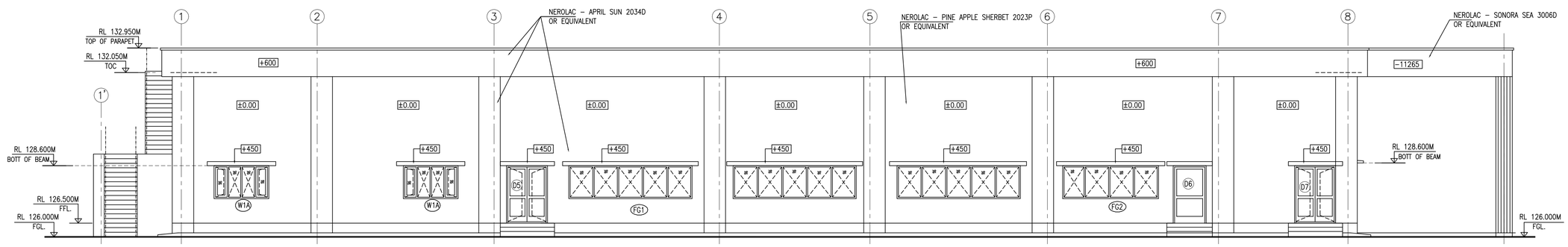
DRG. NO. TB-3-316-401-061



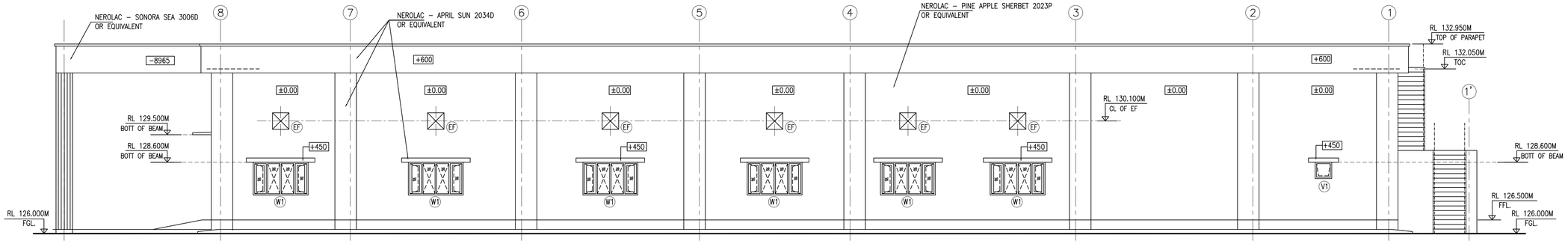
ELEVATION – 4



ELEVATION – 2



ELEVATION – 1



ELEVATION – 3

EXTERNAL FINISH COLOUR SCHEME	
AREA	SHADE
PROJECTED AREA	NEROLAC – APRIL SUN 2034D OR EQUIVALENT
WALL	NEROLAC – PINE APPLE SHERBET 2023P OR EQUIVALENT
PORCH	NEROLAC – SONORA SEA 3006D OR EQUIVALENT

NTPC REFRENCE DRGS.

1. ELECTRICAL LAYOUT PLAN & SECTIONAL OF 400Kv SWITCHYARD DRG. NO. – 9962-001-TB-572-PVE-F-184
2. SWITCHYARD CONTROL BUILDING-LAYOUT & DETAIL OF FOUNDATION & COLUMN DRG. NO. – 9962-001-TB-572-PVC-C-124
3. SWITCHYARD CONTROL BUILDING-FINISHING SCHEDULE DRG. NO. – 9962-001-TB-572-PVC-C-132
4. SWITCHYARD CONTROL BUILDING-DETAIL OF TOILET & PLUMBING DRG. NO. – 9962-001-TB-572-PVC-C-129
5. SWITCHYARD CONTROL BUILDING-CABLE TRENCH LAYOUT & SECTION DETAIL DRG. NO. – 9962-001-TB-572-PVC-U-499
6. SWITCHYARD CONTROL BUILDING-DETAIL OF DOOR & WINDOW DRG. NO. – 9962-001-TB-572-PVC-C-....

NOTES:

1. ALL DIMENSION ARE IN MILIMETRE & ELEVATIONS ARE METRE.
2. RL 126.50M CORRESPONDS TO FFL OF CONTROL BUILDING. FGL OF SWITCHYARD IS RL 126.00M.
3. SIZE OF COLUMNS ARE TENTATIVE AND SUBJECT TO CHANE AS PER STRUCTURAL DRAWING.
4. DOOR WIDTH ARE CLEAR MASONARY OPENING AND DOOR HEIGHTS ARE FROM FFL TO BOTTOM OF LINTEL.
5. ALL DIMENSIONS ARE READ AS UNPLATERED MASONARY & CONCRETE UNLESS NOTED OTHERWISE.
6. READ THIS DRAWING IN CONJECTION WITH TECHNICAL SPECIFICATION AND TENDOR DRAWING.

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHD/APPD			CHD/APPD			CHD/APPD	R1	30-04-19	TKR CHD/APPD AK
ZONE			ZONE			ZONE			ZONE		REVISED AS PER COMMENTS

NTPC DRG. NO.: 9962-001-TB-572-PVC-C-121

PROJECT: 1X660MW PANKI THERMAL POWER PROJECT

CUSTOMER: UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP
NOIDA

STRUCTURAL CONSULTANTS:–
RDA CIVIL ENGINEERING SYSTEM PVT. LTD.
N-43, SRINIWASPURI NEW DELHI -65
☎PH. 011 26845128, FAX 011 26313478

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	TKR	–sd–	06.03.19	N.A.
CHD.	AK	–sd–		
APPD.	DKM	–sd–		

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

TITLE: CONTROOL ROOM BUILDING LAYOUT FOR 400kV ARCHITECTURAL ELEVATIONS

CARD CODE: NA

DRG.NO. TB-3-316-401-061 REV. 01

SHT. No 04 NO. OF SHT. 04

SIZE-A1

400 KV SWITCHYARD AT PANKI THERMAL POWER PROJECT – EXTENSION (1X660MW)

Clarification for & SWITCHYARD CONTROL ROOM BUILDING - ARCHITECTURAL PLAN & ELEVATION

NTPC DWG/DOC NO.:	9962-001-TB-572-PVC-C-121	**BHEL Ref. No.: CLAR/PNK/0024**
BHEL DWG/DOC NO.:	TB-3-607-401-061	**DATE OF SUBMISSION OF REVISED DOCUMENTS**
DWG/DOC NAME:	SWITCHYARD CONTROL ROOM BUILDING - ARCHITECTURAL PLAN & ELEVATION	**30-04-2019**

SL. NO.	Comments From NTPC	BHEL Clarifications.
A	**9962-001-TB-572-PVC-C-121**	
1	Mark coordinate as marked in Electrical Layout..	Cordinate incorporated as per Elec layout on grid F/8 .
2	Indicate column.	Column not required as per structural design.
3	Indicate the type of path	PCC paving
4	of 63 mm down graded aggregates (minimum)	Incorporated
5	Provide reference of drawing wherein detail of plinth protection is provided.	Plinth protection details provided in the above drawing (refer section C-C,sh 03 of 04) .
6	top and bottom	Incorporated

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 3 469 00 02055

REF.DRG.NO.

SIGN.DATE

INVENTORY NO.

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. PAINT SHADE AS PER RAL.7032 (SIEMENS GRAY).
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 0 002055, SHEET 05 OF 06.
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. 03 OF 06.
10. TOLERANCE =±3 ON DIMENSION, WHEREVER NOT SHOWN.

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.
2. TANK IS CONVENTIONAL TYPE DESIGN.

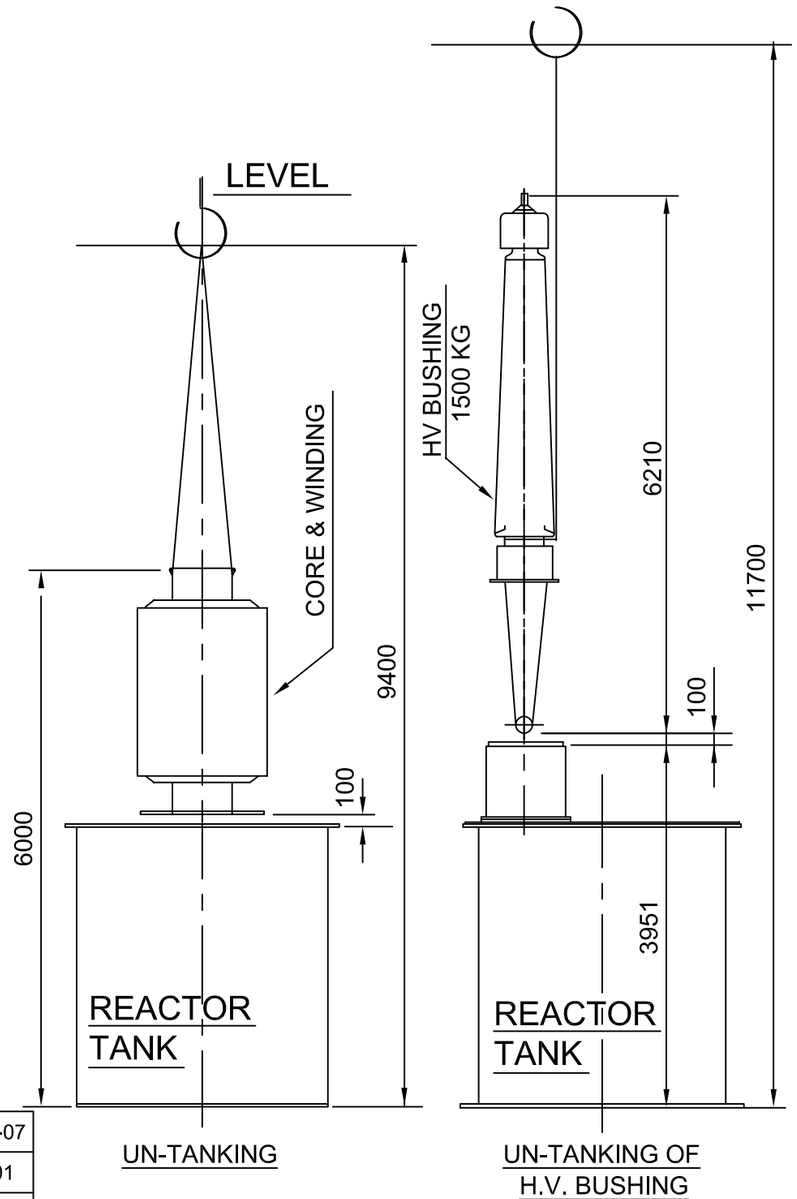
MIN. AIR CLEARANCES (mm)		
	420 KV	145 KV
PHASE TO PHASE	4000	NA
PHASE TO EARTH	3500	1100

TABLE-1 FOR HEADER P/W

SUB ASSY. MK-NO.	MK-01	MK-02	MK-03	MK-04	MK-05	MK-06	MK-07
QTY.	002	001	001	001	001	001	001
IT. NO.	004	005	006	007	008	009	010

TABLE-2 FOR CONSERVATOR P/W

SUB ASSY. MK-NO.	MK-51	MK-52	MK-53	MK-54	MK-55	MK-56	MK-57	MK-58	MK-59	MK-60	MK-61	MK-62	MK-63	MK-64	MK-65	MK-66	MK-67	MK-68
QTY.	001	001	001	001	001	001	001	001	001	002	001	001	001	001	001	001	001	001
IT. NO.	021	022	023	024	025	026	027	028	029	030	031	032	033	034	035	036	037	038



REV		DATE	ALT.			REV		DATE	ALT.			REV		DATE	ALT.			REV		DATE	ALT.		
			CKD.						CKD.						CKD.						CKD.		
			APPD.						APPD.						APPD.						APPD.		
ZONE						ZONE						ZONE						ZONE					

WORK ORDER NO:	66026-A-517-01
TBG DRG NO:	TB-4-316-401-E20A
TYPE OF PRODUCT:	1X80MVAR, 420KV, 3-PHASE, SHUNT REACTOR
LOI NO:	48/PPMM/SE-IV/PANKI EXTN DATED 31.03.2018
STATUS OF DRAWING:	"PR"
DISTRIBUTION OF PRINTS:	TRE-1, TRM-3

NTPC DRG. NO:	9962-001-TB-572-PVE-C-236 REV.00
PROJECT:	1X660MW PANKI THERMAL POWER EXTENSION PROJECT.
OWNER:	UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LTD.
REVIEW CONSULTANT:	NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE)
CONSULTANT:	DEVELOPMENT CONSULTANTS PVT. LTD. KOLKATA
EPC CONTRACTOR:	BHARAT HEAVY ELECTRICALS LTD.

भारत हेवी इलेक्ट्रिकल्स लिमिटेड भोपाल
BHARAT HEAVY ELECTRICALS LTD. BHOPAL

DEPT	CODE	WT(kg)	SCALE
TRE	406	--	1:1

TITLE: OUTLINE GENERAL ARRANGEMENT

	NAME	SIGN	DATE
DRN.	MKP		03.01.2019
CHD.	KD/KA		03.01.2019
APPD.	KD/KA		03.01.2019

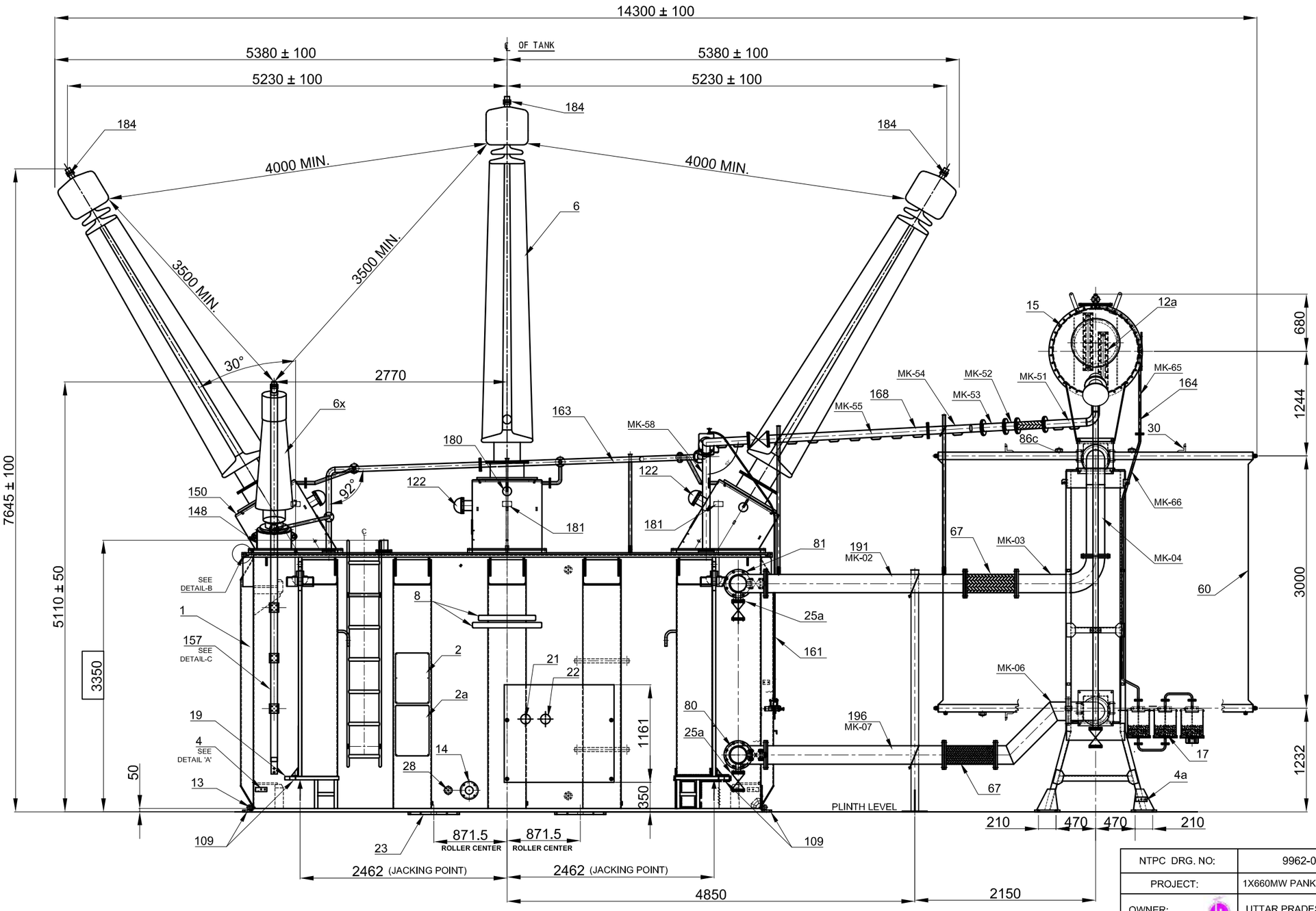
DRG. NO. 3 469 00 02055

SHEET 01 OF 06

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 3 469 00 02055



REV	DATE	ALT.			REV	DATE	ALT.			REV	DATE	ALT.			REV	DATE	ALT.		
		CKD.					CKD.					CKD.					CKD.		
		APPD.					APPD.					APPD.					APPD.		
ZONE					ZONE					ZONE					ZONE				

WORK ORDER NO:	66026-A-517-01
TBG DRG NO:	TB-4-316-401-E20A
TYPE OF PRODUCT:	1X80MVAR, 420KV, 3-PHASE, SHUNT REACTOR
LOI NO:	48/PPMM/SE-IV/PANKI EXTN DATED 31.03.2018
STATUS OF DRAWING:	"PR"
DISTRIBUTION OF PRINTS:	TRE-1, TRM-3

NTPC DRG. NO:	9962-001-TB-572-PVE-C-236		REV.00
PROJECT:	1X660MW PANKI THERMAL POWER EXTENSION PROJECT.		
OWNER:	UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LTD.		
REVIEW CONSULTANT:	NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE)		
CONSULTANT:	DEVELOPMENT CONSULTANTS PVT. LTD. KOLKATA		
EPC CONTRACTOR:	BHARAT HEAVY ELECTRICALS LTD.		

भारत हेवी इलेक्ट्रिकल्स लिमिटेड भोपाल
BHARAT HEAVY ELECTRICALS LTD. BHOPAL

	NAME	SIGN	DATE
DRN.	MKP		03.01.2019
CHD.	KD/KA		03.01.2019
APPD.	KD/KA		03.01.2019

DEPT	CODE	WT(kg)	SCALE
TRE	406	--	1:1

TITLE: OUTLINE GENERAL ARRANGEMENT

DRG. NO. 3 469 00 02055

SHEET 02 OF 06

INVENTORY NO. | SIGN.DATE | REF.DRG.NO.

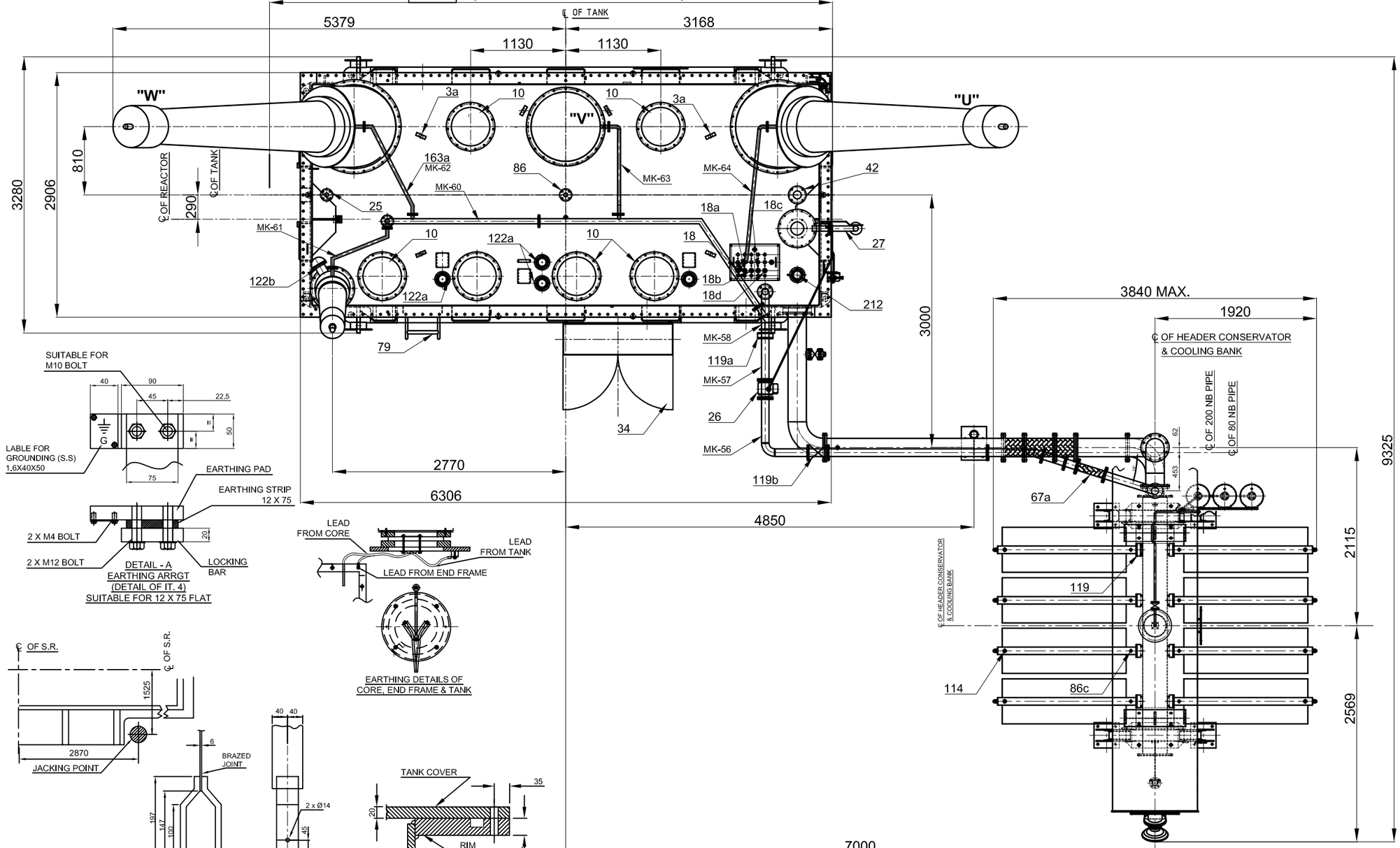
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 3 469 00 02055

INVENTORY NO. | SIGN.DATE | REF.DRG.NO.

6820 (INCLUDING N2 GAS CYL. MTG)



DETAIL - A
EARTHING ARRGT
(DETAIL OF IT. 4)
SUITABLE FOR 12 X 75 FLAT

EARTHING DETAILS OF
CORE, END FRAME & TANK

DETAIL-C
NEUTRAL GROUNDING ARRGT.

DETAIL-'B'

NTPC DRG. NO:	9962-001-TB-572-PVE-C-236	REV.00
PROJECT:	1X660MW PANKI THERMAL POWER EXTENSION PROJECT.	
OWNER:	UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LTD.	
REVIEW CONSULTANT:	NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE)	
CONSULTANT:	DEVELOPMENT CONSULTANTS PVT. LTD. KOLKATA	
EPC CONTRACTOR:	BHARAT HEAVY ELECTRICALS LTD.	

REV	DATE	ALT.			REV	DATE	ALT.			REV	DATE	ALT.			REV	DATE	ALT.		
		CKD.					CKD.					CKD.					CKD.		
		APPD.					APPD.					APPD.					APPD.		
ZONE					ZONE					ZONE					ZONE				

WORK ORDER NO:	66026-A-517-01
TBG DRG NO:	TB-4-316-401-E20A
TYPE OF PRODUCT:	1X80MVAR, 420KV, 3-PHASE, SHUNT REACTOR
LOI NO:	48/PPMM/SE-IV/PANKI EXTN DATED 31.03.2018
STATUS OF DRAWING:	"PR"
DISTRIBUTION OF PRINTS:	TRE-1, TRM-3

भारत हेवी इलेक्टिकल्स लिमिटेड भोपाल
BHARAT HEAVY ELECTRICALS LTD. BHOPAL

	NAME	SIGN	DATE
DRN.	MKP		03.01.2019
CHD.	KD/KA		03.01.2019
APPD.	KD/KA		03.01.2019

DEPT	CODE	WT(kg)	SCALE
TRE	406	--	1:1

TITLE
OUTLINE GENERAL ARRANGEMENT

DRG. NO. 3 469 00 02055

SHEET 03 OF 06

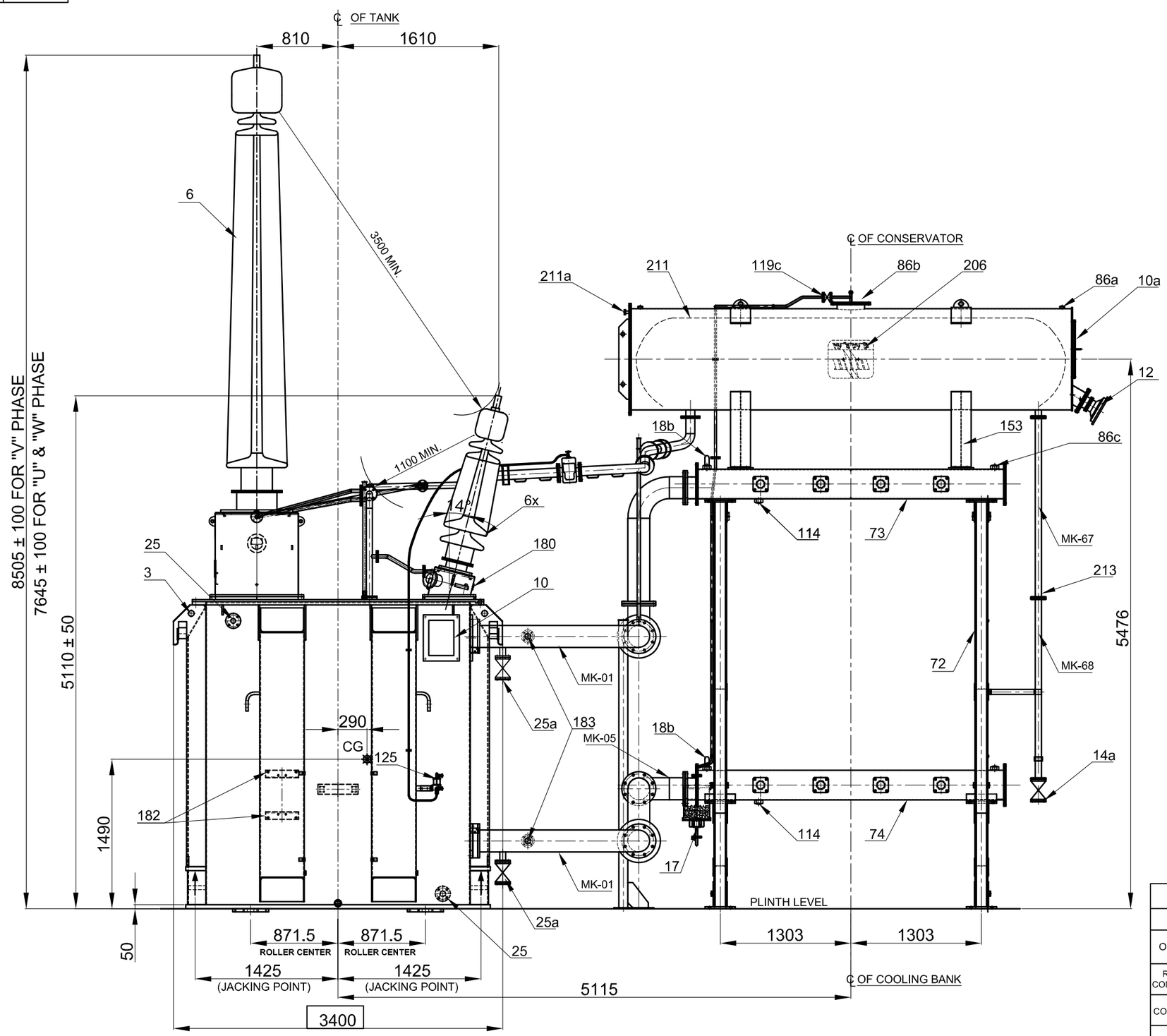
301 302 303 304 305 306 307 308

A B C D E F

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 3 469 00 02055



NTPC DRG. NO:	9962-001-TB-572-PVE-C-236	REV.00
PROJECT:	1X660MW PANKI THERMAL POWER EXTENSION PROJECT.	
OWNER:	UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LTD.	
REVIEW CONSULTANT:	NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE)	
CONSULTANT:	DEVELOPMENT CONSULTANTS PVT. LTD. KOLKATA	
EPC CONTRACTOR:	BHARAT HEAVY ELECTRICALS LTD.	

REV	DATE	ALT.																	
		CKD.					CKD.					CKD.					CKD.		
		APPD.					APPD.					APPD.					APPD.		
ZONE					ZONE					ZONE					ZONE				

WORK ORDER NO:	66026-A-517-01
TBG DRG NO:	TB-4-316-401-E20A
TYPE OF PRODUCT:	1X80MVAR, 420KV, 3-PHASE, SHUNT REACTOR
LOI NO:	48/PPMM/SE-IV/PANKI EXTN DATED 31.03.2018
STATUS OF DRAWING:	"PR"
DISTRIBUTION OF PRINTS:	TRE-1, TRM-3

भारत हेवी इलेक्टिकल्स लिमिटेड भोपाल
BHARAT HEAVY ELECTRICALS LTD. BHOPAL

	NAME	SIGN	DATE
DRN.	MKP		03.01.2019
CHD.	KD/KA		03.01.2019
APPD.	KD/KA		03.01.2019

DEPT	CODE	WT(kg)	SCALE
TRE	406	--	1:1

TITLE
OUTLINE GENERAL ARRANGEMENT

DRG. NO. 3 469 00 02055

SHEET 04 OF 06

INVENTORY NO. | SIGN.DATE | REF.DRG.NO.

401 | 402 | 403 | 404 | 405 | 406 | 407 | 408

A | B | C | D | E | F

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 3 469 00 02055

REF.DRG.NO.

SIGN.DATE

INVENTORY NO.

TABLE OF FITTINGS

COOLING SYSTEM

ITEM NO	DESCRIPTION	QTY	ZONE
4a	EARTHING TERMINAL (20 TK X 50 X 110 LG). (FOR RADIATOR & IT'S SUPPORT)	2 NOS. EACH	207-B
25a	DRAIN/FILTER VALVE (50 NB GATE) FOR COOLING SYSTEM	2	205-C
30	LIFTING LUGS FOR RADIATORS (LIFTING CAPACITY 800 KG EACH)	16	207-D
60	RADIATOR BANK (NO OF WORKING UNITS = 7 + EXTRA UNIT=1)	1	207-C
67	FLEXIBLE HOSE PIPE (200 NB) (TOP & BOTTOM) STAINLESS STEEL	2	206-C
72	"A" FRAME SUPPORTS (BEARING CAPACITY = 30 TONNES)	2	406-C
73	TOP HEADER	1	406-D
74	BOTTOM HEADER	1	406-B
86c	AIR RELEASE PLUGS (3/4"BSP) 8 NOS FOR RADITORS 2 NOS FOR TOP & BOTTOM HEADER	10	306-B 407-D
114	DRAIN PLUG (3/4"BSP) 8 NOS FOR RADITORS 2 NOS FOR TOP & BOTTOM HEADER	10	306-B 405-B
119	ISOLATING VALVES FOR RADIATORS (80 NB BUTTERFLY)	16	306-C
161	GAS COLLECTING DEVICE PIPE (6 NB)	1	205-C
163	EQUALISING PIPE (50NB)	1	204-D
163a	EQUALISING PIPE (25NB) FOR TURRETS	4	303-E
183	40NB GUN METAL VALVE FOR ON LINE GAS MONTG. SYSTEM (PROVISION).	2	404-C
191	TOP OIL PIPE 200 NB (RADIATOR BANK)	1	206-C
196	BOTTOM OIL PIPE 200 NB (RADIATOR BANK)	1	206-B

CONSERVATOR & PIPE WORK

10a	INSPECTION COVER FOR OIL CONSERVATOR (BOLTED) 20 KG	1	407-E
12	OIL GAUGE MAGNETIC TYPE WITH LOLA	1	407-D
12a	PRISMATIC OIL GAUGE	1	207-E
14a	50 NB DRAIN GATE VALVE FOR OIL CONSERVATOR	1	407-C
15	OIL CONSERVATOR 1000 DIA (ATMOSEAL TYPE)	1	207-E
17	DEHYDRATING BREATHER WITH SILICAGEL (3 IN SERIES)	1	208-B
26	BUCHHOLZ RELAY (80 NB)	1	305-D
67a	FLEXIBLE HOSE PIPE (80 NB)	1	306-C
86a	AIR RELEASE PLUG (3/4"BSP) ON CONSERVATOR	2	407-E
86b	AIR RELEASE PLUG (1/4"BSP) FOR CONSERVATOR.	1	406-E
119a	ISOLATING VALVE BUTTERELY FOR BUCHHOLZ RELAY(80 NB)	1	305-D
119b	ISOLATING VALVE GATE FOR BUCHHOLZ RELAY(80 NB)	1	305-D
119c	15 NB GATE VALVE FOR BREATHER	1	405-E
125	GAS COLLECTING DEVICE	1	403-C
153	CONSERVATOR SUPPORTS	2	406-D
164	BREATHER PIPE (15 NB)	1	207-D
168	CONSERVATOR PIPE (80 NB)	1	206-D
206	BHEL MONOGRAM	1	406-E
211	ATMOSEAL ARRANGEMENT (INSIDE THE CONSERVATOR)	1	405-E
211a	AIRCELL RUPTURE RELAY	1	404-E
213	CONSERVATOR DRAIN PIPE (50 NB)	1	407-C

TABLE OF FITTINGS

REACTOR TANK

ITEM NO	DESCRIPTION	QTY	ZONE
1	TRANSFORMER TANK -CONVENTIONAL TYPE	1	202-C
2	RATING AND DIAGRAM PLATE	1	203-C
2a	DO'S & DONT'S INSTRUCTION PLATE	1	203-C
3	LIFTING LUGS (60000 KG. EACH)	4	402-C
3a	LIFTING LUGS FOR TANK COVER	6	303-F
4	EARTHING TERMINAL DIAGONALLY OPPOSITE (SIZE 20 TK X 50 X 120 LG.) STAINLESS STEEL	2	202-B
8	NAME PLATES (ENGLISH & HINDI)	1+1	203-C
10	INSPECTION COVERS (25 Kgs EACH) 6 NOS. ON TANK COVER 1 NO. ON TANK	6+1	303-F 404-C
13	DRAIN PLUGS ON TANK 1"BSP	2	202-B
14	100 NB DRAIN GATE VALVE	1	203-B
18	POCKET FOR OTI	1	304-E
18a	POCKET FOR WTI	1	304-E
18b	ORDINARY THERMOMETER WITH POCKET 1 NO ON TANK COVER 2 NO ON HEADER	2+1	304-E
18c	RTD POCKET FOR OTI	1	305-E
18d	RTD POCKET FOR WTI	1	304-E
19	JACKING PADS 60000 KG EACH	4	202-B
21	OIL TEMPERATURE INDICATOR	1	203-C
22	WINDING TEMPERATURE INDICATOR DIAL TYPE WITH REPEATER	1	203-C
23	MOUNTING PAD FOR 320 DIA TWIN BI-DIRECTIONAL ROLLERS ROLLERS ONLY FOR REACTOR MOVEMENT AT SITE.	4	203-B
25	50 NB GATE VALVE (FILTER VALVE, TOP & BOTTOM DIAGONALLY OPPOSITE) ON TANK AND COVER [2NOS ON TANK 1NO ON COVER]	2+1	402-D 303-E
27	PRESSURE RELIEF DEVICE WITH OIL COLLECTOR ASSY. AND PIPE DISCHARGE ARRANGEMENT.	1	305-E
28	15 NB GATE VALVE FOR OIL SAMPLING 2 IN SERIES	2	203-B
34	COOLER CONTROL CABINET (GROUND MOUNTED)	1	304-D
42	VALVE FOR CONNECTION TO VACUUM PUMP(100 NB BUTTERFLY)	1	305-E
79	LADDER WITH LOCKING DEVICE	1	303-D
80	BUTTERFLY VALVE (200 NB) AT INLET.	1	205-B
81	BUTTERFLY VALVE (200 NB) AT OUTLET.	1	205-C
86	AIR RELEASE PLUG 1/2"BSP.	1	303-E
109	PULLING HOLE DIA 64 /HAULAGE LUGS	8	205-B
182	PAD FOR ONLINE GAS MONITORING SYSTEM	1	402-B
212	COVER EARTHING OF CORE AND CORE CLAMPS.	1	305-E

TURRETS & BUSHINGS

6	HV LINE BUSHINGS 420 KV 1250A	3	204-E
6X	HV NEUTRAL BUSHING 145 KV 1250A	1	203-D
122	CONNECTION BOX FOR C T TERMINAL (HV)	3	203-D
122a	CONNECTION BOX FOR C T TERMINAL (HVN) ON COVER	4	303-E
122b	CONNECTION BOX FOR C T TERMINAL (HVN)	1	302-E
148	NEUTRAL TURRET	1	202-D
150	HV TURRETS	3	202-D
157	NEUTRAL GROUNDING ARRNGEMENT	1 SET	202-C
180	TERMINAL MARKING PLATE	4	203-D
181	CT TERMINAL MARKING PLATE	4	204-C
184	HV TERMINAL CONNECTOR	3	202-F

APPROXIMATE WEIGHT & OIL QTY.

DESCRIPTION	WT. IN KG	OIL (L)
CORE AND WINDING	63360	
TANK & FITTINGS	18025	37390
BUSHINGS	4700	
RADIATOR BANK, CONSERVATOR & PIPE WORK	10595	4820
CONTROL CABINET	310	
TOTAL OIL	36720	42210
TOTAL WEIGHT	133710	

NOTES:-

1. 4 NOS. 60 T EACH JACKS SHALL BE SUPPLIED FOR EACH SITE AS THERE ARE ONLY 4 JACKING PADS ARE AVAILABLE FOR LIFTING OF REACTOR.

REV	DATE	ALT.			REV	DATE	ALT.			REV	DATE	ALT.			REV	DATE	ALT.		
		CKD.					CKD.					CKD.					CKD.		
		APPD.					APPD.					APPD.					APPD.		
ZONE					ZONE					ZONE					ZONE				

WORK ORDER NO:	66026-A-517-01
TBG DRG NO:	TB-4-316-401-E20A
TYPE OF PRODUCT:	1X80MVAR, 420KV, 3-PHASE, SHUNT REACTOR
LOI NO:	48/PPMM/SE-IV/PANKI EXTN DATED 31.03.2018
STATUS OF DRAWING:	"PR"
DISTRIBUTION OF PRINTS:	TRE-1, TRM-3

NTPC DRG. NO:	9962-001-TB-572-PVE-C-236 REV.00
PROJECT:	1X660MW PANKI THERMAL POWER EXTENSION PROJECT.
OWNER:	UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LTD.
REVIEW CONSULTANT:	NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE)
CONSULTANT:	DEVELOPMENT CONSULTANTS PVT. LTD. KOLKATA
EPC CONTRACTOR:	BHARAT HEAVY ELECTRICALS LTD.

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BHARAT HEAVY ELECTRICALS LTD. BHOPAL

DEPT	CODE	WT(kg)	SCALE
TRE	406	--	1:1

TITLE: PART LIST

	NAME	SIGN	DATE
DRN.	MKP		03.01.2019
CHD.	KD/KA		03.01.2019
APPD.	KD/KA		03.01.2019

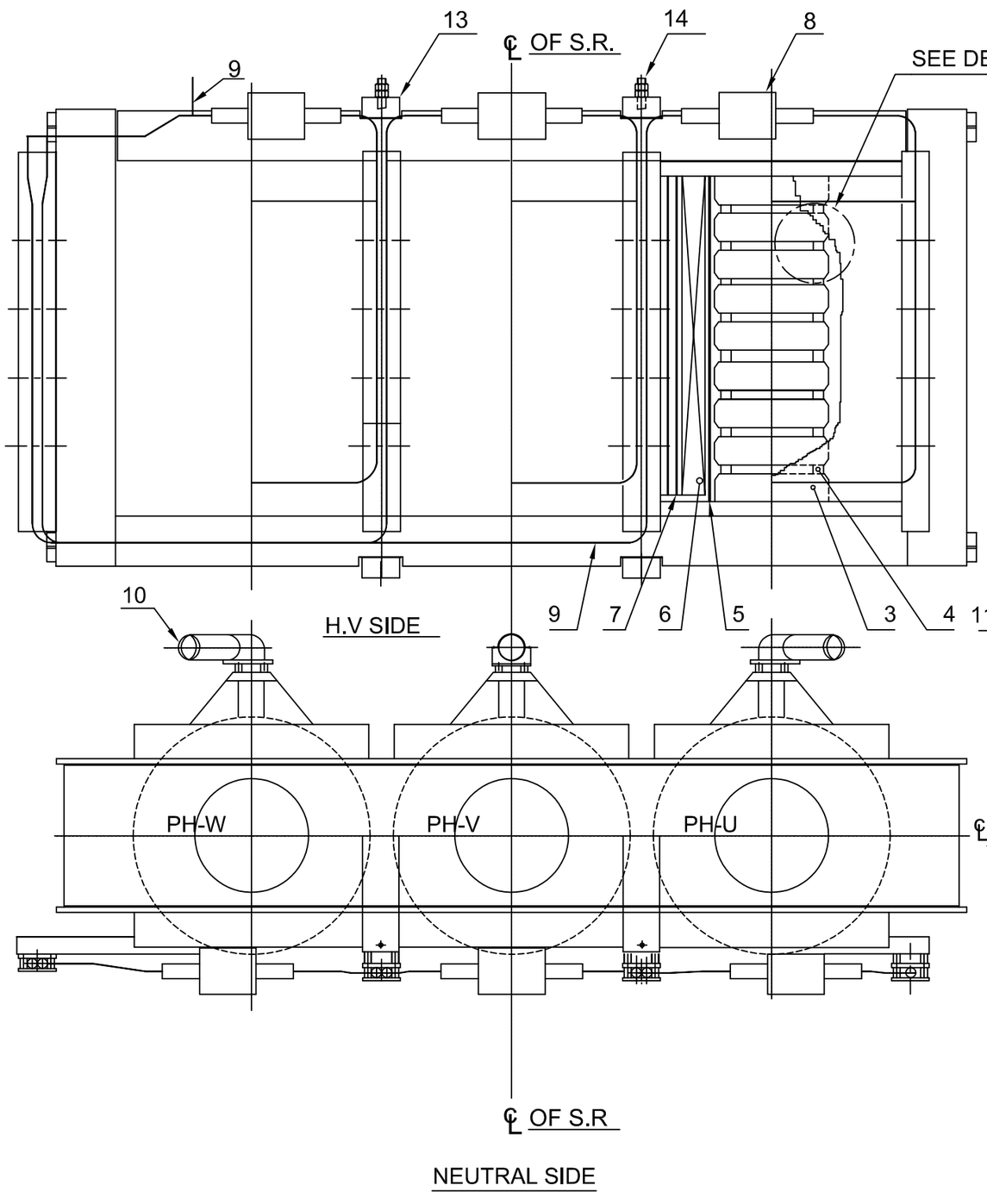
DRG. NO. 3 469 00 02055

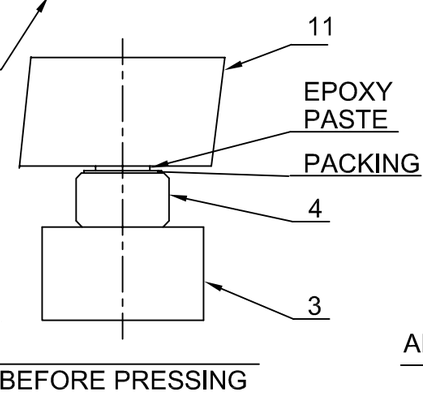
SHEET 05 OF 06

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 3 469 00 02055





DETAIL-A

LEGEND

SL. NOS.	DESCRIPTIONS
1	CORE
2	CORE CLAMP PLATE
3	CORE PACKETS
4	CERAMIC SPACER
5	INSULATING CYL FOR CORE
6	WINDINGS
7	INSULATING CYLINDERS
8	CT FOR NEUTRAL END
9	NEUTRAL LEADS
10	H.V.LEADS
11	WINDING PRESS PLATE
12	TRANSPORT SUPPORTS
13	CROSS BEAMS
14	TIE RODS

REV	DATE	ALT.			REV	DATE	ALT.			REV	DATE	ALT.			REV	DATE	ALT.		
		CKD.					CKD.					CKD.					CKD.		
		APPD.					APPD.					APPD.					APPD.		
ZONE					ZONE					ZONE					ZONE				

WORK ORDER NO:	66026-A-517-01
TBG DRG NO:	TB-4-316-401-E20A
TYPE OF PRODUCT:	1X80MVAR, 420KV, 3-PHASE, SHUNT REACTOR
LOI NO:	48/PPMM/SE-IV/PANKI EXTN DATED 31.03.2018
STATUS OF DRAWING:	"PR"
DISTRIBUTION OF PRINTS:	TRE-1, TRM-3

NTPC DRG. NO:	9962-001-TB-572-PVE-C-236		REV.00
PROJECT:	1X660MW PANKI THERMAL POWER EXTENSION PROJECT.		
OWNER:	UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LTD.		
REVIEW CONSULTANT:	NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE)		
CONSULTANT:	DEVELOPMENT CONSULTANTS PVT. LTD. KOLKATA		
EPC CONTRACTOR:	BHARAT HEAVY ELECTRICALS LTD.		

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भोपाल
BHARAT HEAVY ELECTRICALS LTD.
BHOPAL

DEPT	CODE	WT(kg)	SCALE
TRE	406	--	1:1

TITLE: INTERNAL SKETCH

	NAME	SIGN	DATE
DRN.	MKP		03.01.2019
CHD.	KD/KA		03.01.2019
APPD.	KD/KA		03.01.2019

DRG. NO. 3 469 00 02055

SHEET 06 OF 06

REF.DRG.NO.

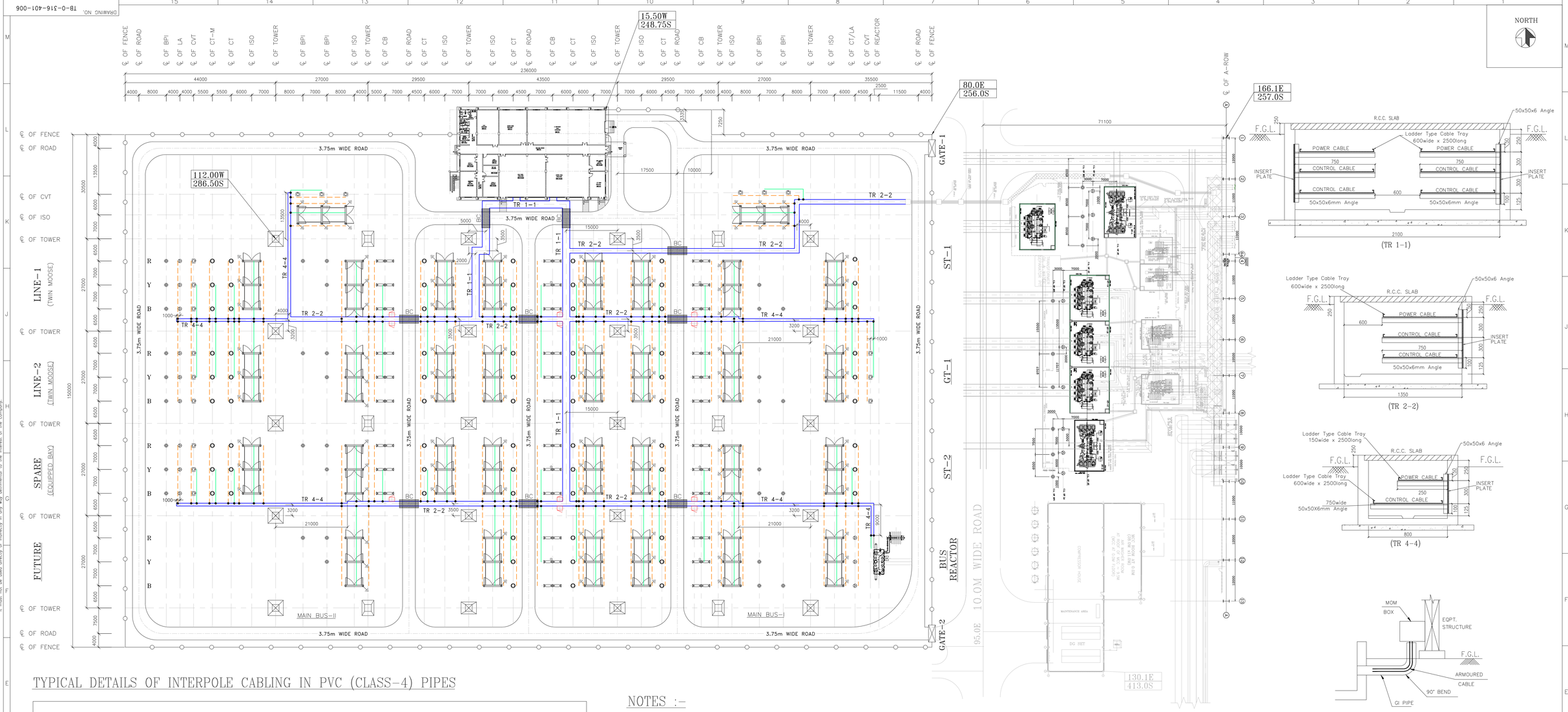
SIGN.DATE

INVENTORY NO.

DRAWING NO. TB-0-316-401-006

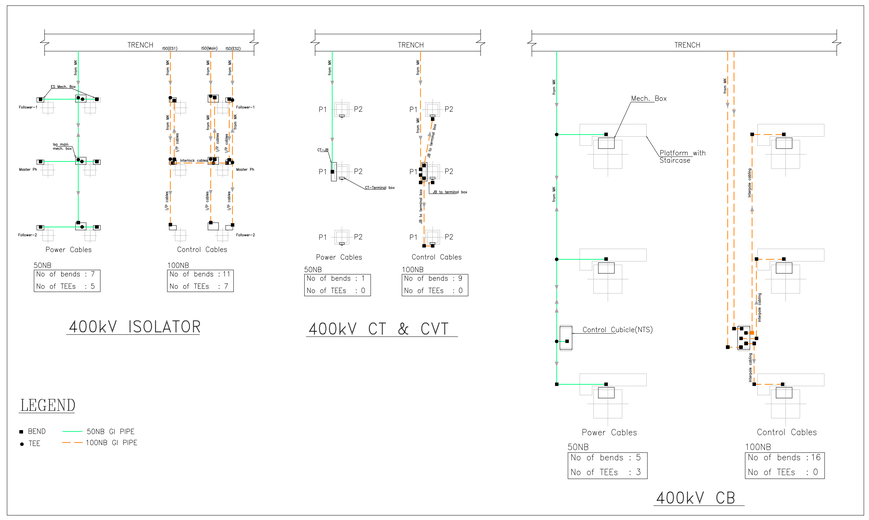
FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM



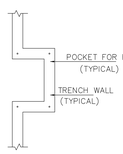
ROUTING OF CABLE INSIDE
PVC PIPE/ CABLE TRENCH TO EQUIPMENT

TYPICAL DETAILS OF INTERPOLE CABLING IN PVC (CLASS-4) PIPES



NOTES :-

1. ALL DIMENSIONS ARE IN mm.
2. THE LOCATION OF CABLE TRENCHES MARKED IN THIS DWG. MAY BE SLIGHTLY MODIFIED TO SUIT SITE CONDITIONS.
3. OPENINGS FOR TAKING OUT PVC PIPES TO EQUIPMENTS SHALL BE PROVIDED IN CABLE TRENCHES. OPENING OF SIZE SUITABLE TO DIA. 50/100 PIPE SHALL BE PROVIDED BELOW TOP CABLE SUPPORT.
4. MK = INDICATES MARSHALLING KIOSK.
5. CABLE ENTRY/EXIT FROM TRENCH IS INDICATED AS
6. MK SHALL BE PLACED IN THE LOCATION SHOWN. EXACT COORDINATES TO BE SUITABLY DECIDED AT SITE.
7. PULL BOXES (400x400x400) SHALL BE USED AT THE FREE END TURNING AND @15M IF PIPE LENGTH EXCEEDS 15M.
8. INSERTS SHALL BE EMBEDDED AT EVERY 1.5M INTERVAL FOR CABLE TRAY SUPPORTS IN OUTDOOR CABLE TRENCH.
9. 1.1kV CONTROL CABLE SHALL BE PLACED IN MULTILAYER ON TRAYS SUPPORTED BY GI CABLE RACK SUPPORT (ANGLE).
10. CABLE SUPPORT FOR OUTDOOR TRENCHES SHALL BE PROVIDED AT EVERY 1500mm INTERVAL.
11. AUXILIARY POWER CABLES SHALL BE LAID IN TOP TIERS AND CONTROL CABLES IN BOTTOM TIERS,
12. FIBER OPTIC CABLE (IF PROVIDED) SHALL BE LAID IN HDPE PIPE AND SAME SHALL BE ROUTED THROUGH BOTTOM OF CABLE TRENCH.
13. CABLES FOR LIGHTING PURPOSE SHALL BE LAID IN PVC PIPE/ TRENCH. SEPARATE DRAWING SHALL BE SUBMITTED FOR LIGHTING SYSTEM.
14. LOCATION OF CABLE TRENCHES INSIDE CONTROL ROOM SHALL BE SHOWN IN SEPARATE DRAWING.
15. EARTH CONDUCTOR 50X6 GI FLAT TO BE WELDED IN VERTICAL ON THE CABLE SUPPORT BEFORE INSTALLATION OF CABLES.
16. FOR POWER & CONTROL CABLES, SEPARATE PIPES SHALL BE USED CONSIDERING 60% VOID FOR EACH PIPE I.E., 40% FILLING CRITERIA.
17. ALL OTHER DETAILS PERTAINING TO CIVIL WORKS SHALL BE REFLECTED IN THE RESPECTIVE CIVIL DRAWINGS.
18. PVC PIPES SHALL BE SECURELY FIXED AT BOTH ENDS.
19. AFTER LAYING THE CABLES THE ENDS OF PIPES SHALL BE FULLY SEALED TO PREVENT INGRESS OF WATER INSIDE THE PIPE.
20. THE PURPOSE OF TRENCH LAYOUT DRAWING IS FOR USE AS FOLLOWS: – TO BE USED AS CIVIL INPUT FOR CABLE TRENCHES. – FOR ERECTION OF CABLE RACKS & TRAYS AT SITE. – FOR CABLE LAYING AND ROUTING AT SITE.
21. THE CABLE OF CT /CVT BETWEEN SECONDARY TERMINAL BOX AND JUNCTION BOX SHALL BE LAID IN 100/50MM GI PIPE.
22. INDICATE BOX CULVERT. CABLES CROSSING ROAD SHALL BE LAID IN BOX CULVERT.
23. PROPER PLANNING SHALL BE MADE AT SITE SUCH THAT THE LA & PI FOUNDATION IN TRANSFORMER. YARD AREA SHALL BE CAST BEFORE CONSTRUCTION OF OIL PIT OF GT & ST.
24. ORIENTATION OF FOUNDATION SHALL BE VERIFIED WITH RESPECT TO LAYOUT BEFORE CONSTRUCTION.
25. IN CASE OF BURIED CABLES, CABLE ROUTE MARKERS SHALL BE PROVIDED AT EVERY 15 MTR. INTERVAL AND AT BENDS.



MK FIXING DETAIL ON TRENCH
A & B DIMENSIONS ARE AS PER MK DRAWING.
X-TRENCH WALL THICKNESS.

REFERENCE DWG :-

DWG. NO.	TITLE
9962-001-TB-572-PVE-F-184	ELECTRICAL LAYOUT PLAN & SECTIONAL ELEVATION OF 400kV SWITCHYARD
9962-001-PE-999-POC-F-001	PLOT PLAN

NTPC DRG. No.	9962-001-TB-572-PVE-F-190 REV. 00
PROJECT:	PANKI THERMAL POWER STATION (1X660MW)
OWNER:	UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LTD.
REVIEW CONSULTANT:	NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE)
CONSULTANT:	DEVELOPMENT CONSULTANTS PVT. LTD. KOLKATA
EPC CONTRACTOR:	BHARAT HEAVY ELECTRICALS LTD.
JOB NO.	
STATUS	
DISTRIBUTION	

BHARAT HEAVY ELECTRICALS LTD
TRANSMISSION BUSINESS GROUP
NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DRN	PK		26.03.19
	DESN	AK		16.04.19
	CHD	VK		19.04.19
	APPD	MK		19.04.19

TITLE: CABLE TRENCH LAYOUT OF 400kV SWITCHYARD (ELECTRICAL)

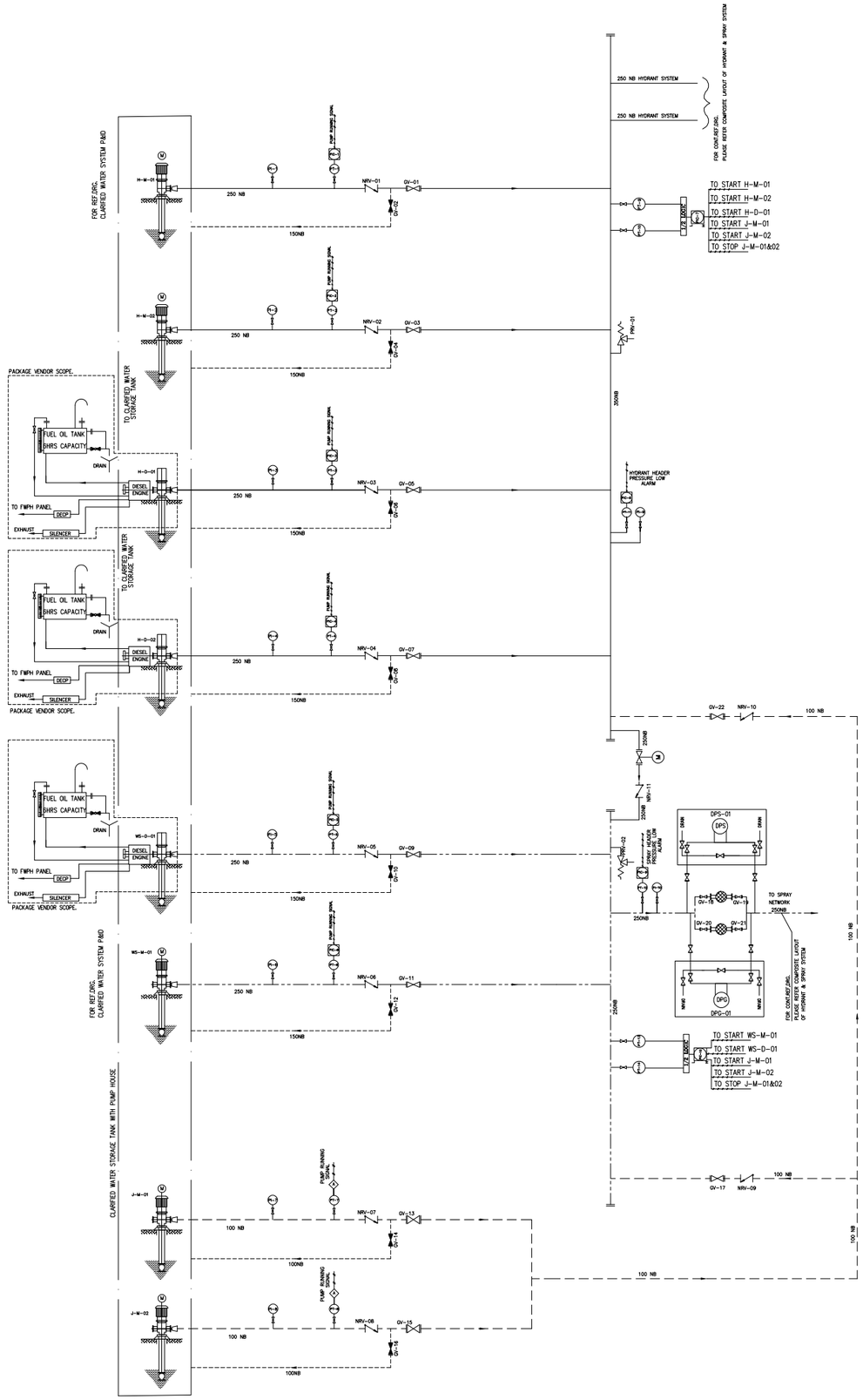
DEPT. SCALE 1: 100 DRAWING NO. TB-0-316-401-006
SIGN SHEET 01 OF 01 REV. 00

SIZE-A0

REV.	DATE	ALTD	CHD	APPD

ELECTRONIC FILE NAME:

DRAWING NO. PYDP1M101866102



TABLE–1

PRESSURE TRANSMITTER SCHEDULE FOR MAIN PUMPS & JOCKEY PUMPS

Sr. No.	PUMP TAG No.	START SIGNAL		STOP SIGNAL		PUMP RUNNING		PUMP FAILS TO START	
		Pr. TRANSMITTER SETTING TAG No.	Kg/cm²(g)	Pr. TRANSMITTER SETTING TAG No.	Kg/cm (g)	Pr. TRANSMITTER SETTING TAG No.	Kg/cm²(g)	Pr. TRANSMITTER SETTING TAG No.	Kg/cm²(g)
1	H–M–01	Avg.of 2 Readings (PT–9 PT–10	10.0	––	––	PT–1	3.0	Avg.of 2 Readings (PT–9 PT–10	10.0
2	H–M–02	Avg.of 2 Readings (PT–9 PT–10	9.0	––	––	PT–2	3.0	Avg.of 2 Readings (PT–9 PT–10	9.0
3	H–D–01	Avg.of 2 Readings (PT–9 PT–10	8.0	––	––	PT–3	3.0	Avg.of 2 Readings (PT–9 PT–10	8.0
4	H–D–02	Avg.of 2 Readings (PT–9 PT–10	7.0	––	––	PT–4	3.0	Avg.of 2 Readings (PT–9 PT–10	7.0
5	WS–M–01	Avg.of 2 Readings (PT–13 PT–14	10.0	––	––	PT–5	3.0	Avg.of 2 Readings (PT–13 PT–14	10.0
6	WS–D–01	Avg.of 2 Readings (PT–13 PT–14	9.0	––	––	PT–6	3.0	Avg.of 2 Readings (PT–13 PT–14	9.0
7	JP–M–01	PT–9 = PT–10 = PT–13 = PT–14	11.0	––	––	PT–7	3.0	PT–9 = PT–10 = PT–13 = PT–14	11.0
8	JP–M–02	PT–9 = PT–10 = PT–13 = PT–14	10.5	––	––	PT–8	3.0	PT–9 = PT–10 = PT–13 = PT–14	10.5
9	JP–M–01 JP–M–02	––	––	PT–9 = PT–10 = PT–13 = PT–14	11.5	PT–7 PT–8	––	––	––

The Fail to Start Annunciation for Fire Pumps is derived from Pressure TRANSMITTER placed on common PUMP delivery header with a Suitable Time Delay and for Jockey Pumps is derived from PressureTRANSMITTER on upstream of NRV with a Suitable Time Delay.

LEGEND:

SR NO.	SYMBOLS	DESCRIPTION
1		SPRAY SYSTEM LINE
2		HYDRANT SYSTEM LINE
3		RECIRCULATION LINE
4		GATE VALVE
5		GATE VALVE (NORMALLY CLOSED)
6		NON RETURN VALVE
7		GLOBE VALVE NORMALLY OPEN
8	PI	PRESSURE INDICATOR
9	PT	PRESSURE TRANSMITTER
10		PRESSURE RELEASE VALVE
11	CAP	CONTROL ANNUNCIATION PANEL
12		BASKET STRIANER
13	DPS	DIFFERRENTIAL PRESSURE SWITCH
14		LEVEL INDICATOR
15	PID	CONTROL / INTERLOCK

SCHEDULE OF INSTRUMENTS

SL. NO.	TYPE OF INSTRUMENTS	DESCRIPTION	QTY
1	PRESSURE TRANSMITTER (PT)	PT–01 TO PT–14	14
2	PRESSURE INDICATOR (PI)	PI–01 TO PI–10	10
3	DIFFERENTIAL PRESSURE SWITCH (DPS)	DPS–01	01
4	DIFFERENTIAL PRESSURE GUAGE (DPG)	DPG–01	01
5	PRESSRE RELIEF VALVE (PRV)	PRV–01 TO PRV–02	02

EQUIPMENT DATA

SL. NO.	NOTATION	EQUIPMENT DESCRIPTION	QTY	CAPACITY (M^3/Hr)	HEAD (TDH)
1	H–M–01	MOTOR DRIVEN HYDRANT MAIN PUMP# 01	01	410	115
2	H–M–02	MOTOR DRIVEN HYDRANT MAIN PUMP# 02	01	410	115
3	H–D–01	DIESEL ENGINE HYDRANT STANDBY PUMP# 01	01	410	115
4	H–D–02	DIESEL ENGINE HYDRANT STANDBY PUMP# 02	01	410	115
5	WS–D–01	DIESEL ENGINE SPRAY STANDBY PUMP# 01	01	410	115
6	WS–M–01	MOTOR DRIVEN SPRAY MAIN PUMP# 01	01	410	115
7	J–M–01	MOTOR DRIVEN JOCKEY MAIN PUMP# 01	01	40	120
8	J–M–02	MOTOR DRIVEN JOCKEY STANDBY PUMP	01	40	120

EQUIPMENT DATA

SL. NO.	DESCRIPTION	CAPACITY (M^3/Hr)	NO. OF PUMPS	VELOCITY	DIA.	EQUI. DIA.
1	OUTLET PIPE OF EACH HYDANT PUMP	410	01	2.5	240.90	250
2	OUTLET PIPE OF EACH SPRAY PUMP	410	01	2.5	240.90	250
3	OUTLET PIPE OF EACH JOCKEY PUMP	40	01	2.1	82.10	100
4	COMMON DELIVERY HYDRANT HEADER	410	02	2.5	340.68	350
5	COMMON DELIVERY SPRAY HEADER	410	01	2.5	240.90	250

NOTE:

1. ALL PUMPS SHALL HAVE MANUAL STARTING IN ADDITION TO AUTO START
2. SUBSEQUENT PUMPS SHALL START AFTER A TIME DELAY OF 10 SEC UPON INITIATING SIGNAL FROM RESPECTIVE PRESSURE TRANSMITTER
3. MAIN PUMP SHALL BE STOPPED BY MANUAL OPERATION ONLY
4. EXHAUST OF ENGINES SHALL BE ROUTED AT SAFE ELEVATIONS OUTSIDE THE PUMP HOUSE

NTPC DRG. No. 9962–001–ES–151–PVM–L–002 REV. 00

PROJECT: 1 X 660MW PANKI THERMAL POWER EXTENSION PROJECT.

OWNER: UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LTD.

REVIEW CONSULTANT: एन टी पी सी NTPC — NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE)

CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD. KOLKATA

EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD.

JOB NO.
STATUS
DISTRIBUTION

REV.	DATE	ALTD	CHD	APPD

BHARAT HEAVY ELECTRICALS LTD
PROJECT ENGINEERING & SYSTEMS DIVISION
RC PURAM, HYDERABAD

DEPT CODE		NAME	SIGN	DATE
M	DRN	HARISH	–sd–	11.05.19
	DESN	HARISH	–sd–	11.05.19
	CHD	KAMALUDDIN	–sd–	11.05.19
	APPD	PCS	–sd–	11.05.19

TITLE: P&ID OF FIRE WATER PUMPING SYSTEM

DEPT. | SCALE | SIGN | DRAWING NO. PYDP1M101866102 | SHEET 01 OF 01 | REV. 00 | SIZE–A0

ELECTRONIC FILE NAME: