

	TITLE: 1x800 MW WANAKBORI STPP TECHNICAL SPECIFICATION FOR PRE TREATMENT PLANT	SPEC NO: PE-TS-408-158-A001	
		VOLUME: II-B	
		SECTION: D1	
		REV NO: 00	DATE:

SECTION-D1

(GENERAL TECHNICAL REQUIREMENT FOR MECHANICAL)

BHEL – PS - PPEI: NOIDA, SECTOR-16A, U.P. – 201301

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1.0 INTRODUCTION:

1.1 **The purpose of the system is to reduce the suspended solids in Raw Water for use in different areas of 1 x 800 MW, WANAKBORI TPS under the scope of BHEL.**

2.0 SYSTEM DESCRIPTION PRE-TREATMENT PLANT (Ref. Drg. no. PE-DG-408-158- A001):

Pre Treatment Plant (PTP) shall receive raw water as per the analysis given in **TABLE – 1**.

PTP shall mainly consist of equipment such as stilling chamber, parshall flume, clarifiers (High Rate Solid Contact Type, HRSCC), alum dosing system, Lime Dosing System, polyelectrolyte dosing system, Chlorine Dosing system (Not in PTP supplier scope, shall be provided by BHEL), sludge sumps and pumps, sludge transfer system to AHP.

The major technical parameters of this equipment are listed in Data Sheet-A. The capacity of PT Plant is 1900 cum/Hr at clarifier outlet.

The stream has one number inlet (regulating) valve to regulate inlet flow entering the stilling chamber. Water from the stilling chamber where Chlorine @ 5 ppm is dosed is passed through parshall flume. The flow after parshall flume goes to a distribution chamber to clarifier (HRSCC) where Alum @ 70 ppm**, Lime @35 ppm** and Coagulant aid (Polyelectrolyte) @1 ppm** may also be dosed if necessary. The sludge from the clarifier collected by gravity into a sludge sump. From the sludge sump the sludge is pumped to AHP. One number telescopic type continuous bleed and intermittent bleed through valve on sludge line from clarifier to sludge sump shall be provided.

A chemical house is located near the clarifiers with Alum, Lime, polyelectrolyte dosing systems and Raw Water Chlorination plant (Not in PTP supplier scope, shall be provided by BHEL), PLC room and MCC room (if applicable, shall be decided later). The solution preparation tanks, PLC are on the first floor and space for storage of chemicals and MCC room are on the ground floor.

The clarified water shall be stored in the clarified water storage tank for various uses in the power plant.

**** Note: Final dosing rate shall be decided during detailed engineering. The indicated dosing rate as minimum is only for equipment sizing only.**

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SECTION-D2

(GENERAL TECHNICAL REQUIREMENT FOR ELECTRICAL)

- 1.1 GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS (NO OF SHEET=5)
- 1.2 CABLE SCHEDULE FORMAT AND CABLE DETAILS (NO OF SHEET=24)

BHEL – PS - PPEI: NOIDA, SECTOR-16A, U.P. – 201301

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101 VOLUME NO. : II-B REV NO. : 00 DATE : 29/08/2005 SHEET : 1 OF 1
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GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
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1.0

INTENT OF SPECIFIATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer’s work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0

CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325	Three phase Induction motors
IS : 900	Code of practice for installation and maintenance of induction motors
IS: 996	Single phase small AC and universal motors
IS: 4722	Rotating Electrical machines
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728	Terminal marking and direction of rotation rotating electrical machines
IS: 1231	Dimensions of three phase foot mounted induction motors
IS: 8789	Values of performance characteristics for three phase induction motors
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148	Flame proof enclosures for electrical appliance
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 12824	Type of duty and classes of rating assigned
IS: 12802	Temperature rise measurement for rotating electrical machnines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechanical vibration of rotating electrical machines

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0

DESIGN REQUIREMENTS

3.1

Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2

Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3

Starting Requirements

3.3.1

Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.3.2

Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

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The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.		
3.3.3 The following frequency of starts shall apply i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature. ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour) iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for minimum 20,000 starts during the life time of the motor		
3.4 Running Requirements		
3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.		
3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.		
3.5 Stress During bus Transfer		
3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.		
3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.		
3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.		
3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.		
4.0 CONSTRUCTIONAL FEATURES		
4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy		
4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.		
Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled		
4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.		

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- 4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.
- 4.5. Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.
- 4.6. In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.
- 4.7 Terminals and Terminal Boxes**
- 4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.
- Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".
- 4.7.2 unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.
- 4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.
- 4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.
- 4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.
- 4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.
- 4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.
- 4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.
- 4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.
- 4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

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4.9.1 Motors provided for similar drives shall be interchangeable. 4.9.2 Suitable foundation bolts are to be supplied alongwith the motors. 4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above. 4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956. 4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz. 4.9.6 Name plate with all particulars as per IS: 325 shall be provided 4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions. 5.0 INSPECTION AND TESTING 5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied. 5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser. 5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan. 5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A. 6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT a) OGA drawing showing the position of terminal boxes, earthing connections etc. b) Arrangement drawing of terminal boxes. c) Characteristic curves: (To be given for motor above 55 kW unless otherwise specified in Data Sheet). i) Current vs. time at rated voltage and minimum starting voltage. ii) Speed vs. time at rated voltage and minimum starting voltage. iii) Torque vs. speed at rated voltage and minimum voltage. For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling. iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.		

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
 - a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
 - b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
 - f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
 - g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

A	NN	A	NNN
Cable	No. of cores	Cable code	Cable size
Voltage	(e.g. 01,03,3H, 07)	(See C below)	(e.g. 035,185,2.5, 0.5)
Code (see B below)			

(A) SYSTEM VOLTAGE CODES:

(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V
 (dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:

A = 11KV (Power cables)

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

B = 6.6KV (Power cables)
C = 3.3KV (Power cables)
D = 1.1KV (LV & DC system power & control cables)
E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

A = Armoured FRLS	B = Armoured Non-FRLS
C = unarmoured FRLS	D = Unarmoured Non-FRLS

PVC Aluminium

E = Armoured FRLS	F = Armoured Non-FRLS
G = unarmoured FRLS	H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS	K = Armoured Non-FRLS
L = unarmoured FRLS	M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS	P = Armoured Non-FRLS
Q = unarmoured FRLS	R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES
T = TOUGH RUBBER SHEATH
U = OVERALL SCREENED
V = PAIRED OVERALL SCREENED
W = PAIRED INDIVIDUAL SCREENED
Y = COMPENSATING CABLES
I = PRE-FABRICATED CABLES
Z = JELLY FILLED CABLES

ANNEXURE III

TECH SPEC NO.
PE-TS-408-158-A001

VOLUME : IIF/2

SECTION-IV

TECHNICAL SPECIFICATION
FOR
CABLES

CONTENT

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2.00.00	CODES & STANDARDS
3.00.00	DESIGN CRITERIA
4.00.00	SPECIFIC REQUIREMENTS
5.00.00	TESTS
6.00.00	DRAWINGS DATA & MANUALS

ATTACHMENTS

ANNEXURE-A	RATINGS AND REQUIREMENTS - H.V POWER CABLES (11KV, 6.6KV & 3.3 KV)
ANNEXURE-B	RATINGS AND REQUIREMENTS - L.V POWER CABLES
ANNEXURE-C	RATINGS AND REQUIREMENTS - CONTROL CABLES
ANNEXURE-D	RATINGS AND REQUIREMENTS - 1.1KV FS POWER CABLE
ANNEXURE-E	RATINGS AND REQUIREMENTS - 1.1KV FS CONTROL CABLE
ANNEXURE-F	RATINGS AND REQUIREMENTS - FLEXIBLE TRAILING CABLES
ANNEXURE-G	CABLE SIZES

SECTION-IV

TECHNICAL SPECIFICATION FOR CABLES

1.00.00 SCOPE OF SUPPLY

1.01.00 Power and Control Cables shall cover the requirement of entire Plant including the switchyard. The cables shall be furnished in accordance with this specification and annexure.

Other cables including special cables if any which are necessary as per proven engineering practice for satisfactory & trouble free operation of the entire cable system of the plant shall also be within the scope of supply. These shall include all such cables for electrical integral with mechanical equipment systems and subsystems.

1.02.00 Cable shall be furnished in accordance with this specification and the following annexures :

- a) 11 kV, 6.6kV & 3.3 kV Power cables : Annexure - A
- b) 1100V Power Cables : Annexure – B
- c) Control Cables : Annexure – C
- d) Fire Survival Cables : Annexure – D & E
- e) Flexible Trailing cable : Annexure – F

1.03.00 All relevant drawings, data and instruction manuals

2.00.00 CODES & STANDARDS

2.01.00 All cable and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

2.02.00 Cable and material conforming to any other standard which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

2.03.00 The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

3.00.00 DESIGN CRITERIA

- 3.01.00 Cables will be generally laid on ladder type trays, perforated type cable trays or drawn through rigid steel conduits [Rigid steel conduits shall be used for interconnection of cables from near-by cable tray to equipment where cable tray cannot be installed as well as to prevent mechanical damage of cables for critical equipment. Moreover in dust prone area the lay out of cable tray shall be in vertical plane].
- 3.02.00 For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard and/or this specification which one is more stringent.
- 3.03.00 The insulation and sheath materials shall be resistant to oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling.
- 3.04.00 Armouring shall be single round wire of galvanized steel for multicore cables and aluminum for single core cable for power and control cables. For fire survival control cable, the armouring over inner sheath shall consist of single layer of wire / round galvanised steel wire as per IS 3975 amended upto date. For Fire survival power cable, Single core cables to be used in A.C. system, the armouring over inner sheath shall consist of single layer of round copper wire, for multi-core cables to be used in A.C. system and single/two core cables in D.C. System, the armouring over inner sheath shall consist of single layer of round galvanised steel wire.
- 3.05.00 The outer sheath shall have flame retardant low smoke halogen evolution (FRLS) characteristics or fire survival characteristics as applicable and shall meet the requirements of additional tests specified for the purpose.
- 3.06.00 Core identification for multicore cable shall be provided by colour coding.
- 3.07.00 HT cables shall be manufactured by triple extrusion dry cured (CCV) process using pressurized nitrogen.

4.00.00 SPECIFIC REQUIREMENTS

4.01.00 General Description

All Cables shall be furnished in strict compliance with ratings and requirements and sizes as given in Annexures to this Specification.

4.02.00 Drum Length and Tolerance

The cables shall be supplied in non-returnable packing steel drum for 11 kV, 6.6 kV & 3.3 kV power cables, wooden drums for 1100V power and control cables, each containing minimum 500 meters length of larger sizes of cable unless specifically asked for. For smaller sizes of cables, each drum shall contain 1000 meters length of cable. Allowable tolerance on individual drum length is $\pm 5\%$.

4.03.00 Non-Standard Length

Non-standard lengths upto 5% of the total ordered quantity may be accepted. However the Contractor will be required to obtain approval before packing the Cables on drums. Non-standard lengths shall not be less than 100 metres in any case.

4.04.00 Cable identification

Cable identification shall be provided by embossing on every meter on the outer sheath the following :

- a) GSECL
- b) Manufacturer's name or trade mark
- c) Voltage grade
- d) Year of manufacture
- e) Type of insulation, e.g. XLPE/PVC/HR85/IE2 etc.
- f) No. of core and size of cables.
- g) Type of improved fire performance, e.g. FR/FRLS/FS
- h) IS number

4.05.00 Packing

4.05.01 Cables shall be supplied in non returnable drums. The drums shall be of heavy construction. All wooden parts shall be manufactured from seasoned wood. All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage. Wooden cable drum shall be treated by immersing in copper-nitrate solution.

4.05.02 Cable shall be wound and packed on drums in such a manner that it will be properly sealed and firmly secured to the drum. The ends of each length shall be sealed before shipment.

4.05.03 The cable drums should carry the following details in printed form:

- a) MSPGCL
- b) Manufacturer's name or trade make
- c) Type of cable & voltage grade
- d) Year of manufacture
- e) Type of insulation e.g. XLPE/HRPVC/IE2
- f) No. of core and size of cables
- g) Cable code e.g. FRLS/FS
- h) Length of cable on drum

- i) No. of length on drum, if more than one
- j) Direction of rotation, by arrow
- k) Approx. gross mass.
- l) IS/IEC number and ISI mark

4.06.00 Joints and Terminations

Materials of construction for a joint/termination shall perfectly match with the dielectric chemical and physical characteristics of the associated cables. The material and design concepts shall incorporate a high degree of operating compatibility between the cable and joints. The protective outer covering (jacket) used on the joints/terminations shall have the same qualities as that of the cable outer sheath in terms of ambient/operating temperature withstand capability and resistance to hazardous environments and corrosive elements. Straight through joints and terminations for HT cables shall be heat shrinkable type.

4.07.00 Selection Criteria

- 4.07.01**
- a) HT and LT power cables shall be selected on the basis of current carrying capacity, short circuit rating and permissible voltage drop.
 - b) While sizing power cables, following aspects shall be reckoned:
 - i) Ground/Ambient Air temperature
 - ii) Depth of Laying.
 - iii) Power Cables touching each other.
 - c) Cables, for circuit breaker controlled feeders, shall withstand the short circuit current for the fault clearing time. 0.2 Sec.
 - d) HT cables shall be sized based on the following considerations:
 - Rated current of the equipment and ground/ambient temperature.
 - Touching/spacing of cable.
 - Depth of laying.
 - The voltage drop of the cable , during motor starting condition , shall be limited to 15% and during full load running condition shall be limited to 3 % rated voltage. Other outgoing feeder /transformer feeder shall be limited to 3% rated voltage.
 - Short circuits withstand capability
 - e) For fuse/MCCB/Breaker protected circuits the conductor size shall depend upon full load current subject to voltage drop limited to 3% during running of all feeders and 15% during starting for motor feeders. In addition, transformer regulation shall also be considered

for loads fed from 415V PMCC. In case of other outgoing line feeder voltage drop shall be limited to 3%.

- f) For loads fed from local panels, the total running voltage drop in cable from 415V PMCC to local panel and from local panel to individual motor shall be limited to 3% at full load motor current while the same during starting shall be limited to 15%.
- g) As per national electric code (NEC) current rating capacity of motor feeder/cables should be 125% of full load current.
- h) For welding receptacle, 3% running drop shall only be considered.

The minimum sizes of L.T cable to be chosen are as below:

AL - 16 mm² (3 core) & 16mm² (2 core); Cu - 2.5 mm²

4.07.02 Apart from above, consideration shall also be given to limit the cable to some standard sizes instead of using too many types.

4.07.03 The standard cable sizes, amp capacities, derating factors, as given in IS/IEC will be generally followed.

4.07.04 a) For breaker protected circuits minimum size of the cable shall be as follows:

1100V Power Cable : 240 Sq mm XLPE AL

6600V & 3300V Power Cable : 185 Sq mm XLPE AL

11000V Power Cable : 240 Sq mm XLPE AL

- b) For motor circuits the selection of size will be made ensuring that the cable shall withstand a short circuit fault directly following a second hot start.

4.07.05 For fuse/MCCB protected circuit, the conductor size will depend on full load current subject to voltage drop not exceeding 3%. For practical purposes, the minimum size chosen is as below :

a) Aluminium : 16 Sq mm.

b) Copper : 2.5 Sq mm.

4.07.06 All control cables shall be 2.5 Sq mm stranded copper cable.

4.07.07 Multicore control cables will generally have spare conductor (s) in accordance with the following chart :

Conductors required	Cables
1 or 2	1-3/C
3 or 4	1-5/C
5 or 6	1-7/C

7 or 8	1-9/C
9 or 10	1-12/C
Above 10	Two or more of above cables

4.07.08 Separate cables for each type of following services/functions as applicable shall be used for each feeder. Same multicore cable using different services shall not be acceptable.

- a) Power.
- b) Control, interlock and indication.
- c) Metering and measuring.
- d) Alarm and annunciation.
- e) C.T. Cables.
- f) V.T. Cables.

4.08.00 Cable Identification

Cable identification shall be provided by embossing on the outer sheath the following :

- a) Manufacturer's name or trade mark
- b) Manufacturer's name or trade mark
- c) Voltage grade
- d) Year of manufacture
- e) Type of insulation, e.g. XLPE, HRPVC & IE2 etc.
- f) No. of core & size of cables
- g) Type of outer sheath e.g. FRLS, FS etc.

4.09.00 Selected sizes of power and control cables are given in Annexure-G.

4.10.00 Fire Survival Cables shall be used for important auxiliaries / area as recommended by Standard Technical Specification by CEA as below for the following :

Fire Survival Power & Control Cables shall be used for important auxiliaries/ areas like:

- i. DC emergency lube oil pump
- ii. DC hydrogen seal pump
- iii. Turbine lube oil pump/barring gear

- iv. DC emergency lighting for main building and service building
- v. DC cables for battery to charger & DC distribution boards
- vi. Jacking oil pump
- vii. Emergency turbine trip in control room
- viii. Boiler Turbine : Generator inter trip which include the interconnection between
 - Boiler master fuel trip and turbine trip relays
 - Generator trip relays & turbine trip relays
 - Generator trip relays & generator breaker
 - Generator trip relays & field breaker
 - Generator trip relays & unit auxiliary transformer breaker
 - Incomer cables for DG board, emergency board, DC lighting board etc.

5.00.00 TESTS

5.01.00 Shop Tests

The Cables shall be subject to shop tests in accordance relevant IS/IEC standards to prove the design and general qualities of the Cables as below:

- 5.01.01 Routine tests on each drum of cables.
- 5.01.02 Acceptance Tests on 1 drum out of every 10 drums chosen at random for acceptance of the lot for every size.
- 5.01.03 Type test on each type and size of cable, inclusive of measurement of armour DC resistance of power cables on one drum out of every 10 drums of cable.

5.02.00 Additional Tests

Following additional acceptance tests shall also be performed on each type of cables having outer sheath with improved fire performance (Type FRLS, FS):

- 5.02.01 Oxygen index test

The Oxygen index shall not be less than 29.
- 5.02.02 Temperature Index Test

The measured value of temperature index shall be 21 at a temperature of 250°C for FRLS cables and 350°C for FS cables
- 5.02.03 Flame Retardance test on single cable and on bunched cables

After the test, there should be no visible damages on the test specimen within 300mm from its upper end.

After burning has ceased, the cables should be wiped clean and the charred or affected portion should not have reached a height exceeding 2.5 meter above the bottom edge of the burner, measured at the front and rear of the cable assembly. 3 Hours fire rating test shall be carried out for FS cable as per IEC331

5.02.04 Halogen acid gas evolution test

The level of HCL evolved shall not exceed 20 per cent by weight. HCL evolved shall not be exceed 2% for FS cable.

5.02.05 Smoke density test

The test shall be smoke generation by the outer sheath under fire as per ASTM D 2843. The FRLS cables shall meet the requirements of light transmission of minimum 40% after the test. Minimum transmission shall be 80% for Fire Survival cables.

5.02.06 Test for specific optical density of smoke

The cables shall meet the requirements of IS/IEC.

5.02.07 Test for rodent & termite repulsion property

The test shall be carried out to note the presence of rodent and termite repelling chemical in PVC compound. Normal procedure is that a few chippings of the PVC compound are slowly ignited in a porcelain dish or crucible in a muffle furnace at about 600°C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). A drop of aqueous sodium sulphide solution is placed on a thick filter paper and it is allowed to soak. The spot is touched with a drop of above extract. A black spot indicates the presence of anti-termite & rodent compound.

Flammability test shall be carried on finished cables as per following standards-

- a) Swedish Chimney test – SS: 424-14-75
- b) IEEE std.383 – 1974 latest
- c) IEC std. 332-1 and IEC 331

5.03.00 Test Witness

Tests shall be performed in presence of Owner/Purchaser's representative. The Contractor shall give at least thirty (30) days' advance notice of the date when the tests are to be carried out.

5.04.00 Test Certificates

5.04.01 Certified reports of all the tests carried out at the works shall be furnished for approval of the Owner/Purchaser.

5.04.02 Test reports shall be completed with all details and shall also contain IS/IEC specified limit values, wherever applicable, to facilitate review.

5.04.03 The cables shall be dispatched from works only after receipt of Owner/ Purchaser's written approval of the test reports.

6.00.00 DRAWINGS, DATA & MANUALS

6.01.00 Drawings, Data and Manuals shall be submitted with the bid and for approval/ reference and subsequent distribution after the issue of Letter of Intent in quantities and procedures as specified in General condition of contract and/or elsewhere in this specification.

6.02.00 To be submitted with the Bid

- a) Manufacturer's catalogues giving cable construction details and characteristics.
- b) Cable current ratings for different types of installation, inclusive of derating factors for ambient temperature, grouping etc.
- c) Write-up on Manufacturer's recommended method of splicing, jointing, termination etc. of the cables.
- d) Type test reports on 11 KV, 6.6KV, 3.3 KV Power, LT FRLS Power & control, FS power and control cables
- e) Filled-up proposal particulars.

6.03.00 To be submitted after award of contract

6.03.01 Guaranteed Technical Particulars

6.03.02 Quality assurance plan

6.03.03 Shop Test reports

6.03.04 Instruction manuals

The manual shall clearly indicate method of laying, termination, check-ups and tests to be carried out before commissioning.

6.04.00 The bidder may note that the drawings, data and manuals listed herein are minimum requirement only. The bidder shall ensure that all other necessary write-up, information, etc required to fully describe the cable are to be submitted with the bid.

ANNEXURE-A

**RATINGS AND REQUIREMENTS
HV POWER CABLES (11 KV, 6.6KV & 3.3 KV)**

- 1.0 11000/11000V, 6600/6600V & 3300/3300V grade 90⁰C continuous rating under normal condition and 250⁰C rating under short circuit condition heavy duty XLPE power cable suitable for use in 11000V/6600V/3300V non-effectively earthed system conforming to following requirement and in line with IS-7098, IS-8130, IS-5831 & IS-3975, manufactured by Triple Extrusion Dry Cure (CCV) process using pressurized Nitrogen.
- 1.1 Conductor : Stranded and compacted aluminium conductor of grade H2 & class 2 for all sizes, generally conforming to IS: 8130.
- 1.2 Conductor Screen : Extruded semi-conducting compound.
- 1.3 Insulation : Extruded cross linked polyethylene (XLPE) conforming to IS: 7098 (Part-2)
- 1.4 Insulation Screen : Extruded semi-conducting compound with a layer of non-magnetic metallic tape. For single core armoured cables, the armouring shall constitute the metallic part of screening. The semi-conducting tape shall be easily strippable.
- 1.5 Core Identification : By coloured strips applied on (For three core cables) cores or by numerals.
- 1.6 Inner Sheath : Extruded HRPVC/FRLS compound conforming to type ST2 of IS: 5831 for three core cables. Single core cables shall have inner sheath. Filler material shall also be of type ST2 PVC.
- 1.7 Armour : Galvanised single round steel wire armour for twin and multicore cables.

Non-magnetic hard drawn aluminum single round wire conforming to H4 of IS-8130 latest for single core cables
- 1.8 Overall Sheath : Extruded FRLS HRPVC compound conforming to type ST2 of IS: 5831.
- 1.9 Drum : Steel Drum

ANNEXURE-B

**RATINGS AND REQUIREMENTS
LV POWER CABLES [1.1KV (XLPE TYPE)]**

- 1.0 1100 V grade, 90°C continuous rating under normal condition and 250°C under short circuit condition rating, XLPE heavy duty, power cable conforming to following requirement and in line with IS 7098 Part-I. IS 8130 & IS 5831 and IS 3975.
- 1.1 Conductor : Stranded and compacted plain aluminium of grade H2 and class 2 stranded, high conductivity annealed plain copper for cable sizes upto 2.5 mm² conforming to IS:8130.
- 1.2 Insulation : Extruded cross-linked polyethylene (XLPE) conforming to IS: 7098 (Part-1)
- 1.3 Core Identification : By color coding
- 1.4 Inner Sheath : Extruded HRPVC FRLS compound conforming to type ST2 of IS: 5831 for multicore cable. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2
- 1.5 Armour : Galvanized single round steel wire armour for twin and multicore cables.

Non-magnetic hard drawn aluminum single round wire conforming to H4 of IS-8130 latest for single core cables
- 1.6 Overall Sheath : Extruded FRLS HRPVC compound conforming to type ST2 of IS: 5831.
- 1.7 Drum : Conforming to IS-10418 (Wooden drum)

ANNEXURE-C

RATINGS AND REQUIREMENTS
CONTROL CABLES

- 1.0 1100 V grade 85°C continuous rating under normal condition and 160°C under short circuit condition rating HRPVC Control cable (YWW) conforming to following requirement and in line with IS:1554, IS:8130, IS:5831 and IS:3975.
- 1.1 Conductor : Stranded, non-compacted & circular, high conductivity annealed plain copper, generally conforming to IS: 8130.
- 1.2 Insulation : Extruded HRPVC type-C compound conforming to IS: 5831. The minimum volume resistivity of insulation shall be 3.5×10^{14} ohm-cm at 27°C and 3.5×10^{11} OHM-CM at 85°C.
- 1.3 Core Identification : By color coding and numbering at interval of 100mm or less
- 1.4 Inner sheath : Extruded HRPVC compound conforming to type ST2 FRLS of IS: 5831 for multicore cables. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2.
- 1.5 Armour : Galvanised single round steel wire for twin and multicore cables.
- 1.6 Overall sheath : Extruded FRLS HRPVC compound conforming to type ST2 of IS: 5831.
- 1.7 Drum : conforming to IS: 10418 (Wooden drum)

ANNEXURE-D

**RATINGS AND REQUIREMENTS
(1.1KV GRADE COPPER CONDUCTOR FS POWER CABLES)**

- 1.1 Conductor : Conductor shall be of stranded construction, consisting of high conductivity annealed tinned copper wires conforming to Class-II of IS 8130.
- A suitable heat barrier tape, preferably glass mica tape shall be provided over the conductor.
- 1.2 Insulation : The insulation shall consist of heat resisting electrometric material EPR (Ethylene Propylene rubber) and shall conform to Type IE-2 of IS: 6380/1984 amended up to date.
- 1.3 Laying up of cores
(For multicore cables only) : The core shall be suitably identified in accordance with IS: 9968 (Part-I).
- The suitable fire retardant material fillers shall be used for filling in the interstices.
- Two layers of plain glass fibre binder tape shall be applied over the laid up cores.
- 1.4 Inner Sheath : An inner sheath of extruded special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric (HOFR) compound of black colour conforming to Type SE-3 of IS – 6380/1984, ammended up to date, shall be provided over the laid up cores. This shall be provided even for single core cables after providing two layers of plain glass fibre tape over the insulation.
- 1.5 Armour : For Single core cables to be used in A.C. system, the armouring over inner sheath shall consist of single layer of round copper wire.
- For multi-core cables to be used in A.C. system and single/two core cables in D.C. System, the armouring over inner sheath shall consist of single layer of round galvanised steel wire.

1.6 Outer Sheath : The extruded outer sheath shall be of special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric HOFR compound comprising of synthetic rubber and shall generally conform to the type SE-3 of IS: 6380 latest revision.

Minimum value of 'Tensile Strength' and 'Percentage elongation at rupture' shall be 8 Newton/sq.mm. and 250% respectively.

The colour of outer sheath shall be black or any other colour agreed mutually between Owner & Contractor.

ANNEXURE-E

ANNEXURE-E

**RATINGS AND REQUIREMENTS
(1.1KV GRADE COPPER CONDUCTOR FS CONTROL CABLES)**

- 1.1 Conductor : It shall be of stranded construction, consisting of high conductivity annealed tinned copper conductors conforming to IS:8130 / 1984 amended upto date.
- A suitable heat barrier tape, preferably glass mica tape shall be provided over conductor.
- 1.2 Insulation : The conductor insulation shall consist of heat resisting elastomeric material EPR (Ethelene Propylene rubber) and shall conform to type IE-2 of IS: 6380/1984 latest revision.
- 1.3 Laying up of cores
(For multicore cables only) :
- The core shall be suitably identified in accordance with IS: 9968 (Part-I)
- The suitable fire retardant material fillers shall be used for filling in the interstices.
- Two layers of plain glass fiber binder tape shall be applied over the laid up cores.
- 1.4 Inner Sheath : An inner sheath of extruded very low halogen (acid gas generation shall be less than 2% by weight) elastomeric HOFR compound of black colour or any other natural colour with prior approval from Owner conforming to Type SE3 of IS 6380 / 1984 amended upto date shall be provided over the laid up cores.
- 1.5 Armour : The armouring over inner sheath shall consist of single layer of wire / round galvanised steel wire as per IS 3975 amended upto date.
- 1.6 Outer Sheath : The outer sheath shall be of special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric HOFR compound comprising of synthetic rubber and shall generally conform to the type SE-3 of IS:6380 latest revision.
- The colour of outer sheath shall be black or any other natural colour with prior approval of the Owner.

ANNEXURE-F

**RATINGS AND REQUIREMENTS
FLEXIBLE TRAILING CABLES**

i) 6600 V Unearthed Grade

Flexible trailing cable, annealed plain copper conductor, Class-5 of IS-8130, insulated with EPR, conductor and insulation shielded with EPR, cores screened with ATC wire braiding, cores laid up, HD CSP inner sheathed, proof cotton taped and FRLS HD CSP sheathed overall, conforming to IS:9968. Alternatively PCP sheathing may be acceptable.

ii) 1100 V Grade

1100 V Grade trailing cable shall be plain copper of Class-5 of IS-8130, heat resistant elastomeric compound based on EPR insulation, inner sheath of heat resistant elastomeric compound PCP sheath, nylon cord reinforcement and heat resistant, oil resistant and flame retardant heavy duty elastomeric compound FRLS CSP outer sheath.

ANNEXURE-G

CABLE SIZES

Sl. No.	Cable Size	Conductor	Insulation
1.0	H. T. CABLES (11kV)		
1.1	1 core 630 Sq.mm	AL	XLPE (FRLS)
1.2	3 core 400 Sq.mm	AL	XLPE (FRLS)
1.3	3 core 240 Sq.mm	AL	XLPE (FRLS)
1.4	1 core 70 Sq.mm	AL	XLPE (FRLS)
1.0	H. T. CABLES (6.6kV & 3.3kV)		
1.1	1 core 630 Sq.mm	AL	XLPE (FRLS)
1.2	3 core 300 Sq.mm	AL	XLPE (FRLS)
1.3	3 core 240 Sq.mm	AL	XLPE (FRLS)
1.4	3 core 185 Sq.mm	AL	XLPE (FRLS)
1.5	1 core 70 Sq.mm	AL	XLPE (FRLS)
2.0	L. T. POWER CABLES		
2.1	3 core 2.5 Sq.mm	CU	XLPE (FRLS)
2.2	3 or 4 core 4.0 Sq. mm	CU	XLPE (FRLS)
2.3	3 or 4 core 10 Sq.mm	CU	XLPE (FRLS)
2.4	2 core 16 Sq.mm	AL	XLPE (FRLS)
2.5	3 core 16 Sq.mm	AL	XLPE (FRLS)
2.6	4 core 16 Sq.mm	AL	XLPE (FRLS)
2.7	2 core 35 Sq.mm	AL	XLPE (FRLS)
2.8	3 core 35 Sq.mm	AL	XLPE (FRLS)
2.9	4 core 35 Sq.mm	AL	XLPE (FRLS)
2.10	3 core 70 Sq.mm	AL	XLPE (FRLS)

Sl. No.	Cable Size	Conductor	Insulation
2.11	3.1/2 core 70 Sq.mm	AL	XLPE (FRLS)
2.12	3 core 95 Sq.mm	AL	XLPE (FRLS)
2.13	3.1/2 core 95 Sq.mm	AL	XLPE (FRLS)
2.14	3 core 185 Sq.mm	AL	XLPE (FRLS)
2.15	3.1/2 core 185 Sq.mm	AL	XLPE (FRLS)
2.16	3 core 240 Sq.mm	AL	XLPE (FRLS)
2.17	3.1/2 core 240 Sq.mm	AL	XLPE (FRLS)
2.18	3 core 300 Sq.mm	AL	XLPE (FRLS)
2.19	3.1/2 core 300 Sq.mm	AL	XLPE (FRLS)
2.20	1 core 630 Sq.mm	AL	XLPE (FRLS)
3.0	CONTROL CABLE		
3.1	2 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.2	3 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.3	5 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.4	7 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.5	9 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.6	12 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.7	20 core 2.5 Sq.mm	CU	HRPVC (FRLS)
4.0	FS POWER CABLES		
4.1	3 core 2.5 Sq.mm	CU	EPR
4.2	2 core 16 Sq.mm	CU	EPR
4.3	3 core 16 Sq.mm	CU	EPR
4.4	4 core 16 Sq.mm	CU	EPR
4.5	2 core 35 Sq.mm	CU	EPR

Sl. No.	Cable Size	Conductor	Insulation
4.6	3 core 35 Sq.mm	CU	EPR
4.7	4 core 35 Sq.mm	CU	EPR
4.8	3 core 95 Sq.mm	CU	EPR
4.9	3.1/2 core 95 Sq.mm	CU	EPR
5.0	FS CONTROL CABLE		
5.1	2 core 2.5 Sq.mm	CU	EPR
5.2	3 core 2.5 Sq.mm	CU	EPR
5.3	5 core 2.5 Sq.mm	CU	EPR
5.4	7 core 2.5 Sq.mm	CU	EPR
5.5	9 core 2.5 Sq.mm	CU	EPR
5.6	12 core 2.5 Sq.mm	CU	EPR

	TITLE: 1x800 MW WANAKBORI STPP TECHNICAL SPECIFICATION FOR PRE TREATMENT PLANT	SPEC NO: PE-TS-408-158-A001	
		VOLUME: II-B	
		SECTION: D3	
		REV NO: 00	DATE:

SECTION-D3

(GENERAL TECHNICAL REQUIREMENT FOR C&I)

BHEL – PS - PPEI: NOIDA, SECTOR-16A, U.P. – 201301

	1X800 MW Wanakbori STPP	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

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	1X800 MW Wanakbori STPP	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
GENERAL & SPECIFIC TECHNICAL REQUIREMENT		

	1X800 MW Wanakbori STPP	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
GENERAL REQUIREMENT 1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems. 2.0. The quantity of instruments for auxiliary system shall be as per tender P & ID, wherever provided, for the respective system as a minimum for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication. 3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by the employer' during detail engineering. 4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc for external connection including spare contacts shall be wired out to suitably located junction boxes. 5.0 The customer specification attached as Specific Technical Requirement will supercede the Data sheets, if there is any mismatch.		

	1X800 MW Wanakbori STPP	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

Specific Technical Requirements (C&I):

The control of Pre-Treatment Plant shall be through PLC based control system having hot redundant Central Processing Unit. The operation and control philosophy of Pre-Treatment plant has been elaborated in separate section in the specification. The PLC shall be located in PT Plant Control Room. One (1) nos. OWS(Operator Works Station) and one(1) no. OEWS(Operator cum Engineering Work Station) with 24" colour TFT monitor ,one(01) nos.A3 size colour laser printers, keyboard, mouse etc. shall be provided by the bidder. OWS/EWS shall be provided with anti-glare coating. In addition to OWS operation, hardware based monitoring / control / annunciation shall be provided for the systems where HMI workstations are not envisaged or need for such back up is strongly recommended by Bidder for the safe shutdown of the system.The Complete PLC based control system with OWS, Laptop, Remote I/Os, Printer, UPS (for PLC, OWS, Remote I/Os,Printer etc.), desk along with furniture shall be in Bidder's scope. PC for OWS shall be of workstation grade. Additional laptop shall be provided.

- 1) Bidder to consider I/Os for hardwired linking of important parameters from Pre-Treatment plant to Station DCS.
- 2) Control Systems including protection/interlock logics for various pumps of Plant water system shall be suitably clubbed with Pre-Treatment plant.
- 3) Bidder to keep the provision to connect PT plant PLC to the DM plant PLC via MODBUS / OPC link for monitoring and control of PT plant from DM plant operator's station.
- 4) The communication between PLC and Main plant DCS shall be OPC compliant (Data Access 2.0) TCP/IP on Fibre Optic link. The communication link between PLC and Main plant DCS shall be redundant. The necessary hardware/software including LIU (Light Interface unit) at PLC end shall be in Bidder's scope. Repeaters, if required for interfacing shall also be provided by the bidder. For communication between main plant DCS and PLC, the PLC end shall be considered as server and DCS shall be considered as client.
- 5) PLC control system shall be time synchronized with the Master clock system of the main plant to ensure uniform time indication throughout the Plant. The required provision (IRIG-B) shall be made by the bidder at the PLC end to achieve the same.
- 6) The software and hardware for offered PLC system shall be of latest version and shall be upgradable. Bidder to ensure the availability of spares and service support for the offered PLC system for minimum 20 years after guarantee period. The software tool shall have facility to interface with third party software

	1X800 MW Wanakbori STPP	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
packages. Easy up gradation and future expansion facility shall be available. All softwares used shall be licensed versions only. All software user licenses shall be valid for entire life of power plant and shall be in the name of customer. User shall not have to pay any recurring license fee during the usage period of the system. It shall be possible to upgrade the installed system with the latest available version of the software model during the plant life. 7) All electrical actuators shall be non-integral type. 8) The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with. 9) The solenoid valves shall have limit switches for open/close feedback. 10) Interface of MCC, HT SWGR, Actuators etc. with PLC based control system shall be as per Drive Control Philosophy attached in the specification. The attached philosophy is for DCS based control system. However, the same is applicable for PLC as well. 11) All the instruments/drives shall be terminated on JB's/Panels in field. JB's/Panels shall be in Bidder's scope. RTD's shall be of duplex type. 12) Scope of Instrumentation cables (Screened Control Cables), Fibre Optic cable & Control cables shall be as per Electrical Cable scope matrix in Electrical portion of specification. Any cable in Bidder's scope shall be as per specification. 13) UPS for PLC, OWS etc. shall be in bidder's scope with 2X100% configuration along with SVS(Static Voltage Stabiliser). UPS shall have 2X100%, Ni-Cd type battery bank with 30 min back up. For further details UPS specification attached elsewhere shall be referred. 14) Bidder shall provide Customer training on the proper application and maintenance of PLC Hardware & Software at Vendor's work or at Wanakbori site. 15) Following documents to be furnished by the bidder along with the bid: • Proposed PLC system configuration drawing with write-up • Duly stamped and signed copy of Quality Plan.		

	1X800 MW Wanakbori STPP	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
• Product catalogues and specifications for PLC as well as HMI application. • Requirement of electronic earthing, if any, for PLC based control system 16) Ergonomically & aesthetically designed furniture viz. control desks & Chairs shall be provided for workstations, programming stations, PCs and various peripherals at control room/computer room/equipment room. Furniture shall include documentation racks, tables for laydown etc. Control Desk profile shall be in line with drawing K9213R-DWG-I-0161. 17) Bidder to comply with codes and standards as mentioned in the specification. 18) All local gauges,transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. All transmitters shall be HART compatible. 19) Bidder to delegate /depute their persons/experts as per owner/consultants' requirement. 20) Bidder must offer general tools and tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the system. 21) The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL.		

1.00.00 **GENERAL**

1.01.00 In conformity with the guidelines provided in the specification, the scope of works shall completely cover all Instrumentation & Control equipment, functions, activities and documentation specified under the accompanying Technical Specifications and shall not be limited to the following:

- a) Detailed design and engineering of the manufactured equipment; system integration and system engineering.
- b) Complete manufacture including shop testing before shipment.
- c) Specifying, procurement, quality inspection of bought-out items from sub-suppliers. Design co-ordination for and integration with bought-out items.
- d) Coordination, integration and interface between various BOP control systems such as Water Pretreatment plant, Demineralized Water plant, Coal Handling Plant, Ash Handling Plant, ETP etc. and the station DCS for centralized monitoring & selective operation.
- e) Providing engineering drawings, documents, licensed copy of software and developmental tools, data, instruction, operation and maintenance manual etc. for Owner's review / approval / record.
- f) Arranging for Owner's inspection and testing of manufactured as well as bought-out items at the respective works.
- g) Packaging and transportation of instruments, equipments, accessories and erection hardware from the manufacturer's works to the site, including transit insurance.
- h) Pre-assembly (if any), erection, testing and commissioning of all equipments and instruments supplied, in totality.
- i) Performing availability tests, Performance and Guarantee tests.
- j) Prepare and submit approved & as-built drawings and documents in hard and soft copies.
- k) Furnishing of spares, tools and tackle and test instruments.
- l) Fulfilling post-commissioning liabilities.
- m) Arranging for the training of Owner's personnel of different categories at manufacturer's works as well as plant site.
- n) Other activities detailed in subsequent sections of the Specification.
- o) Any other activity, not mentioned explicitly, but felt essential by Bidder for successful completion of work.

1.02.00 Requirements enumerated in this specification are qualitative in nature and are based on typical configuration of various BOP plants for the purpose of bidding. It shall be the responsibility of Bidder to offer Instrumentation &

- Control system to meet the actual functional requirements of the BOP systems offered.
- 1.03.00 Operation and control of various BOP systems like Water system, Coal Handling plant, Ash Handling plant, Compressed air system, Ventilation & AC system, DM plant, PT plant, CW treatment system, DG set, , Fuel unloading system etc. shall be carried out from redundant PLC / Microprocessor based control system. There may be other systems where control is not critical. In such cases hardwired / relay based interlock shall be envisaged.
- However, hardware based monitoring / control / annunciation shall be provided for the systems where HMI workstations are not envisaged or need for such back up is strongly recommended by Bidder for the safe shutdown of the BOP systems.
- 1.04.00 In case of any conflict or contradiction between any two or more sections of this specification the more stringent condition shall generally be applicable. Owner, however, reserves the right to relax this condition at his discretion.
- 1.05.00 Type of control vis-a vis the plant area are delineated below
- 1.05.01 Plant Auxiliaries System:
- a) DM Cooling Water System & process Heat exchangers
 - b) Condenser Cooling Water (CW system) with tube cleaning system.
 - c) Auxiliary Cooling Water System (ACW system) with self-cleaning strainers.
 - d) Condensate Transfer (CT) pump
 - e) DM Service Water (DMSW) pumps
 - f) Mill Reject Handling System
 - g) Fuel Oil Pressurizing & Heating System
 - h) Condensate On-line Polishing Unit
 - i) Chemical Feed system
- 1.05.02 Interface with Other Off site Plants under BOP Package
- Data acquisition / indication of selected parameters / selective operation (as required) from the following off site plants to station DCS are foreseen through MODBUS / OPC protocol:
- a) Pretreatment Plant;
 - b) Demineralization Plant;
 - c) Coal Handling plant;
 - d) Fuel Oil Unloading & Storage;

- e) Turbine Oil Purification system;
- f) ETP Plant;
- g) Ash Handling Plant;
- h) Fire sensing and protection system;
- i) Compressed air system;
- j) AC & Ventilation System.

1.05.03 Off Site Plants shall be operated from their local control stations located in the respective plant local control rooms. Some of the Plants shall have limited operational facility from Central Control Room as well.

1.05.04 All PLC based based control systems for plant auxiliaries and other offsite plants shall be powered from separate redundant UPS. Local control panels for such systems shall be kept in air condition environment.

1.05.05 Control matrix for the Auxiliaary system & off-site systems shall be in general as below:

SL. NO.	AUX.SYSTEM / PLANT	CONTROL SYSTEM	CONTROL LOCATION	DCS INTERFACE
A. Plant Auxiliaries System				
a)	DM Cooling Water System (Turbine)	DCS	DCS Monitoring & Operation from Central Control Room	
b)	DM Cooling Water System (Boiler)	DCS	DCS Monitoring & Operation from Central Control Room	
c)	CW system	Through Remote I/O Cabinet to DCS	DCS Monitoring & Operation from Central Control Room	
d)	ACW system	Through Remote I/O Cabinet to DCS	DCS Monitoring & Operation from Central Control Room	
e)	Condenser tube cleaning system	PLC	Local operating panel .	Hardware connectivity for alarm and monitoring.
f)	Mill Reject Handling	Redundant PLC	Operator stations in local	MODBUS Soft link for remote

SL. NO.	AUX.SYSTEM / PLANT	CONTROL SYSTEM	CONTROL LOCATION	DCS INTERFACE
			Control Room	monitoring
f)	Instrument Air & Service Air Compressors & air drying plant	Microprocessor based control for each compressor with master controller	Individual unit with operator interface & PC based master Operating Station with 24" TFT monitor in Compressor Room.	MODBUS Soft link for remote monitoring
g)	Fire sensing and protection system for Entire Plant.	Microprocessor based Intelligent Detectors & PLC based Fire Water Pump control System	Microprocessor based Main Fire Alarm Panel in Control Room & Local panel in Fire Water Pump House. One repeater Fire Alarm Panel in existing Fire Station and depending on distance cabling interface shall be decided by Bidder.	Hard wired interface to DCS for monitoring and status indication.
h)	Pretreatment Plant	Redundant PLC	Within the boundary limit of PTPlant	MODBUS Soft link for remote monitoring

NOTE: As per concept of integration of control system Bidder may consider propriatory control systems as integrated part of DCS.

1.05.06 Considering the high ambient noise and electromagnetic interference prevailing in power plant, communication links between off-site controls and plant DCS shall be based on Optical Fiber Communication (OFC) along with necessary hardware at both ends.

2.00.00 DESIGN PHILOSOPHY

2.01.00 General design philosophy outlined in Vol IIE Section 1 of the specification shall apply to plant auxiliaries as well.

2.02.00 PLC systems shall be time synchronized with the GPS Master Clock. Bidder shall arrange for the necessary ports and cable for the purpose as well.

3.00.00 INSTRUMENT & SYSTEM PHILOSOPHY

3.01.00 Fuel Oil Pressurising & Heating System

- 3.01.01 Control system shall be responsible for withdrawal from storage and transportation of fuel oil from the storage tank up to the furnace.
- 3.01.02 Pressurizing pumps shall be operated from local station as well as from control room. Start of standby pump in case of running pump trip or pump developing low pressure shall be automatic by selection. Required pressure transmitter shall be furnished.
- 3.01.03 HFO temperature at outlet of heaters shall be adjusted by regulating steam flow to heater. Adjustment shall be possible from both local station as well as from control room.
- 3.01.04 Fuel oil pump discharge header pressure control shall be automatic. Adjustment shall be possible from both local station as well as from remote. Control valve with accessories and pressure transmitters shall be provided.
- 3.01.05 Drain oil pumps in boiler area shall be operated from Control Room. Drain tank shall be provided with high and low level switch for alarm & protection.
- 3.01.06 Non contact radar type level transmitters, mechanical type level gauges, level switches, temperature elements & gauges etc. shall be provided on fuel oil day tanks for control & monitoring.
- 3.01.07 Strainers shall be monitored for fouling with local indication and remote alarm.
- 3.02.00 Water System
- 3.02.01 DM plant shall be controlled and monitored from DM plant control room. PLC based control system shall be envisaged for this plant. The PLC system shall be redundant in all respect with DCS interface via Modbus / OPC link.
- 3.02.02 There shall be two (2) nos. of Operator's Station and one (1) no. Engineering Station to be located in the DM plant Control room. Engineering station shall perform engineering activities e.g. program generation, control loop tuning, Program modification required etc. Operator's / Engineer's Stations shall be complete with 24" colour TFT monitor, keyboard, mouse etc. Two (2) nos.A3 size colour laser printers are envisaged for printing of various logs, reports, graphics etc.
- 3.02.03 PLC based local control panel shall be provided for Pre-Treatment (PT) plant which will be located in the pre-treatment plant area. The local panel shall be complete with necessary lamps, push buttons, annunciation systems and mimic for local operation of the plant. The PT plant PLC shall be connected with the DCS via soft link. Also this PT plant PLC shall be connected to the DM plant PLC via MODBUS / OPC link for monitoring and control of PT plant from DM plant operator's station.
- 3.02.04 The PLC system of DM plant and PT plant shall meet the requirement of monitoring, sequential starting / stopping of drives, interlock and protection, individual/sequential control metering, annunciation and on-line monitoring including electrical power distribution systems and all other routine functions with minimum operator's intervention.
- 3.02.05 The complete process will be represented in various graphic pages to be displayed in the DM plant work stations. These graphic pages shall indicate

various equipments/components of the plant and their status/ parameters like different filters, exchanger units, measuring tanks, opening / closing of different valves, ON / OFF status of different pumps and blowers, etc. Colour coding shall be used to differentiate lines for different services, such as, service water line, backwash lines, acid/alkali lines, etc.

3.02.06 Potable water plant shall be controlled from the DM plant PLC.

3.03.00 CW Treatment Plant

3.03.01 Circulating Water Treatment Plant shall be controlled through redundant PLC and shall be monitored from the Operating Station located in Control Room inside C.W. Treatment Building.

3.03.02 There shall be 1no Operator's Station for operation of the plant. A separate, work station shall carry out the engineering activities (control loop tuning, program / sequence generation etc.).The operator's / engineer's work stations shall have 24" colour TFT monitor, keyboard, mouse etc. Also one colour laser printer is envisaged for printing of various logs, reports, graphics etc.

3.03.03 The PLC system shall meet the requirement of monitoring, sequential starting / stopping of drives, interlock and protection, individual / sequential control metering, annunciation and on-line monitoring including electrical power distribution systems and all other routine functions with minimum operator's intervention.

3.03.04 ON / OFF / TRIP status of all pumps, blowers, agitators and drive motors as required shall be displayed in Operating Station. Ammeters for drive motors wherever required shall be displayed in Operating Station.

3.03.05 All drive motors shall be provided with arrangement of local starting and stopping. Local starting shall be possible through remote/local selection key in Operating Station or in MCC. Tripping of drive motors locally shall be permissible irrespective of position of remote/local selector switch. Provision for locking the local stop push buttons after tripping the motor from local push button shall be there. All drive motors, valves etc shall be connected to PLC and the functions described above shall be performed in PLC.

3.03.06 Annunciation showing tripping of different motors, level alarms from level switches shall be located in the Operating Station.

3.04.00 Waste Water Treatment System

3.04.01 Waste Water Treatment System shall be controlled through Local Control Panels (LCP) to be located at different strategic locations of the plant as described below:

- a) One (1) no. LCP is to be provided within CMB Wastewater Pump House adjacent to Central Monitoring Basin
- b) One (1) no. LCP is to be provided near Cooling Towers
- c) One (1) no. LCP is to be provided near Coal Handling Area (Within Chemical House for Coal Pile Rainfall Run-off-Single storied)

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 8 of 17
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
C&I DELIVERABLES LIST		

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT						
1X800 MW WANAKBORI TPP						
DOCUMENT NUMBER PE-GL-408-145-I100						
Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY	CUSTOMER	FROM	USER
INSTRUMENTATION						
1	PE-V9-408-XXX-I901	INSTRUMENT DATA SHEETS	A	-	VENDOR	C&I
2	PE-V9-408-XXX-I902	INSTRUMENT SCHEDULE	I	-	VENDOR	C&I
3	PE-V9-408-XXX-I903	INSTRUMENT INSTALLATION/ HOOK UP DIAGRAMS	A	-	VENDOR	C&I
4	PE-V9-408-XXX-I904	FIELD JB TERMINATIONS /GROUPING DOCUMENT	I	-	VENDOR	C&I
5	PE-V9-408-XXX-I905	QUALITY PLANS (CV,FE, Tx and Analyser)	A	-	VENDOR	C&I
PLC PANEL						
1	PE-V9-408-XXX-I906	PLC CONFIGURATION DRAWING	A	A	VENDOR	C&I
2	PE-V9-408-XXX-I907	PLC PANEL GA (INTERNAL & EXTERNAL) DRAWING	A	-	VENDOR	C&I
3	PE-V9-408-XXX-I908	CONTROL SCHEMES (BLOCK LOGIC)	A	-	VENDOR	C&I
4	PE-V9-408-XXX-I909	PLC INPUT / OUTPUT SIGNAL LIST	I	-	VENDOR	C&I
5	PE-V9-408-XXX-I910	UPS BATTERY CHARGER/ BATTERY DATASHEET & SLD	I	\$\$	VENDOR	C&I
6	PE-V9-408-XXX-I911	UPS SIZING CALCULATIONS	I	-	VENDOR	C&I
7	PE-V9-408-XXX-I912	BATTERY SIZING CALCULATIONS	I	-	VENDOR	C&I
8	PE-V9-408-XXX-I913	CONTROL DESK LAYOUT / GA DRAWING	A	-	VENDOR	C&I
9	PE-V9-408-XXX-I914	PLC-OWS/PRINTER FURNITURE BOM	A	-	VENDOR	C&I
10	PE-V9-408-XXX-I915	PLC CONTROL ROOM LAYOUT DRAWING	A	-	VENDOR	C&I
11	PE-V9-408-XXX-I916	PLC CATALOGUE	I	-	VENDOR	C&I
12	PE-V9-408-XXX-I917	PLC QUALITY PLAN & FAT PROCEDURE	A	-	VENDOR	C&I
13	PE-V9-408-XXX-I918	LIST OF SIGNAL EXCHANGE WITH DDCMIS (BOTH HARDWIRED & SERIAL INTERFACE IN BHEL FORMAT)	A	,	VENDOR	C&I
14	PE-V9-408-XXX-I919	PROCESS GRAPHIC MANUSCRIPTS PLC	I	-	VENDOR	C&I
15	PE-V9-408-XXX-I920	PROCESS GRAPHIC MANUSCRIPTS FOR DDCMIS	I	-	VENDOR	C&I
16	PE-V9-408-XXX-I921	CABLE SCHEDULE (IN BHEL EXCEL FORMAT) & CABLE INTERCONNECTION DETAILS	I	-	VENDOR	C&I
17	PE-V9-408-XXX-I923	PANEL & ELECTRONIC EARTHING REQUIREMENT	I	-	VENDOR	C&I
18	PE-V9-408-XXX-I924	PANEL HEAT DISSIPATION DATA	I	-	VENDOR	C&I
19	PE-V9-408-XXX-I925	MANDATORY SPARES BILL OF MATERIAL	A	A	VENDOR	C&I
20	PE-V9-408-XXX-I926	PLC O & M MANUAL	I	-	VENDOR	C&I
21	PE-V9-408-XXX-I927	PLC EARTHING SCHEME	I	-	VENDOR	C&I
	Notes:	408 - Project No.				
		XXX -MAX Package Code				
		\$\$ -Approval by BHEL if Vendor BBU Item. Approval by Customer if Customer BBU Item				

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 9 of 18
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
SPECIFICATION FOR MOTORISED VALVE ACTUATOR		

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.: PE-ID-408-145-I902	
			VOLUME II B	
			SECTION D	
			REV. NO. 00	DATE: 04.04.15
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GENERAL*	* PROJECT		
	OFFER REFERENCE		
	* TAG NO. SERVICE		
	* DUTY	☐ ON / OFF	☐ INCHING
	* LINE SIZE (inlet/outlet): MATERIAL		
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY	
	* OPENING / CLOSING TIME		
	* WORKING PRESSURE		
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%	
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY	
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY	
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY	
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, IPW:55	
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL	
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.	
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.	
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM.	
HANDWHEEL	* REQUIRED	☒ YES ☐ NO	
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED	
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.		
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY	
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY	
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT- INCLUSIVE OF I.S. TOLERANCE	
	ACTUATOR APPLICABLE WIRING DIAGRAM	☒ ENCLOSED (BIDDER TO CONFIRM) A: ☐ DRG. NO. 3-V-MISC-24227 R00 B: ☐ DRG. NO. 3-V-MISC-24550 R00 C: ☐ DRG. NO. 3-V-MISC-24283 R00 D: ☒ DRG. NO. 4-V-MISC-90271 R11 E: ☐ For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram	
	COLOUR SHADE	☐ BLUE (RAL 5012) ☐ (TO BE DECIDED BY BHEL DURING DETAIL ENGG.)	
	PAINT TYPE (## Refer Notes)	☐ ENAMEL ☐ EPOXY ☐ (TO BE DECIDED BY BHEL DURING DETAIL ENGG.)	
	SHAFT RPM	BIDDER TO SPECIFY	
	OLR SET VALUE	BIDDER TO SPECIFY	
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY	
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY	

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	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC		
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ☒ 110 V		
	@ ENCLOSURE CLASS OF MOTOR	☒ IP 65 ☐ FLAME PROOF		
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B		
	@ WINDING TEMP PROTECTION	☒ THERMOSTAT (3 Nos., 1 IN EACH PHASE) ☒ ---THERMOSTAT- 1 NO+1 NC CONTACT -----		
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED		
INTEGRAL STARTER	INTEGRAL STARTER	☐ REQUIRED ☒ NOT REQUIRED		
	TYPE OF SWITCHING DEVICE	☐ CONTACTORS ☐ THYRISTORS		
	TYPE	☐ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)		
	IF SMART			
	a) SERIAL LINK INTERFACE	☐ INTEGRAL ☐ FIELD MOUNTED		
	b) SERIAL LINK PROTOCOL	☐ FOUNDATION FIELD-BUS ☐ PROFI-BUS ☐ DEVICE NET ☐		
	c) SERIAL LINK MEDIA	☐ TWISTED PAIR Cu-CBL ☐ CO-AXIAL Cu-CBL ☐ OFC		
	d) HAND HELD PROGRAMMER	☐ REQUIRED ☐ NOT REQUIRED		
	e) TYPE OF HAND HELD PROGRAMMER	☐ BLUETOOTH ☐ INFRARED ☐		
	f) MASTER STATION	☐ REQUIRED ☐ NOT REQUIRED		
	g) MASTER STN INTRFACE WITH DCS	☐ MODBUS ☐ TCP/IP		
	h) DETAILS OF SPECIAL CABLE	☐ ENCLOSED ☐ NOT REQUIRED		
	STEP DOWN CONT. TRANSFORMER	☐ REQUIRED		
	OPEN / CLOSE PB	☐ REQUIRED ☐ NOT REQUIRED		
	STOP PB	☐ REQUIRED ☐ NOT REQUIRED		
	INDICATING LAMPS	☐ REQUIRED ☐ NOT REQUIRED		
	LOCAL REMOTE S/S	☐ REQUIRED ☐ NOT REQUIRED		
	STATUS CONTACTS FOR MONITORING	☐ REQUIRED ☐ NOT REQUIRED		
INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)			
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	☐ INTERPOSING RELAY ☐ OPTO COUPLER ☐ EITHER		
	QUANTITY	☐ 2 NOs. ☐ 3 NOs.		
	DRIVING VOLTAGE	☒ 20.5 – 24V DC ☐ _____ V DC		
	DRIVING CURRENT	☒ 125mA MAX ☐ _____ mA MAX		
	LOAD RESISTANCE	☒ > 192 ohms - <25 k ohms ☐ > _____ ohms - < _____ ohms		
TORQUE SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY		
	OPEN / CLOSE	☒ 1 No. ☐ 2Nos. / ☒ 1 No. ☐ 2Nos		
	CONTACT TYPE	2 NO + 2 NC		
	RATING	5A 240V AC AND 0.5A 220V DC		
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE		
	ACCURACY	+3% OF SET VALUE		

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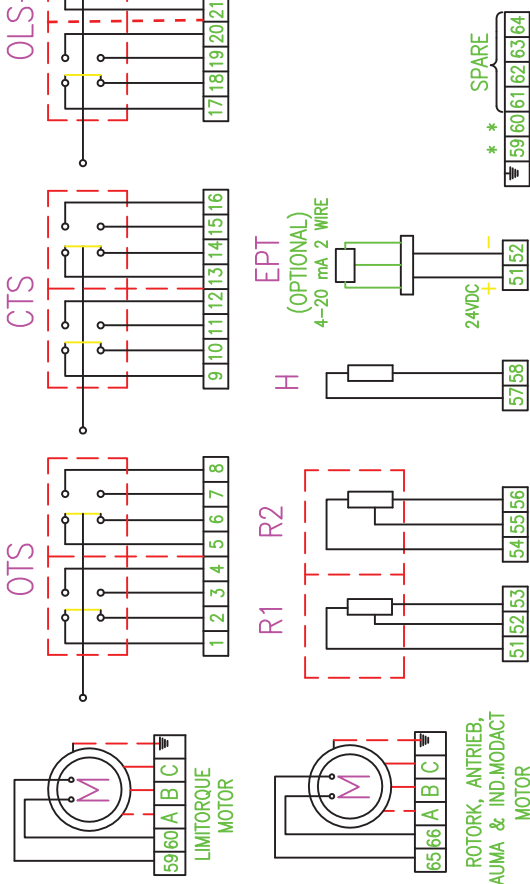
LIMIT SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY			
	OPEN : INT : CLOSE	☐ 1 No. ☒ 2 Nos.	2 Nos. (ADJ.)	☐ 1 No. ☒ 2Nos.	
	CONTACT TYPE	2 NO + 2 NC			
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC			

POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications)	☒ REQUIRED ☐ NOT REQUIRED	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	☒ ELECTRONIC (2 WIRE) R/I CONVERTER ☐ ELECTRONIC (2 WIRE) CONTACTLESS	
	SUPPLY	☒ 24V DC ☐	
	OUTPUT	☒ 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	230V AC, 1 PH., 50 Hz	
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY	
	@ RATING	decided as per load data received tender stage	
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@ ☐ IP 68 @ ☐	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET (9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	☐ REQUIRED ☐ NOT REQUIRED ☐ 2 NOS. ☐	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE: decided as per load data received tender stage	
	@ SPACE HEATER CABLE GLAND	SIZE: decided as per load data received tender stage	
	OTHER CONTROL CABLE GLANDS-1	☐ 1No. for BFV of CW PUMP (Cable size 2Px1.5mm2)	
	OTHER CONTROL CABLE GLANDS-2	QUANTITY & SIZE :-----	

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WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.
NOTES: 1. SCOPE: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY. 2. CODES & STANDARDS: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH: IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722 3. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C. 4. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED. 5. THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION. THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE. 6. THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%. 7. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING. 8. CANOPY FOR OUTDOOR SERVICES SHALL BE PROVIDED. \$\$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE. ## EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.			
NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY
	VENDOR COMPANY SEAL		
	NAME		
	SIGNATURE		
	DATE		
NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @ = TO BE FILLED BY ES			



* - SPARE FOR ROTORK, AUMA, ANTRIEB & IND.MODACT SWITCHES - ALL ARE POTENTIAL FREE AND TWO PAIR OF CONTACTS CAN BE USED FOR DIFFERENT SUPPLY THERMOSTAT - 65-66 (ROTORK, AUMA, ANTRIEB & IND.MODACT), 59-60 (LIMITORQUE).
EPT - ELECTRONIC POSITION TRANSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)
THERMOSTAT TERMINALS - TERMINATED IN MOTOR TB IN ANTRIEB & IND.MODACT AND IN MAIN TB IN OTHER MAKES
CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE) - 2 NO+2 NC
OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN) - 2 NO+2 NC
OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN - 2 NO+2 NC
CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE - 2 NO+2 NC
OTS, CTS - TWO INDEPENDENT SWITCHES IN ANTRIEB & LIMITORQUE
OLS-2 & CLS-2 - CAM DISC IN ROTORK & ANTRIEB
R1-R2- POTENTIOMETER 2 x 100 OHMS
H - SPACE HEATER 1ø 240V AC SUPPLY
M - MOTOR 3ø 415V 50 Hz AC SUPPLY

VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS	CTS	⊕

⊕ - CLS NOT TO BE CONNECTED IN TRIP CIRCUIT
NOTE:
1. BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)
2. CONNECT THERMOSTAT WITHOUT FAIL IN THE STARTER CIRCUIT

CONTACT DEVELOPMENT DIAGRAM		OFF AT OVER TORQUE DURING OPENING TRAVEL			
		1-2	5-6	3-4	7-8
OTS					
CTS					
OLS-1					
CLS-1					
OLS-2					
CLS-2					
SWITCH		TERMINAL NO.	FULL OPEN	INTERMEDIATE	FULL CLOSE
			a	b	
		VALVE POSITION			
		INDICATES CONTACT CLOSED			
		INDICATES CONTACT OPEN			

CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

		BHARAT HEAVY ELECTRICALS LTD.	
		UNIT: HIGH PRESSURE BOILER PLANT. TIRUCHIRAPPALLI 620014.	
365-139		TITLE	
N.P.ESWAR		INTERNAL WIRING DIAGRAM	
DRAWN		FOR	
CHECKED		ELECTRICAL VALVE ACTUATORS (AC)	
APPROVED		(DRAWN FOR INTERMEDIATE POSITION OF VALVES)	
DATE		DATE	
11 09.09 2000		09.09.2000	
REV		DRAWING No.	
DATE		4-V-MISC-90271	
CHD		REV	
APPD		11	
DESCRIPTION		RETRACED WITH REVISION 11	

VOLUME : IIF/1

SECTION-III

**TECHNICAL SPECIFICATION
FOR
ELECTRIC MOTOR ACTUATORS**

1.00.00 SCOPE

1.01.00 This Section covers the general requirements of Electric Motor Actuators for valves, dampers and gates.

1.02.00 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification.

2.00.00 STANDARDS

2.01.00 All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification.

2.02.00 Major standards, which shall be followed, are listed below. Other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed

i) IS-9334

ii) IS-325

3.00.00 SERVICE CONDITIONS

3.01.00 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.

3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the general specification.

3.03.00 For actuator motor installed outdoor and exposed to direct sun rays , the effect of solar heat [manufacturer to decide] shall be considered or overhead shed shall be provided locally to avoid direct sun rays.

4.00.00 RATING

4.01.00 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or 15 minutes, whichever is longer.

4.02.00 For regulating service, the actuator shall be suitably time-rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.

5.00.00 **PERFORMANCE**

The actuator shall meet the following performance requirements:

5.01.00 Open and close the valve completely and make leak-tight valve closure without jamming.

5.02.00 Attain full speed operation before valve load is encountered and impart an unseating blow to start the valve in motion (hammer blow effect).

5.03.00 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.

5.04.00 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.

5.05.00 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.

6.00.00 **SPECIFIC REQUIREMENT**

6.01.00 **Construction**

6.01.01 The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator/ transmitter, in-built thermostat for over load protection, space heater and internal wiring. Actuator shall be non integral type.

6.01.02 The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy.

6.01.03 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.

6.01.04 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.

6.02.00 **Motor**

6.02.01 The drive motor shall be three phase, squirrel cage, induction machine with minimum class B insulation and IPW-55 enclosure, designed for high torque and reversing service. Canopy shall be provided for outdoor service.

6.02.02 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current.

6.02.03 The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each.

- 6.02.04 Motor leads shall be terminated in the limit switch compartment.
- 6.02.05 Motor actuators for valves/dampers shall be non-integral type with separate starter units and operable from remote.
- 6.02.06 Earthing terminals shall be provided on either side of the motor.
- 6.03.00 **Limit Switches**
- Each actuator shall be provided with following limit switches: -
- 6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.
- 6.03.02 4 end-of-travel limit switches, two for each direction of travel.
- 6.03.03 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.
- 6.03.04 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.
- 6.04.00 **Hand Wheel**
- Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.
- 6.05.00 Position Indicator/Transmitter
- The actuator shall have:
- 6.05.01 One (1) built-in local position indicator for 0-100% travel.
- 6.05.02 One (1) position transmitter, potentiometer type, for remote indicator.
- 6.06.00 **Space Heater**
- A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.
- 6.07.00 **Wiring**
- All electrical devices shall be wired up to and terminated in a terminal box. The internal wiring shall be of sufficient size for the power rating involved but in no case less than 1.5 Sq.mm copper. All wiring shall be identified at both ends with ferrules. All wires shall be fire resistance type.
- 6.08.00 **Terminal Box**
- The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2.5 Sq.mm copper conductor.

7.00.00 ACCESSORIES

As required for the driven equipment, the actuator shall be furnished with starting equipment mounted on the actuator. This shall include:

- 7.01.00 One (1) triple pole MCCB for local isolation near the actuator
- 7.02.00 One (1) reversing starter with mechanically interlocked contactors, 3 thermal overload relays, 2 NO + 2 NC auxiliary contacts for each contactor.
- 7.03.00 One (1) remote-local selector switch.
- 7.04.00 CLOSE-STOP-OPEN oil tight push buttons with indication lights.
- 7.05.00 415/240 V or 415/110V control transformer with primary protected by fuse & secondary protected by Miniature Circuit Breaker (MCB).

8.00.00 TEST

The actuator and all components thereof shall be subject to tests as per relevant Standards. In addition, if any special test is called for in equipment specification, the same shall be performed.

9.00.00 DRAWINGS, DATA & MANUALS

- 9.01.01 To be Submitted with Bid

Data sheet for each type of actuator shall be furnished along with internal wiring diagram, suggested control schematic and torque limit switch contact development and manufacturer's catalogues.

- 9.01.02 To be Submitted after Award of Contract

- a) Actuator Data Sheet
- b) Internal wiring diagram and suggested control schematic
- c) Torque switch and limit switch contact development
- d) Manufacturer's Catalogue
- e) Instruction manual indicating clearly the installation methods, check ups and tests to be carried out before commissioning of the equipment.
- f) Any other relevant drawings, documents or data necessary for satisfactory installation , operation and manufacturing.

- 9.02.00 The Bidder may note that the drawings, data and manuals listed herein are minimum requirements only. The Bidder shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment are submitted with his bid.

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 10 of 18
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
SPECIFICATION FOR FIELD INSTRUMENTS		

1.00.00 **FIELD INSTRUMENTS**

This section provides general hardware guidelines for field instruments and equipment to be supplied under this specification.

1.01.00 Pressure Transmitter

- | | | | |
|-----|---------------------|---|---|
| 01. | Working Principle | : | Smart (HART Compatible) |
| 02. | Type | : | 2 - Wire |
| 03. | Output Signal | : | 4-20 mA DC. |
| 04. | Signal Processing | : | Silicon solid state electronic circuitry |
| 05. | Measuring Element | : | Capsule / Diaphragm |
| 06. | Element material | : | AISI-316 (Stainless Steel) or better |
| 07. | Static Pressure | : | 150 % of maximum span continuously, without affecting the calibration. |
| 08. | Turn-down ratio | : | 60: 1. |
| 09. | Span and Zero | : | Locally adjustable non-interacting. Facility for elevation and suppression by 100% of span |
| 10. | Enclosure Class | : | IP-65 |
| 11. | Output Indicator | : | LCD |
| 12. | Nameplate | : | Tag number, service engraved in SS tag plate |
| 13. | Body | : | Forged Carbon Steel for air and flue gas application and SS for other application. |
| 14. | Operating Voltage | : | 16 - 48 Volts D.C. |
| 15. | Load | : | 600 Ohms (min.) at 24 Volts D.C. |
| 16. | Ambient Temperature | : | 0 - 50 °C |
| 17. | Performance: | | |
| | i) Accuracy | : | ± 0.1% of Span or better |
| | ii) Repeatability | : | ± 0.05% of Span or better |
| | iii) Response time | : | 100 msec or better |
| 18. | Sealing/Isolation | : | Extended diaphragm with 5 meters SS armoured capillary for viscous fluid applications. |
| 19. | Accessories | : | a) Universal mounting bracket suitable for 2" pipe mounting.
b) High tensile carbon steel U- bolts.
c) Siphon for steam and hot water services.
d) ½" NPT 2-valve stainless steel manifold, constructed from SS316 bar stock.
e) Companion flange with nuts, bolts and gaskets. |

- f) ½" NPT cable gland
- 1.02.00 Differential Pressure Transmitter / Flow transmitter
01. Working Principle : Smart (HART compatible)
 02. Type : 2-Wire
 03. Output signal : 4-20 mA DC.
 04. Signal Processing Unit : Silicon solid-state electronic circuitry
 05. Measuring element : Capsule/Diaphragm
 06. Element material : AISI-316 (Stainless Steel) or better
 07. Static Pressure/
Overload Pressure : Maximum line (or static) pressure on either side without permanent deformation or loss of accuracy
 08. Turn-down ratio : 60 : 1 minimum
 09. Span and Zero : Locally adjustable, non-interacting
 10. Enclosure class : IP-65
 11. Zero suppression /
elevation : At least 100% of Span
 12. Output Indicator : LCD type
 13. Nameplate : Tag number and Service engraved in SS tag plate
 14. Body : Forged Carbon Steel for air and flue gas application and SS for other application
 15. Ambient temperature : 0 - 50 °C
 16. Operating Voltage : 16 - 48 Volts DC
 17. Load : 600 Ohms (min.) at 24 Volts DC
 18. Performance:-
 - i) Accuracy : ±0.1 % of span or better
 - ii) Repeatability : ± 0.05 % of span or better
 - iii) Response time : 100 msec or better
 19. Sealing / Isolation : Extended diaphragm with 5 meters SS armoured capillary for viscous fluid applications.
 20. Accessories :
 - a) Universal mounting bracket suitable for 2" pipe mounting.
 - b) High tensile carbon steel U-bolts.
 - c) Siphon for steam and hot water services.
 - d) Companion flange with nuts, bolts and gaskets.
 - e) ½" NPT cable gland

- f) ½" NPT generally 5-valve stainless steel manifold, constructed from SS316 bar stock. 3 valve manifold for DP application in flue gas and air.

1.03.00 Displacer Type Level Transmitters

01. Type : Smart (HART compatible)
02. Stages of operation : Continuous
03. Material -
 - i) Displacer : AISI 316 SS
 - ii) Suspension wire : AISI 316 SS
 - iii) Torque tube housing : Carbon steel or SS as per application
 - iv) Torque tube : Inconel
 - v) Displacer chamber : CS or SS as per process application
 - vi) Transmitter Housing : Die cast aluminium or better
04. Operating Voltage : 16-48 Volts D.C.
05. Transmission : 2-wire
06. Output Signal : 4-20 mA DC.
07. Signal processing : Solid-state electronic circuitry
08. Static / overload pressure : Maximum static pressure without permanent deformation or loss of accuracy.
09. Turn-down ratio : 10 : 1 or better
10. Zero & Span : Easily accessible (local zero & span adjustment and non-interactive type)
11. Enclosure Class : IP-65
12. Output Indicator : LCD type
13. Nameplate : Tag number and Service engraved in stainless steel tag plate
14. Ambient Temperature : 0 - 50 °C
15. Load Impedance : 600 Ohms at 24 Volts (minimum)
16. Process Connection : 2" Companion flange with nuts, bolts and gaskets
17. Performance -
 - Accuracy : ± 0.5 % of span or better
18. Accessories :
 - a) Counter Flange, nuts, bolts, gaskets etc.
 - b) Weights for 5 point calibration of instruments.
 - c) Vent and drain plugs
 - d) Special calibration tool/configurator, if any.
 - e) ½"NPT cable gland

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| 19. | Preferred Features | : | a) Test plug connection and cutout terminals physically separated from other electronics.
b) Electronic Damping facility (adjustable). |
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| 1.04.00 | Mass Flow meter | | |
| 1.04.01 | Sensor | | |
| 01. | Measuring Principle | : | Coriolis Mass flow. |
| 02. | Primary Element | : | Flow Tube of 316SS or better |
| 03. | Heating Arrangement | : | Integral. |
| 04. | Temperature Control | : | For heavy fuel oil application. |
| 05. | Process Connection | : | Flanged of rating as per process requirement. |
| 06. | Drain | : | Self-draining facility |
| 07. | Enclosure | : | Stainless steel |
| 08. | Accessories | : | Counter flanges, Mounting nuts, bolts, gaskets etc. |
|
 | | | |
| 1.04.02 | Transmitter | | |
| 01. | Measured quantities | : | Mass Flow rate, Total Mass Flow, Density. |
| 02. | Input Signal Processing | : | Digital Processing. |
| 03. | Display | : | Digital Display (LCD). |
| 04. | Output | : | 2 off. isolated 4-20mA DC output. |
| 05. | Load | : | < 750 ohms. |
| 06. | Power supply | : | 240V AC, 50 Hz. |
| 07. | Turn Down | : | 100:1 |
| 08. | Accuracy | : | ± 0.2 % of measured value |
| 09. | Housing | : | IP 65 |
| 10. | Nameplate | : | Tag number, service engraved in stainless steel tag plate |
| 11. | Accessories | : | a) Handheld configurator
b) Mounting U-bolts, nuts, bolts, prefab cable etc.
c) ½"NPT cable gland |
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| 1.05.00 | Pressure Gauge and Differential Pressure Gauge | | |
| 01. | Type | : | Bourdon/Bellows/Diaphragm |
| 02. | Sensing & Socket | : | AISI-316 SS |
| 03. | Movement Material | : | AISI-304 SS |
| 04. | Case Material | : | Stainless steel. IP-65. |
| 05. | Dial Size | : | Generally 150 mm |
| 06. | Scale | : | Black lettering on white in 270 ° arc. |

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| 07. | Window | : | Shatterproof glass |
| 08. | Range Selection | : | Normal process pressure: 50~70 % of range |
| 09. | Over-range Protection | : | 125% of maximum range by internal stop. External stop at zero. |
| 10. | Adjustment | : | Micrometer screw for zero. Internal micrometer screw for range. |
| 11. | Element Connection | : | Argon welding |
| 12. | Process Connection | : | 1/2" NPT (M) Bottom for local, back for panel mounting. |
| 13. | Performance | : | Accuracy of ± 1.0 % of span or better. |
| 14. | Operating ambient | : | 0 - 50 °C |
| 15. | Safety Feature | : | Blow out disc /diaphragm at the back |
| 16. | Accessories | : | <ul style="list-style-type: none"> a) Snubbers and Glycerin filled for pulsating fluid applications and at pump discharge. b) Stainless steel Diaphragm seals for viscous fluids. c) 3-Way SS316 Gauge cock for pressure gauges. d) 5-valve SS316 manifold from barstock for differential pressure gauge. e) Siphons for steam and hot water services. |
| 17. | Applicable standard | : | IS-3624 / 1996 |
| 18. | Nameplate | : | Tag number, service engraved in stainless steel tag plate |

1.06.00 Temperature Gauge

- | | | | |
|-----|--------------------------|---|--|
| 01. | Type | : | Bimetallic or gas filled. |
| 02. | Sensing Element Material | : | Bourdon - AISI-316 SS |
| 03. | Capillary Armoring | : | Stainless steel flexible |
| 04. | Movement Material | : | AISI 304 SS |
| 05. | Bulb / Stem Diameter | : | 12 mm |
| 06. | Bulb / Stem Material | : | AISI 316 |
| 07. | Capillary | : | Stainless Steel |
| 08. | Connection to well | : | ½" NPT |
| 09. | Case Material | : | Stainless steel |
| 10. | Dial Size | : | 150 mm in general |
| 11. | Scale | : | Black lettering on white in 270 ° arc. |
| 12. | Mounting | : | Surface/Panel |
| 13. | Over range Protection | : | 125 % of range or more |

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|-----|-----------------------|---|--|
| 14. | Instrument connection | : | Bottom for local and back for panel mounting. |
| 15. | Range | : | Normal temperature—50~70% of range. |
| 16. | Zero adjuster | : | Micrometer screw adjustable from front. |
| 17. | Window | : | Shatterproof glass. |
| 18. | Accuracy | : | ± 1 % or better |
| 19. | Enclosure Class | : | IP-65 |
| 20. | Capillary | : | 5 meters (local surface)/15.0 meters (local panel) - armoured stainless steel |
| 21. | Compensation | : | Capillary and Case Compensation |
| 22. | Accessories | : | a) Forged barstock thermowell screwed as per ASME PTC code. Process connection M 33X2 (M).

Material of construction of Thermowell:
- SS 316: In general
- Inconel: For flue gas application
- Tungsten carbide: For coal mill application. |
| 23. | Nameplate | : | Tag number, service engraved in stainless steel tag plate |
- 1.07.00 Thermocouples
- | | | | |
|-----|----------------------|---|--|
| 01. | Type | : | a) Type-J (Iron Constantan) / Type-K (Chromel Alumel) / Type-R (Pt.-Rhodium Pt.) / Type-S (90% Pt – 10% Rhodium). [As per application]

b) Duplex
c) Ungrounded |
| 02. | Wire gauge | : | 16 AWG for Type-K, 24 AWG for Type-R |
| 03. | Standard | : | ANSI-MC 96.1. |
| 04. | Protecting Tube :- | | |
| | i) O.D. | : | 8 mm |
| | ii) Material | : | 316-SS Seamless |
| | iii) Filling | : | Magnesium Oxide (Purity above 99.4%) |
| 05. | Response time | : | a) < 20 seconds for measurement.
b) < 10 seconds for control. |
| 06. | Accuracy | : | ± 1.1 ⁰ C up to 300 ⁰ C & 0.4% of measured temperature range above 300 ⁰ C. |
| 07. | Head: | | |
| | i) Type | : | IP-65 universal screwed type. |
| | ii) Material | : | Die cast aluminum or better |
| | iii) Terminal blocks | : | Nickel plated Brass - screw type/ silver plated |

- iv) Instrument connection : ½" NPT to well
- v) Cable connection : ½" NPT gland and grommet.
- vi) Others : Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells.

08. Accessories :
- a) Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT (M)] with thermowell connection
 - b) Compression fittings/unions
 - c) Flanges etc. (for flanged connections only)
 - d) Forged barstock thermowell as per ASME PTC code. Process connection M 33X2 (M) in general or 1½" Flanged for Flue gas/Furnace/Air etc. application.

Material of construction of Thermowell:

SS 316: In general

Inconel: For flue gas application

Tungsten carbide: For coal mill application.

09. Nameplate : Tag number, service engraved in stainless steel tag plate

1.08.00 Resistance Temperature Detector

- 01. Type : Platinum (Duplex), Ungrounded
- 02. Resistance : 100 ohm at 0 °C
- 03. Base : Wound on ceramic (anti-inductive)
- 04. Wiring : 3 /4 Wire
- 05. Protecting Tube :-
 - i) O.D. : 8 mm
 - ii) Material : SS-316, Seamless
 - iii) Filling : Magnesium oxide (Purity above 99.4%).
- 06. Response time :
 - a) < 20 seconds for measurement.
 - b) < 10 seconds for control.
- 07. Calibration : DIN 43760
- 08. Accuracy : ± 0.5%
- 09. Head :

- | | | |
|---------|--------------------------|--|
| | i) Type | : IP-65 universal screwed type. |
| | ii) Material | : Die cast aluminum or better |
| | iii) Terminal blocks | : Nickel plated Brass-screw type / silver plated |
| | iv) Cable connection | : ½" NPT gland and grommet. |
| | v) Others | : Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells |
| 10. | Accessories | : a) Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT (M)] with thermowell connection
b) Compression fittings/unions
c) Flanges etc. (for flanged connections only)
d) Forged/barstock thermowell as per ASME PTC code. Process connection M33X2 (M). |
| | | Material of construction of Thermowell:
SS 316: In general
Inconel: For flue gas application
Tungsten carbide: For coal mill application. |
| 11. | Nameplate | : Tag number, service engraved in stainless steel tag plate |
| 1.09.00 | Pressure Switch | |
| 01. | Type | : i) Piston for high pressure application
ii) Bellow / Diaphragm for low pressure application |
| 02. | Sensing element material | : AISI SS-316. All other wetted part SS316. |
| 03. | Case Material | : Die-cast aluminum alloy, neoprene gasket. |
| 04. | Setter Scale | : Black graduation on white linear scale. Graduation 0-100% with red pointer for set points. |
| 05. | Over range | : 150 % of maximum pressure |
| 06. | Adjustments | : a) Internal Set Point
b) Differential adjustment |
| 07. | End Connection | : 1/2" NPT (M) bottom connected |
| 08. | Switch configuration | : Two SPDT |
| 09. | Switch Rating | : 240V, 5A AC/220V, 0.5A DC |

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|-----|---------------------|---|--|
| 10. | Switch Type | : | Snap acting, shock & vibration proof |
| 11. | Terminal Block | : | Suitable for full ring lugs. |
| 12. | Cable connection | : | ½" NPT conduit connection. |
| 13. | Enclosure Class | : | IP-65. |
| 14. | Performance | : | a) Repeat accuracy $\pm 1.0\%$
b) Accuracy of Setting Indication of $\pm 1.5\%$ |
| 15. | Ambient temperature | : | 0 – 50 Deg.C |
| 16. | Nameplate | : | Tag number, service engraved in SS tag plate |
| 17. | Accessories | : | a) Remote diaphragm seal with SS-316 capillary for viscous & corrosive application.
b) Siphons for steam and hot water services.
c) Retention ring and screws for surface mounting.
d) ½" NPT 2 Valve SS-316 barstock manifold
e) ½" NPT cable gland |
- 1.10.00 Differential Pressure Switch
- | | | | |
|-----|--------------------------|---|---|
| 01. | Type | : | Bellows / Diaphragm / Piston actuated |
| 02. | Sensing element material | : | AISI SS-316. For all other wetted part SS 316 |
| 03. | Case Material | : | Die-cast aluminum alloy with neoprene gasket. |
| 04. | Setter Scale | : | Black graduation on white scale with 0-100% graduation and provided with red pointer for set point adjustment |
| 05. | Over range | : | Static pressure on any one side, the other side being open to atmosphere. |
| 06. | Adjustments | : | a) Internal set point adjustment
b) Differential adjustment |
| 07. | Process Connection | : | 1/2" NPT (M) bottom / back connected. |
| 08. | Switch configuration | : | Two SPDT |
| 09. | Switch rating | : | 240V, 5A AC/220V, 0.5A DC. |
| 10. | Switch type | : | Snap acting type contacts, shock and vibration proof. |
| 11. | Terminal Blocks | : | Suitable for full ring lugs for cable connection. |
| 12. | Cable Connection | : | ½" NPT conduit connection or compression gland. |
| 13. | Performance | : | a) Repeat accuracy $\pm 1.0\%$
b) Accuracy of set point Indication: $\pm 1.5\%$ |

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|-----|--|---|--|
| 14. | Operating Ambient | : | 0 - 50 °C (Maximum Continuous) |
| 15. | Enclosure | : | IP-65 |
| 16. | Accessories | : | a) Snubbers for pulsating fluid application.
b) Syphons for steam and hot water services.
c) Retention ring and screws for surface mounting.
d) 1/2" NPT 3-Valve SS-316 manifold constructed from barstock
e) 1/2" NPT Cable gland |
| 17. | Nameplate | : | Tag number, service engraved in stainless steel tag plate |
| 18. | Remote Seal type for special application | : | a) Silicone oil / fluorolube filled remote diaphragm seal for dirty / viscous / corrosive fluid.
b) SS armoured capillary at least 3 meters each.
c) Adapter flanges with nuts, bolts and gaskets for instrument and process side. |
- 1.11.00 Level Switch
- | | | | |
|-----|------------------------------|---|---|
| 01. | Type | : | External cage float operated. Magnetically coupled. |
| 02. | Float Material | : | AISI-316 stainless steel or better |
| 03. | Other wetted parts | : | AISI-316 stainless steel or better |
| 04. | External Cage | : | Carbon steel / Stainless steel as per process requirements, welded type / flanged construction. Cage pressure rating shall equal or exceed the rating of the main vessel. |
| 05. | External cage mounting | : | Side-Side. |
| 06. | External cage connection | : | 25 NB socket welded. |
| 07. | Switch housing | : | Epoxy coated die-cast aluminum alloy with neoprene gasket conforming to IP-65. |
| 08. | Type of switch configuration | : | 2 SPDT (two nos.) |
| 09. | Contact rating | : | 5A, 240V/AC, 0.25A, 220V DC |
| 10. | Accessories | : | a) Counter flange, nuts & bolts, suitable gasket etc. |

- b) Steel globe type drain valve.
- c) ½"NPT cable gland
- d) Stainless steel nameplate with alpha-numeric engraved for service and tag.
11. Preferred feature : Switch operating point marked on cage
12. Mounting : On standpipe
- 1.12.00 Conductivity Type Level Switch
01. Type : Conductivity discrimination.
02. Application : Drain pots viz. on CRH line
03. Mounting : Flanged – on external cage.
04. Probe MOC : Stainless steel with high purity ceramic.
05. Probe rating : > Maximum design pressure of vessel.
06. Input : Four independent channel with selectable switching threshold for water conductivity.
07. Relay Output : Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.
08. Contact type & rating : 2SPDT or 1 DPDT @ 5A 30V DC.
09. Local Display : Coloured LEDs for Hi, Lo, Hi-Hi, Lo-Lo, Power & fault.
10. Power supply : Dual 240V AC, 50 Hz, 1Ph.
11. Enclosure : IP-65, corrosion resistant & wall mounting type (Explosion proof for NEC Class-1, Division-1 area).
12. Accessories : a) PTFE cable from probe to electronics
b) Mounting accessories
c) External cage
d) Washer & gasket
13. Test pressure : Two times rated pressure
14. Cable connection : ½" NPT with cable gland
- 1.13.00 Orifice Plate
01. Application : Low fluid velocity flow measurement
02. Design Standard : BS-1042, Part-I
03. Number of Tapings : As required plus one additional pair of taps
04. Diameter Ratio : Between 0.4 to 0.7
05. Thickness : 3 mm for main pipe diameter up to 250 mm, 6 mm for main pipe diameter above 250 mm and 10 mm for main pipe diameter of 500 mm and above.

- | | | | |
|--|--------------------|---|---|
| 06. | Document | : | Beta ratio calculation, assembly drawing and Flow vs. DP curve. |
| 07. | Meter run pipe | : | Same as pipe material |
| 08. | Accessories | : | Flanges, gaskets, nuts & bolts, root valves jack screw, meter run pipe, Drain & vent hole as per application etc.. |
| 1.14.00 Flow Nozzle | | | |
| 01. | Application | : | High fluid velocity flow measurement |
| 02. | Design Standard | : | ASME PTC 19.5 |
| 03. | Number of Tappings | : | As required plus one additional pair of taps |
| 04. | Diameter Ratio | : | Between 0.4 and 0.7 |
| 05. | Thickness | : | Suitable for the application |
| 06. | Document | : | Beta ratio calculation, assembly drawing and Flow vs. DP curve. |
| 07. | Meter run pipe | : | Same as pipe material |
| 08. | Accessories | : | Meter run pipe, nipples and root valves.
(Inspection port assembly for nozzles used in plant performance purpose) |
| 1.15.00 Gauge Glass | | | |
| 01. | Type | : | Reflex |
| 02. | Glass | : | Toughened borosilicate. Resistant to mechanical and thermal shocks. |
| 03. | Body material | : | Carbon steel / stainless steel- As per process requirements (Flanged Connection) |
| 04. | Pressure rating | : | Twice the maximum working pressure |
| 05. | Temperature rating | : | As required |
| 06. | Bolts and nuts | : | Rust proof alloy steel |
| 07. | Accessories | : | Suitable ball check valves of SS-304/316 body, gaskets, companion flange etc. |
| 1.16.00 Power Cylinders (Pneumatic) | | | |
| 01. | Mounting Type | : | a) Fixed position mounting (End mounting).
b) Trunnion mounting |
| 02. | Control Signal | : | 4-20 mA DC to electro-pneumatic positioner. 24V DC operated solenoid valve operating on pneumatic line for open & closing purpose of on & off drive. |
| 03. | Supply Air | : | 0-7 Kg / Cm ² . |
| 04. | Selection | : | Based upon thrust / torque, stroke length, angular movement, full-scale travel time, repeatability, space factor etc. Provision for air-to-open and air-to-close operation. |

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| 05. | Casing | : | IP-65. |
| 06. | Accessories | : | a) Air lock relay
b) Hand wheel.
c) Air filter regulator with gauge.
d) Volume Booster.
e) Limit Switches.
f) Positioner with Input and Output pressure gauges, local keypad & display.
g) Solenoid Valve
h) Integral non contact type position Transmitter (4-20 mA DC linear output).
i) Junction box with cable gland |
| 07. | Fail-safe operation | : | For regulating duty- stay put against power & air fail. |
| 08. | Repeatability | : | Better than 0.5% of full travel. |
| 09. | Hysteresis | : | Less than $\pm 1\%$ of full travel |
| 10. | Operating Temp. limit | : | 50 Deg. C (min.) |
| 1.17.00 | Smoke Density Analyzer | | |
| 01. | Type | : | In-situ infra red |
| 02. | Principle of measurement | : | Transmission & absorption (Dual beam type) |
| 03. | Light source | : | Modulated high intensity LED |
| 04. | Display | : | Back Lit LCD |
| 05. | Measurement range | : | 0-999 mg/m ³ , 0-999 mg/Nm ³ , 0-100% opacity |
| 06. | Measurement averaging | : | Selectable 10 sec to 60 minutes |
| 07. | Accuracy | : | 0.2% opacity |
| 08. | Resolution | : | 0.1% opacity |
| 09. | Linearity | : | 0.1% opacity |
| 10. | Repeatability | : | 0.1% opacity |
| 11. | Flue gas temperature | : | 350 °C (max 600 °C) |
| 12. | Ambient temperature | : | 0 - 60 °C |
| 13. | Operating temperature | : | Transmitter & receiver- 0-90°C, Electronic unit - 70 °C |
| 14. | Mounting | : | Transceiver on opposite side of the duct |
| 15. | Analog output | : | 4-20mA DC (in 500 ohm resistance) to |
| 16. | Alarm output | : | 2 SPCO potential free rated at 230 VAC, 5A |
| 17. | Power Supply | : | 240V AC, 50 Hz, 1 Phase |
| 18. | Automatic misalignment detection | : | Required |

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|-----|--|---|---|
| 19. | Automatic compensation of lens contamination | : | Required |
| 20. | Purge air Failure | : | Purge air to be provided from Blower unit and to be monitored for failure. |
| 21. | Span and Zero Check | : | Automatic periodic with manual override |
| 22. | Housing | : | Corrosion resistant painted aluminium rated at IP-65 |
| 23. | Fail safe shutter | : | Automatic fail safe shutter against power and air failure |
| 24. | Input normalisation | : | Correction for temperature, pressure, oxygen and water vapour to be provided. |
| 25. | Preferred Features | : | "Power Supply On" LED visible from front |
| 26. | Accessories | : | <ul style="list-style-type: none"> a) Mounting pads suitable for mounting projector and receiver units on duct, flanges, etc. b) Blower unit (Purging System) with purge fail alarm at CCR c) Enclosure for electronic units & indicators d) Control unit for interface with PC based data logger |
| 27. | Application | : | <p>At chimney</p> <p>At each ESP outlet</p> |
- 1.18.00 SO_x, NO_x, CO, CO₂, O₂ & Moisture Analyzer
- | | | | |
|-----|--------------------------|---|--|
| 01. | Type | : | In-situ Probe type combined analyser / Sampling extraction type. |
| 02. | Gases to be measured | : | SO _x , NO _x , CO, CO ₂ , O ₂ and Moisture |
| 03. | Principle of measurement | : | Infrared absorption |
| 04. | Flue gas Temperature | : | 350 °C |
| 05. | Ambient temperature | : | 60 °C |
| 06. | Mounting | : | On chimney |
| 07. | Measurement range | : | 0-3000 ppm / mg/Nm ³ for SO _x , NO _x , CO, O ₂ and 0-25% for CO ₂ and Moisture - fully selectable |
| 08. | Units of measurement | : | PPM, mg / Nm ³ and % |
| 09. | Power Supply | : | 240V, 50 Hz, 1 Phase |
| 10. | Local Display | : | Back lit LCD / LED |
| 11. | Measurement averaging | : | 10 sec to 60minutes (selectable) |
| 12. | Accuracy | : | 2% of measured value |
| 13. | Repeatability | : | 2% of full scale |
| 14. | Response time | : | 5 seconds or better for 95% of full scale |

	15. Zero & Span drift	: 2% per month
	16. Calibration	: Zero and Span calibration in manual and automatic mode. Automatic calibration interval shall be fully selectable.
	17. Analog output	: 4-20 mA DC (in 500 ohm resistor) to for each channel
	18. Alarm output	: 1NO + 1NC rated at 230V AC, 5A
	19. Input normalisation	: Required—online with pressure and temperature sensor and also provision for key pad entry of inputs
	20. Probe material	: Stainless Steel 316L
	21. Enclosure	: Corrosion resistant epoxy painted aluminium housing & enclosure rated to IP-65.
	22. Accessories	: a) Blower unit, tubes & fittings for calibration and purging, purge fail alarm in CCR b) Calibration gas cylinders for SO ₂ , NO _x , CO ₂ , O ₂ and CO filled in 10 Ltrs. Of WC carbon cylinder with necessary SS regulators with pressure & flow gauges, solenoid valve & SS tubings and SS fittings etc. as required. c) Mounting flanges, gasket etc. d) Control unit for interface with PC based data logger
	23. Application	: On flue gas stack.
1.19.00	Stack Gas Velocity Monitor	
	01. Type	: Non contact type
	02. Measurement	: Flue gas velocity
	03. Principle of measurement	: Time delay correlation of flue gas Infrared emission received by two detectors located at a distance apart on the chimney.
	04. Flue gas Temperature	: Up to 350 ° C
	05. Ambient temperature	: 60 ° C
	06. Mounting	: On chimney
	07. Measurement range	: As required
	08. Units of measurement	: velocity- m/sec, flow- m ³ /sec
	09. Power Supply	: 240V, 50 Hz, 1 Phase
	10. Local Display	: Back lit LCD / LED
	11. Measurement averaging	: 10 sec to 60minutes (selectable)
	12. Accuracy	: 2% of measured value
	13. Linearity	: 2% of full scale

	14.	Response time	:	5 seconds or better for 95% of full scale
	15.	Zero & Span drift	:	2% per month
	16.	Calibration	:	Zero and Span adjustment
	17.	Analog output	:	4-20 mA DC (in 500 ohm resistor) to for each channel
	18.	Probe material	:	Stainless Steel 316L
	19.	Enclosure	:	Corrosion resistant epoxy painted aluminium housing & enclosure rated to IP-65.
	20.	Accessories	:	a) Blower unit, tubes & fittings for calibration and purging, purge fail alarm in CCR b) Mounting flanges, gasket etc. c) Control unit for interface with PC based data logger
	21.	Application	:	On chimney
1.20.00		Oxygen Analyzer		
	01.	Type	:	In-situ, Zirconium sensor, micro-processor-based transmitter, field repairable.
	02.	Range	:	0.1-10% / 0.25-25% by volume
	03.	Output	:	4-20 mA DC linear
	04.	Probe Length	:	1800 mm (approximate depending on duct size)
	05.	Process Temperature	:	850 °C approx.
	06.	Measurement Reference	:	Instrument Air
	07.	Accuracy	:	±1% of F.S.
	08.	Response Time	:	Less than 5 (five) seconds
	09.	Amplifier Housing	:	IP-65
	10.	Calibration	:	Automatic periodic
	11.	Calibration Frequency	:	Once every 24 hours
	12.	Power Supply	:	240V, 50 Hz, 1 Phase
	13.	Material for Gas Carrying Components	:	Stainless Steel
	14.	Read Out	:	LED/LCD Local indicating meter
	15.	Protection	:	Automatic cell protection against reducing atmosphere
	16.	Alarm Facility	:	1 HI and 1 LO independently adjustable over span. Contact rating 500 mA at 220 V DC (minimum).
	17.	Preferred Features	:	a) HI and LO alarm LED visible from front. b) Power Supply On/Failure LED visible from front

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| 18. | Accessories | : | a) Mounting flanges, adaptor plate and protection shield
b) Gasket, nuts and bolts
c) Cable with conduit from cell to amplifier (as required) and other special cables (if any)
d) Automatic calibration kit (complete with all accessories and standard Gas Cylinders) |
| 19. | Application | : | a) At each economizer outlet
b) At each air preheater outlet |
- 1.21.00 CO, NOx & Moisture Analyzer
- | | | | |
|-----|--------------------------|---|---|
| 01. | Type | : | In-situ Probe type combined analyser |
| 02. | Gases to be measured | : | CO, NOx and Moisture |
| 03. | Principle of measurement | : | Infrared absorption |
| 04. | Flue gas Temperature | : | 850 ° C (max) |
| 05. | Ambient temperature | : | 60 ° C |
| 06. | Mounting | : | On duct |
| 07. | Measurement range | : | 0-3000 fully selectable |
| 08. | Units of measurement | : | PPM and mg / Nm ³ |
| 09. | Power Supply | : | 240V, 50 Hz, 1 Phase |
| 10. | Display | : | Back lit LCD / LED |
| 11. | Measurement averaging | : | 10 sec to 60minutes (selectable) |
| 12. | Accuracy | : | 2% of measured value |
| 13. | Repeatability | : | 2% of full scale |
| 14. | Response time | : | 5 seconds or better for 95% of full scale |
| 15. | Zero & Span drift | : | 2% per month |
| 16. | Calibration | : | Zero and Span calibration in manual and automatic mode. Automatic calibration interval shall be fully selectable. |
| 17. | Analog output | : | 4-20 mA DC (in 500 ohm resistor) to for each channel |
| 18. | Alarm output | : | 1NO + 1NC rated at 230V AC, 5A |
| 19. | Input normalisation | : | Required – online with pressure and temperature sensor and also provision for keypad entry of inputs |
| 20. | Probe material | : | Stainless Steel 316L |
| 21. | Enclosure | : | Corrosion resistant epoxy coated aluminium housing & enclosure rated to IP-65. |

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| 22. | Accessories | : | a) Blower unit, tubes & fittings for calibration and purging, purge fail alarm in CCR |
| | | | b) Calibration gas cylinders for NO _x and CO filled in 10 Ltrs. of WC carbon cylinder with necessary SS regulator, SS gauges, SS tubings and SS fittings etc. as required. |
| | | | c) Mounting flanges, gasket etc. |
| 23. | Application | : | At economizer outlet |
| 1.22.00 | H2 + CO2 + Air Analyzer | | |
| 01. | Type | : | Thermal Conductivity |
| 02. | Range Selection | : | 3 ranges (H ₂ in CO ₂ , H ₂ in air and CO ₂ in air) |
| 03. | Range | : | As required |
| 04. | Output | : | 4-20mA DC (Isolated) |
| 05. | Operating ambient temp. | : | 10 ° C to 50 Deg. C |
| 06. | Power Supply | : | 240V AC, 50Hz |
| 07. | Sample gas flow control | : | Required |
| 08. | Reference gas flow | : | Required |
| 09. | Reference gas pressure regulator | : | Required |
| 10. | Cell response | : | 95% of change in 30 Sec.(Appox.) |
| 11. | Accuracy | : | 2% of full scale |
| 12. | Repeatability | : | 1% of full scale |
| 13. | Local Indicator | : | Indicating meter of 1% accuracy |
| 14. | Alarm facility | : | Dual (High & Low) independently adjustable. |
| 15. | Contact rating | : | 0.5A at 220 V AC |
| 16. | Enclosure | : | Flame Proof |
| 17. | Accessories | : | Calibration gas, mounting accessories and others as required to be provided |
| 18. | Application | : | Generator Gas Purity. |
| 1.23.00 | Radar Type Level Measurement | | |
| 01. | Type | : | Radar based on Time Domain Reflectometry |
| 02. | Antenna | : | Co axial / single rod type guided wave or Horn type as required for the application |
| 03. | Communication | : | Two wire 4-20mA DC, HART or Field Bus protocol. |
| 04. | Environmental temperature | : | 0 – 50 °C |
| 05. | Enclosure | : | Explosion proof /IP 65 as per application |
| 06. | Cable Entry | : | ½" NPT |

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|-----|---------------------------|---|---|
| 07. | Calibration | : | a) Self calibration with internal reference
b) Zero & Span calibration |
| 08. | Programming | : | Handheld programmer & Local keypad |
| 09. | Process Connection | : | Flanged /screwed |
| 10. | Electronic Housing | : | Epoxy painted Die-Cast aluminium alloy |
| 11. | Antenna / Flange assembly | : | 316 SS or Hest alloy (as required) |
| 12. | Output Indicator | : | Digital Integral Display |
| 13. | Accuracy | : | 5 mm or 0.1% of probe length |
| 14. | Accessories | : | a) Programming tool kit
b) Gasket |
- 1.24.00 Temperature Switch
- | | | | |
|-----|--------------------------|---|--|
| 01. | Type | : | Bimetallic or gas filled. |
| 02. | Sensing Element Material | : | Bellow / Bourdon AISI SS-316 |
| 03. | Bulb Material | : | AISI SS-316 |
| 04. | Capillary | : | Stainless steel armored |
| 05. | Movement Material | : | AISI SS-304 |
| 06. | Case material | : | Epoxy coated steel plate or die-cast aluminum alloy with neoprene gasket and clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area). |
| 07. | Scale | : | Black lettering on white background |
| 08. | Over range Protection | : | 120 % |
| 09. | Instrument connection | : | Bottom |
| 10. | Switch configuration | : | Two SPDT |
| 11. | Switch rating | : | 240V, 5A AC/220V, 0.5A DC |
| 12. | Switch type | : | Snap acting, shock and vibration-proof. |
| 13. | Adjustability | : | Internal Set point adjustable over span range |
| 14. | Cable connection | : | 3/4" ET conduit connection or compression gland. |
| 15. | Compensation | : | a) Capillary compensation with invar wire throughout the capillary length.
b) Case compensation |
| 16. | Performance : | | |
| | i) Scale Accuracy | : | ± 1.0 % of full scale |
| | i) Repeatability | : | < 0.5 % of full range |
| | ii) Response time | : | Less than 40 seconds with thermowell |
| 17. | Capillary length | : | 5 meters (minimum) for local mounting/15 meters for local panel mounting. |

	18. Nameplate	:	Tag number, service engraved in stainless steel tag plate
	19. Accessories	:	Mounting accessories, 3/4"ET cable gland.
1.25.00	Rotameter		
	01. Type	:	On-line up to 2". By-pass above 2"
	02. Metering tube	:	Borosilicate glass
	03. Float	:	AISI 316-SS unless the process fluid demands some other material.
	04. Body MOC	:	AISI 316-SS
	05. Scale	:	Graduated- Engraved black on white background.
	06. Process connection	:	Flanged
	07. Accuracy	:	± 2% of full scale detection or better for on-line type and ±4% of full-scale detection or better for by-pass type.
	08. Nameplate	:	Tag number, service engraved in stainless steel tag plate
	09. Accessories	:	Slip-on orifice plate of 316-SS and taps of Stainless Steel as per application requirements. Applicable SS Isolation valves and SS Range Orifice - for bypass type rotameters.
1.26.00	I/P Converter		
	01. Type	:	Electro-pneumatic (Outdoor Type)
	02. Input level	:	4-20 mA DC
	03. Output range	:	0.2 to 1.0 Kg/Sq. cm With 'Fail Freeze' feature. (i.e in case of wire snapping the last good value of pneumatic signal out put will hold for at least six hours)
	04. Split range	:	For typical application wherever required.
	05. Control Action	:	Selectable air to close, air to open and fail freeze application
	06. Supply pressure	:	1.2 to 1.6 Kg/cm ² (1.4 typical)
	07. Max. supply pressure	:	7 Kg/ sq.cm.
	08. Response Time	:	5 Seconds for 0 to 90% output pressure
	09. Housing	:	IP 55
	10. Repeatability	:	±0.1% of span
	11. Accuracy	:	± 0.25% of span
	12. Supply pressure effect	:	Less than 1%
	13. Span and Zero adjustments	:	Screw
	14. Pneumatic connection	:	1/4" NPT

	15. Stability	: Less than 0.25% of Span / Zero for six months.
	16. Cable connection	: ¾" ET
	17. Mounting	: Field (pipe/wall mounting)
	18. Accessories	: Air filter regulator, mounting accessories, cable gland etc.
1.27.00	Air Filter Regulator	
	01. Filter Element	: Sintered Bronze
	02. Filter Size	: 5 microns
	03. Input Air	: 10.0 Kg/Sq. cm (maximum)
	04. Output	: Adjustable from 0-2.0 Kg / Sq. cm or 0-7.0 Kg / Sq. cm (continuous) as applicable for I/P converter, control drives and control valve
	05. Effect of Supply	: Maximum 0.02 Kg/Sq. cm for a change pressure variation in supply pressure of 4 Kg/Sq. cm
	06. Bowl Material	: Metallic cover around high temperature area / clear transparent polycarbonate with metallic cover for ordinary applications.
	07. Accessories	: 2" dial size output pressure gauge
	08. Desirable Feature	: No perceptible drop of pressure on opening the drain port.
1.28.00	Solenoid Valve	
	01. Operating Principle	: Electromagnetic (noiseless)
	02. Coil voltage rating	: 240 V AC / 220 V DC/24 V DC/110 V (as required)
	03. Ways	: Generally 3-ways other depending on requirement
	04. Port size	: 1/4" NPT all ports
	05. Body	: SS bar stock
	06. Trim	: SS-316
	07. Duty	: Suitable for continuous energization
	08. Sealing	: Airtight and leak proof
	09. Ambient Temperature	: 0 - 50 ° C
	10. Fluid Temperature	: 0-150 ° C (approx.)
	11. Coil Enclosure	: Stainless Steel
	12. Insulation	: Class-H
	13. Coil Casing	: IP-65 (Explosion proof for NEC Class-1, Division-1 area)
	14. Mounting	: On pipe or on panel
	15. Cable Connection	: 3/4" ET
	16. Accessories	: Mounting brackets, nuts and bolts

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| 17. | Preferred feature | : | a) Solenoid valve directly integral to actuator body shall have NAMOOR interface for uniformity
b) Local indication for power |
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| 1.29.00 | Sight Glass | | |
| 01. | Type | : | Flap-type |
| 02. | End connection | : | Screwed / Flanged |
| 03. | Material: | | |
| | a) Body | : | CS/SS as per process medium |
| | b) Indicator | : | Stainless steel |
| 04. | Sight Glass | : | Toughened Borosilicate |
| 05. | Gasket | : | Neoprene |
| 06. | Bolts & Nuts | : | High tensile steel |
| 07. | Hydraulic Test Pressure | : | 1.5 times maximum working pressure |
| 08. | Accessories | : | As required |
|
 | | | |
| 1.30.00 | Flow Indicating Switch | | |
| 01. | Type | : | On line metal tube Rotameter |
| 02. | End connection | : | Flanged |
| 03. | Material: | | |
| | a) Body | : | CS/SS as per process medium |
| | b) Float | : | Stainless steel |
| | c) End fittings/flange | : | Stainless steel |
| | d) Other wetted part | : | Stainless steel |
| | b) Casing | : | Di cast Alluminium |
| 04. | Accuracy | : | +/- 2.0% of FSR |
| 05. | Rangeability | : | 10:1 |
| 06. | Electrical connection | : | ¾" ET |
| 07. | Switch type | : | Snap acting hermitically sealed 2 nos. SPDT |
| 08. | Contact rating | : | 5A, 240V AC |
| 09. | Protection class | : | IP-65 |
| 10. | Accessories | : | As required |
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| 2.00.00 | CLOSED CIRCUIT TELEVISION SYSTEM | | |
| 2.01.00 | Closed Circuit Television System | | |
| 2.01.01 | Closed Circuit Television System (CCTV) with all equipment and accessories shall be installed for the purpose of surveillance of major plant areas. Also, cameras shall be installed at the Main plant (TG Hall, Boiler ESP) and other common auxiliary plants. | | |
| 2.01.02 | The CCTV system shall meet the specific functional & design requirements towards collecting live video information from the various areas of the plant and displaying that information at monitors. | | |

08507

21.00.00	WATER SYSTEM RELATED SPECIAL INSTRUMENTS(DM PLANT, CPU PLANT, PT PLANT, AWRS ETC)	
21.01.00	ANALYSER INSTRUMENTS:	
	Common Requirements	
	1	Output signals Analog 4-20 mA DC
	2.	Zero & span Adjustment To be provided
	3.	Ambient temp. 50°C
	4.	Indication LCD
	5.	Enclosure Type/Material Weather & Dust proof (IP 55) Die cast Aluminium/SS
	6.	Type of Electronics Microprocessor based
	7.	Calibration Auto & Manual (hand held HART calibrator)
	8.	Error Diagnostic To be provided.
	9.	Power supply 240V AC 50, Hz single phase/ 24 V DC. Power supply is to be arranged by Contractor. In case the Analysers require UPS, then the same shall also be in the scope of Contractor.

21.02.00	10	Load	500 Ohms minimum
	11.	Other Requirements	Instruments shall be HART compatible All mounting arrangements for the sensors and the monitors are to be provided by the Contractor. A free standing cabinet is to be provided by the Contractor for mounting the transmitters/meters. All weather canopy for protecting the electronics/sensors are to be provided. The analyser type, model and make shall be as approved by Employer during detailed Engineering. The estimated volume of reagents required for 30 days continuous operation of each analyser and their estimated cost FOB shipping point with freight allowed to the plant site shall be submitted. All chemical reagents for 12 months operation of the analyser shall be furnished. Shelf life of reagents shall also be indicated in the proposal. Auto & Manual (hand held HART calibrator) To be provided.
		pH Analyser	
	1.	Type	Cell - flow through
	2.	Accuracy	$< \pm 1\%$ of span
	3.	Response time	< 5 minutes.
	4.	Range	0 - 14 pH, programmable
	5.	No. of streams	Single
	6.	Stability	< 0.001 pH / week
	7.	Temp. coefficient / Temp. error	0.001 pH / Deg. C

21.03.00

8. Type of electronics Microprocessor based with self-diagnostic Facility.
9. Indication Digital
10. Enclosure Weather dust proof (IP55) Die cast aluminum.

Conductivity Monitors

Specific conductance cell

Specific conductance cell shall be provided with suitable electrode material and cell body material taking into account the various factors of actual service conditions, corrosion resistance etc. Cell constant shall be subject to Owner's approval, the cell shall be provided with automatic temperature compensation. The specific conductance cell shall be suitable for use in the plant discharge water.

Conductivity cells are shall be compatible with the conductivity monitors.

The monitor shall have the following design features :

- a) Power supply : 240V AC 50, Hz single phase/ 24 V DC
- b) Range : 0-1, 0-10, 0-100, 0- 1000, 0- 10,000 micro mho/cm
programmable.
0-2500 ppm for dissolved solids.
- c) Signal accuracy : Approximately 1% of full scale
excluding meter
accuracy
- d) Temperature : Automatic
compensation
- e) Response time : <=1 sec.
- f) Identification : Phenolic nameplate stating monitor number, sample
and conductivity cell number.
- g) Output : 4-20 mA DC buffered output capable of driving a
minimum load impedance of 500 Ohms.

Analysers, monitors shall be microprocessor based.

The monitor shall be of multi-range type, single range monitor shall not be acceptable.

21.04.00	Turbidity Analyser
	Type Light reflection principle
	Accuracy <=2% Low range <=5% High range
	Response Time(90 % of Full Scale) <= 5 Min.
	Range 0-100, 0-200 NTU programmable.
	No. Of Streams Single
21.05.00	Residual Chlorine Analyser
	a An automatic chlorine residual analyser of amperometric type shall be provided alongwith the chlorinating plant for monitoring the residual chlorine content of cooling water. The analyser shall be suitable for accurate residual measurement in open/closed systems. The measurement accuracy shall not be affected by presence of treatment chemicals as chromates, phosphates, de-former highly polluted water, change in temperature etc.
	b The analyser shall comply with the following specification requirements, as a minimum
	(i) Indicator : Provision of LC display in the panel of analyser.
	(ii) Range : 0 to 20.0 mg/L (ppm)
	(iii) Accuracy : 2% or better
	(iv) Sensitivity : 0.01 mg/l
	(v) Output signal : 4-20mA DC isolated output, capable of driving a load resistance of 500 Ohms minimum.
	(vi) Alarm annunciation : High and low alarms to be provided on panel and shall be field adjustable.
	(vii) Calibration : Zero and span adjustment facility to be provided. Final calibration adjustments of the analyser to be done at site and duly verified by titration. Temperature compensation range 0 to 50 deg.C.
	(viii) Connections : All connections for sampling drain etc. to be provided.
	(ix) Cabling : All field cabling power cables and panel wiring etc., to be provided.

- (x) Mounting : The analyser shall be suitable for field mounting conform to protection class IP-55.
- (xi) Power supply : Suitable for 240V AC 50, Hz single phase/ 24 V DC.
- (xii) Electrodes : Platinum/Gold and copper electrodes shall be provided with cell cleaning system.
- (xiii) Chemical reagents : All chemical & reagents required for normal operation and routine maintenance shall be provided for 12 months. Shelf life of reagents shall be indicated in the proposal.
- (xiv) Type & Make : The analyser type, model and make shall be as approved by Employer during detailed Engineering.

(c) Circulating water as sample to residual chlorine analyser shall be taken from hot circulating water pipe work before entry to cooling towers. Exact location and layout of sampling arrangement shall be finalised during detailed engg. stage. Bidder shall provide necessary pumping system (with 100% standby) for meeting the analyser requirements, if needed. All the drains shall be terminated upto the nearest Employer's plant drainage system.

21.06.00

Silica Analyser

Silica analysers shall be continuous colorimetric type and shall be furnished complete with all required accessories, piped, wired and mounted in the analyser section of panel. The analyser shall be designed to accurately determine silica concentrations in the presence of phosphate.

The analyser shall have the following design features :

- a) Sample : 50-150ml per minute
- b) Power supply : Power supply is to be arranged by Contractor
- c) Drain : Open, corrosion resistant drain
- d) Range : 0-50, 0-100, 0-500 ppb freely programmable.
- e) Accuracy : $\pm 5\%$ of measured value
- f) Terminal Points : All components piped and wired to terminal points.
- g) Temperature compensation : Automatic
- h) Phosphate intrference error : Upto 30 mg/l, error negligible. Above 30 mg/l phosphate error 1% of reading.

21.07.00	i) Output	: 4-20 mA DC buffered output capable of driving a minimum load impedance of 500 Ohms.
	Analyser shall be of multi range as indicated above. Single range analyser will not be acceptable.	
	Solenoid valves for automatic reagent shunt off on loss of sample to be provided.	
	Requirements Sodium Analyser	
	Type	Continuous Flow Through sample
	Power supply	Power supply is to be arranged by Contractor
	Accuracy	< = +/- 10% of reading
	Response Time (90% of Full Scale)	< = 4 Min
	Stability	Calibration Once in a Month
	Range	0-1, 0-10,0-200, 0-2000 ppb freely programmable
	No. of Streams	At least four streams.
	Temperature Compensation	Automatic
	Sample Flow	125 ml/min (max.)
	All Weather Canopy	To be provided

CCTV network configuration shall be built on the Stackable Managed Ethernet switches for better control of data traffic & performance and future expansion. Switch configuration shall be redundant with seamless changeover without any upset in the CCTV operation. MTBF of the switch shall be more than 20 Years. Configuration shall be automatic.

3.00.00 CONTROL PANEL/DESK MOUNTED INSTRUMENTS AND ELECTRICAL SYSTEM ACCESSORIES

3.01.00 Coupling Relay

- | | | |
|---------------------|---|--|
| 01. Type | : | Octal base plug-in type/ DIN rail Mounting |
| 02. Coil voltage | : | 24 V D.C. in general / other as required |
| 03. Contact | : | 2 NO & 2 NC (Minimum) |
| 04. Contact rating | : | 250 V/5A (A.C)/220V/2A (D.C) |
| 05. Operating range | : | 70 to 110% of rated voltage. |
| 06. Insulation | : | 2 KV for 1 minutes between terminal & earth. |
| 07. Mechanical life | : | 20 million operations |
| 08. Coil protection | : | Diode |
| 09. Indication | : | Coil on LED |
| 10. Enclosure | : | Transparent cover |
| 11. Connection | : | Screw terminals. |
| 12. Mounting | : | Projection mounting inside panel / DIN rail mounting |

3.02.00 Bar graph Indicator

- | | | |
|-----------------------------|---|---|
| 01. Type | : | Bar graph |
| 02. Number of channels | : | One / Two (as required) |
| 03. Input | : | 4-20 mA/1-5 V/Thermocouple/RTD |
| 04. Indication | : | Green LED / LCD |
| 05. Scale | : | 100 mm vertical one for each channel graduated in engineering unit (linear scale) |
| 06. Readable Distance | : | 3 meters (minimum) |
| 07. Mounting | : | Flush panel |
| 08. Face Dimension | : | 36(W) x 144(H) mm (approx) / 72 x 144 (H) mm |
| 09. Resolution | : | 1% of scale or better |
| 10. Power Supply | : | 240V, 1 Phase, 50 Hz AC |
| 11. Operating Conditions :- | | |
| a) Temperature | : | 0-50 ° C |
| b) Relative Humidity | : | 5%-95% |
| c) Supply Voltage | : | -15% to +10% |
| 12. Connection between | | |

	Indicator and Tray	:	Prefab Cable
13.	Accessories	:	i) Mounting Tray ii) Engraved phenolic nameplate affixed to front flange to identify each indicator by tag number and each point by measured variables.
14.	Alarm Facility	:	1 HI and 1 LO for each channel independently adjustable over span. Voltage free outputs
15.	Reference Junction Compensation	:	Built-in cold junction compensation for thermocouple inputs
16.	Feature	:	i) Alarm level indication by flashing cursor ii) Green Digital display of parameter value in front panel with a 3.1/2 digit display.
3.03.00	Valve Position Indicator		
01.	Input	:	4-20 mA DC/1-5 Volts DC
02.	Indication	:	Pointer and Scale. Moving Coil Meter
03.	Readable Distance	:	3 meters (minimum)
04.	Pointer Deflection	:	90 Deg Sector or linear
05.	Mounting	:	Flush Panel (Horizontal/vertical)
06.	Accuracy	:	±1% or better
07.	Protection Class	:	IP-42
08.	Operating Ambient Temp.	:	0-50 °C
09.	Scale	:	0-100%
10.	Bezel Size	:	DIN Standard
3.04.00	Digital Indicator		
01.	Type	:	Four and half digit LED seven-segment display with sign.
02.	Face Dimension	:	72 x 144 mm / 48 x 96 mm (as applicable)
03.	Display Character	:	13.8 mm, Green (LED)
04.	Accuracy	:	0.1% of reading, ±2 digit
05.	Input	:	4-20mA DC/1-5 V DC/RTD/Thermocouple
06.	Mounting	:	Flush Panel
07.	Power Supply	:	240V ±10%, 50 ±2.5 Hz
08.	Output Contact	:	2 nos SPDT, contact rating 5A at 240V AC/ 0.25A at 220V DC
09.	Power/Signal Connection	:	Screwed
	Large Display (150x300 mm) indicators shall be provided for MW, MVAR and frequency indications.		

3.05.00 Push Button

- | | | | |
|-----|-----------------------|---|--|
| 01. | Type | : | Shrouded square format |
| 02. | Face Dimension | : | 32 x 32 mm (maximum) |
| 03. | Contact Configuration | : | 2 NO + 2 NC |
| 04. | Contact Addition | : | Add-on block up to 4 each with 2 pairs of contacts |
| 05. | Contact Material | : | Hard Silver Alloy |
| 06. | Contact Rating | : | 500V / 10 A |
| 07. | Utilization Category | : | AC11 / DC11 |
| 08. | Insulation Voltage | : | 2 KV for 1 minute between terminals and earth |
| 09. | Mechanical Life | : | 1 million operation |
| 10. | Construction | : | Aluminum shrouding with plastic lens |
| 11. | Colors | : | Red, Green, Yellow, Black, etc. |
| 12. | Connection | : | Screw terminals |
| 13. | Enclosure Class | : | IP-52 |
| 14. | Legend | : | Engraving |

3.06.00 Illuminated Push Button

- | | | | |
|-----|-----------------------|---|--|
| 01. | Type | : | Square format |
| 02. | Face Dimension | : | 32 x 32 mm (maximum) |
| 03. | Contact Configuration | : | 2 NO + 2 NC (minimum) |
| 04. | Contact Addition | : | Add-on-Block up to 4 each with 2 pairs of contacts |
| 05. | Contact Material | : | Hard Silver Alloy |
| 06. | Contact Rating | : | 500 V/ 10A |
| 07. | Utilization Category | : | A C11 / DC11 |
| 08. | Insulation Voltage | : | 2 KV for 1 minute between terminals and earth |
| 09. | Mechanical Life | : | 1 Million Operation |
| 10. | Lamp | : | LED with built-in resistors as required |
| 11. | Lamp Rating :- | | |
| | a) Voltage | : | 240 V AC |
| | b) Watt | : | 2 Watt (approx.) |
| 12. | Lamp and Lens | | |
| | Replacement | : | From front |
| 13. | Construction | : | Transparent Plastic Lens |
| 14. | Color | : | Red, Green, Amber, Yellow etc. |
| 15. | Connection | : | Screw terminals |

	16. Enclosure Class	:	IP-52
	17. Legend	:	Engraving
3.07.00	Selector Switch		
	01. Type	:	2/3/4 position stay put type with rotary lever actuator.
	02. Face Dimension	:	32 x 32 mm (maximum)
	03. Contact Configuration	:	4 pair of contacts
	04. Contact Addition	:	Add-on-Block up to 4 each with 2 pairs of contact
	05. Contact Material	:	Hard silver Alloy
	06. Contact Rating	:	500 V/10 A
	07. Utilization Category	:	AC11 / DC11
	08. Insulation Voltage	:	2 KV for 1 minute between terminals and earth
	09. Mechanical Life	:	1 million operation
	10. Construction	:	Aluminum shrouding
	11. Connection	:	Screw terminals
	12. Enclosure Class	:	IP-52
3.08.00	Indicating Lamp		
	01. Type	:	LED with built-in resistor
	02. Face Dimension	:	32 x 32 mm (maximum)
	03. Voltage	:	240 V AC
	04. Watt	:	2.5 Watt (approximate)
	05. Lamp and Lens Replacement	:	From front
	06. Construction	:	Transparent Plastic lens
	07. Color	:	Red, Green, Amber, Yellow etc.
	08. Connection	:	Screw terminals
	09. Legend	:	Engraving
3.09.00	Indicating Meters (A.C)		
	01. Type	:	Rectifier type
	02. Face Dimension	:	96 x 96 mm
	03. Scale	:	Radial arc of 240 Deg.
	04. Accuracy	:	1.5% of full scale. ±0.5 Hz for frequency meter
	05. Input	:	0-1/0-5A for current measurement, 0-240V, 50 ± 2.5 Hz for voltage / frequency measurement
	06. Zero Adjustment	:	Screw on meter face

- | | | | |
|-----|-----------------------|---|---|
| 07. | Enclosure | : | Shielded Case |
| 08. | Mounting | : | Flush Panel |
| 09. | End Scale Suppression | : | 6 times the measuring range only for motor ammeters |

3.10.00 Indicating Meters (D.C)

- | | | | |
|-----|-----------------------|---|--|
| 01. | Type | : | Taut band moving coil |
| 02. | Face Dimension | : | 96 x 96 mm |
| 03. | Scale | : | Radial arc of 240 Deg. |
| 04. | Accuracy | : | 1.5% of full scale |
| 05. | Input | : | 0-75 mA for current measurement. Direct reading for voltage measurement. |
| 06. | Zero Adjustment | : | Screw on meter face |
| 07. | Enclosure | : | Shielded case |
| 08. | Mounting | : | Flush Panel |
| 09. | End Scale Suppression | : | 2 times the measuring range only for motor ammeters. |

For electrical system's meter and for synchronization, Bidder shall refer to electrical volume of the specification

3.11.00 Auxiliary Relay

- | | | | |
|-----|-----------------------|---|---|
| 01. | Type | : | Electromagnetic |
| 02. | Coil voltage | : | 240 V A.C / 220V DC. For any other voltage bidder to make his own arrangement. |
| 03. | Contact Configuration | : | 2 NO & 2 NC (Minimum), additional contacts as per requirement with provision for additional contact block expansion |
| 04. | Contact rating | : | 250V/5A (A.C/D.C.) |
| 05. | Operating range | : | 80 to 110% of rated voltage |
| 06. | Insulation | : | 2 KV for 1 minute between terminals & earth. |
| 07. | Mechanical life | : | 20 million operations |
| 08. | Coil protection | : | Diode/surge suppressor |
| 09. | Connection | : | Screw terminals. |
| 10. | Mounting | : | Projection mounting inside panel |

3.12.00 Electrical Transducer

Transducers shall be provided for conversion of AC electrical quantities such as voltage, current and power. Transducer shall be suitable for 220V DC auxiliary supply. Transducers shall be of low burden type having 4 – 20 mA DC linear galvanically isolated output compatible with secondary indicating instrument. Transducer shall be dual channel type. Accuracy class of Transducers shall be as per IS14570:1998 or IEC688:992

3.13.00 Synchroscope

Synchroscope shall be designed to provide an illuminate and indication of phase and frequency difference between bus voltage and Generator voltage. It shall denote the actual frequency difference corresponding to the inverse of time taken for one rotation of the illuminated vector spot. The instrument shall be designed for industrial applications, which require precise, reliable and robust instruments for the display range and indication. Synchroscope shall be designed as per the DIN / IEC / BS standards.

4.00.00 **CONTROL VALVES, ACTUATORS & ACCESSORIES**

General Technical Guidelines for the Control Valves shall be as follows :

- a) Bidder shall exercise caution in selecting severe service control valves like BFP recirculation valves, HP & LP bypass valves, superheater & reheater attemperator valves, PRDS valves for Boiler & Turbine, Soot blower steam pressure control valve, control valves whose down stream are connected to vacuum such as HP/LP heater emergency level control, condenser make up water control valve, separator level control and CEP minimum flow control valve. For such critical applications, Bidder shall offer valves which are proven for similar application. Above valves shall have leakage class equal or better than class-V with metal-to-metal seating.
- b) Wherever, steam conditioning calls for Pressure reducing & desuperheating, combined PRDS type valves shall be offered.
- c) Bidder shall provide redundant control valves for Main condensate flow control, Superheat attemperation control and Reheat attemperation control as a minimum for high availability. For other application, if the availability criteria for the plant cannot be met even with the best established product, redundant control valves shall be provided.
- d) Control valves shall be located near floor or platform for ease of access and with adequate clearances for maintenance and lay-down and shall be placed as station with upstream motorized isolating valve, down-stream isolating valve, inching duty motorized bypass valve and manual drain valves. Each redundant control valve shall have its upstream motorized and down-stream manual isolating valves. Where quick shut off requirement is foreseen such as in case of SH & RH attemperation valves, upstream isolation valve shall be pneumatic type.

4.01.00 General

- 4.01.01 Control valves for regulating service shall normally be globe body, preferably cage guided, metal-to-metal seated, pneumatically operated and shall be provided with characterized plugs having ANSI leakage class-IV except for the control valves indicated above.
- 4.01.02 Where the operating time is critical for the operation of the plant, as in case of HP or LP bypass valves, hydraulic actuators with electro-hydraulic interface shall be offered.
- 4.01.03 Bonnet joints for all control valves shall be of flanged and bolted type.
- 4.01.04 Flanged valve shall be rated at no less than class 300 lbs.
- 4.01.05 Valve Body / End Connections

- 4.01.06 Valve end to end dimension and connection shall be according to ANSI standard, straight through pattern. However, Bidder may offer angle body valve for high pressure drop applications. For high pressure drop applications, construction of the valve shall be such that the gland is not exposed to inlet pressure.
- 4.01.07 Control valves of 40 mm. size and above with line pressure up to 50 Kg / Sq. cm may have flanged or welded end connections.
- 4.01.08 Control valves, used in high pressure services shall have butt welded end connections for size 65mm and above and socket weld end connection for size 50 mm or below.
- 4.01.09 Control valve body shall be selected as per the ISA guideline. Generally control valve body shall be cast and machined for pressure rating up to 1500 lbs. Above 1500 lbs, valve body shall be of forged steel. For Demineralized Water application, valve body shall be Stainless Steel.
- 4.01.10 The direction of flow shall be clearly engraved on the body .
- 4.02.00 Valve Body Material (material shall match the process condition for super critical boiler)

Sr. No.	SERVICE	MATERIAL
1.	Non corrosive, non-flashing and non cavitating service for fluid temperature up to 275°C	Cast carbon steel ASTM A216 Gr. WCB
2.	Non corrosive, non-flashing and non cavitating service for fluid temperature above 275°C	Cast alloy steel ASTM A217 Gr. WC9
3.	Severe flashing / cavitating services	Cast alloy steel ASTM A217 Gr. WC9
4.	Low flashing / cavitating services	Cast alloy steel ASTM A217 Gr. WC6
5.	DM water application (condenser hotwell normal, emergency make up etc.)	Cast type 316 stainless steel ASTM A351 Gr. CF8M

4.03.00 Valve Size

The control valve sizing (Cv / Kv) shall be based on following guidelines :

- The valves shall pass normal flow (MCR condition) with 60 to 70 percent opening for linear characterised valves and between 70 to 80 percent opening for equal percentage characterised valves.
- The valves shall have adequate rangeability to pass the minimum and maximum flows at 10% and 85% of the valve opening respectively. Valve stem travel range from minimum to maximum flow condition shall not be less than 50% of the total valve stem travel.

- c) Valve Cv shall be selected in such a way that the valve shall be capable of handling at least 120% of required maximum flow.
 - d) The valve selection shall be based on the highest size dictated by the above considerations unless noise, flashing or other factors dictate the final selection.
 - e) Trim outlet velocity for the control valves shall be no more than 7 m/sec for water service and Mach number less than 1/3 for steam and air service application.
 - f) The sizing procedure followed shall be as per latest edition of ANSI/ISA or equivalent standard.
- 4.04.00 Valve Top work
- 4.04.01 Top work shall be sized so that the valve shall operate properly when upstream pressure is 10 percent above maximum inlet pressure and downstream pressure is atmospheric.
- 4.04.02 Extended bonnet/Finned bonnet and high temperature packing shall be used for high temperature application.
- 4.04.03 The gland material shall be chosen to suit the operating temperature. PTFE may be chosen for lower temperature application (232°C maximum) and for high temperature application graphited asbestos glands are to be provided. For vacuum services, the glands shall be of dry seal type.
- 4.05.00 Valve Trim
- 4.05.01 Valve trim for applications up to leakage class-V shall be stainless steel 316 SS for pressure drop up to 7 Kg/ Sq. cm. For pressure drops above 7 Kg/Sq. cm hard trim (stellited or equivalent) shall be used. Other alloys or treatment such as nitride shall be used if severe erosion is expected.
- 4.05.02 Balanced trim valves shall be offered for high shut-off pressure or high pressure drop condition to reduce the size of the actuators.
- 4.05.03 For flashing services and two stage mixtures, the trim material shall be 17-4 PH SS or equivalent.
- 4.05.04 If cavitating condition is foreseen, Bidder shall offer multistage or labyrinth trims valves. Trim of severe service valves shall be of multistage and multipath design with number of discrete pressure drop stages to eliminate the chances of erosion, cavitation, noise and vibration throughout the control range of the valve.
- 4.05.05 Quick replacement type trim shall be considered for easy maintenance.
- 4.05.06 Trim Material

SR. NO.	SERVICE	MATERIAL
1.	Non corrosive, non-flashing and non cavitating service for fluid temperature up to 275°C.	: SS 316 stellited
2.	Non corrosive, non-flashing and non cavitating service for fluid temperature above 275°C.	: SS 316 stellited

SR. NO.	SERVICE	MATERIAL
3.	Severe flashing /cavitating services	: 440 C
4.	Low flashing /cavitating services	: 17-4 PH SS
5.	DM water application (condenser hotwell normal, emergency make up etc.)	: 17-4 PH SS
4.06.00	Noise Level	
	The equivalent sound level measured at 1.5M above nearest floor level in elevation and 1 M horizontally from the control valve expressed in decibels to a reference of 0.0002 microbar shall not exceed 85 dBA. If the calculated noise is more than the above limit, even with low noise trim design, diffusers shall be included. Diffusers shall be made of stainless steel and shall be integrally connected to the control valve with spool piece. The spool piece shall be in conformity with the main line piping specification.	
4.07.00	Valve Actuators	
	Spring-diaphragm type actuators shall generally be used. Piston type actuators shall be offered in case of high shut-off pressure & quick response requirement.	
4.07.01	The actuator shall be designed for 150% thrust required for the valve (at shut-off pressure) at an air line supply pressure of 5.5 Kg/Sq. cm.	
4.07.02	Diaphragms shall be designed for 200% maximum operating pressure.	
4.07.03	Nylon reinforced neoprene is preferred as diaphragm material.	
4.07.04	Valve actuators shall be capable of operating at 80O C ambient, continuously.	
4.07.05	Entire actuator assembly shall be painted with corrosion inhibiting paint.	
4.07.06	Air connection size shall be 1/4" NPT (F) unless otherwise dictated by process response time. Integral tubing shall be stainless steel.	
4.07.07	Bidder shall indicate the stroking time of the valve assemblies with positioner and ensure that the stroke time shall meet the process and equipment dynamics and shall be better than 20 seconds.	
4.07.08	All actuators shall be of fail safe design signifying that the spring direction will tend to move the valve (open or close) in a direction safe for the process. "Failure to Open" or "Failure to Close" shall be marked on the actuator.	
4.08.00	Valve Positioners	
4.08.01	Regulating duty valves shall be offered with Electro Pneumatic Positioners to ensure accuracy and repeatability of response.	
4.08.02	Positioners shall have integral non contact (LVDT) type position transmitter, input and output gauges, local keypad & display.	
4.08.03	Positioners shall be capable of functioning under hot, humid and vibrating conditions.	
4.08.04	Positioner casings shall be dust tight, corrosion resistant and weatherproof.	
4.08.05	In general, positioner shall operate at signal range 4 - 20 mA DC for the full travel of the valve.	

- 4.09.00 Valve Accessories
Accessories shall include side mounted hand wheels, limit switches, junction boxes, airlock relays etc.. Solenoid valve wherever required shall be furnished.
- 5.00.00 **CONTROL DESK / PANEL / RACK**
- 5.01.00 Convenient and logical approach to operational interfaces and aesthetics in the overall view of the panel /desk shall be considered.
- 5.02.00 For items susceptible to vibration, suitable anti-vibration padding shall be provided to prevent damage or malfunction.
- 5.03.00 All items inside the panels/cabinets shall be neatly arranged with easy access/maintenance approach.
- 5.04.00 Incoming power supply feeders shall be duplicated. Alarm shall be provided for failure of a power supply feed.
- 5.05.00 Desk / panel shall be provided with interior illumination, utility receptacles with plug and cooling fan.
- 5.06.00 Panel / Desk shall have gland plate at cable entry to panel. Thickness of gland plate shall not be less than 3 mm.
- 5.07.00 Wire shall be routed / laid through covered trough.
- 5.08.00 Crating of the panels and desks shall be suitable for protection against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. Mounted equipment shall have adequate protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.
- 5.09.00 Nameplate
a) Nameplate shall be provided for instrument or device mounted on the panel.
b) Nameplates for panels shall be provided both in front and rear.
- 5.10.00 Control Desks
- 5.10.01 Devices mounted on the desks shall be flush type. Devices shall be so mounted that their removal and replacement can be accomplished without interruption of services to others.
- 5.10.02 Desk shall be ergonomically designed to suit working on a 24 X 7 basis. Aesthetics, ergonomics and illumination shall be considered while positioning of the desk, large video screen and panels in control room.
- 5.10.03 Control desk shall be free standing floor mounting type of table-top design with compartments for locating the hardware. Desk shall be constructed from aluminum extrusion with high pressure laminate MDF board for work surface of approved colour. Aluminium structure shall be anodized or powder coated paint finish.
- 5.10.04 Monitors with retractable keyboard, emergency push buttons shall be provided on the desk. Desk shall be arranged in arc-like shape without any sharp edges. Edges shall be extruded PVC or rounded post-formed laminate..
- 5.10.05 Desks shall be of modular, scalable and industrially ruggedized design and shall have Telephones and Intercom connections.
- 5.10.06 Desks shall have concealed cable trays for wire dressing.

- 5.10.07 Design shall include Earthing bolts.
- 5.10.08 Back installed items shall be suitably concealed from front view.
- 5.11.00 Back Up Panel
- 5.11.01 Construction shall be from sheet steel of thickness not less than 3mm.
- 5.11.02 Electrical upright Panel construction & design shall be similar to back up panel. Control switches, meters, indicators, synchronizer, excitation control switch, annunciation window etc. along with associated mimic diagram, as recommended, shall be provided for manual synchronization of generator.
- 5.12.00 Cabinets / Enclosure / Panels
01. Material of construction : Cold rolled steel sheet
 02. Thickness of Sheet :
 - a) 3.0 mm for faces supporting instruments / terminals.
 - b) 2 mm for other sides and top.
 03. Construction : Welded throughout as per approved National Standards.
 04. Panel height : 2300 mm (approx)
 05.
 - i) Corners : 7 mm inner radius
 - ii) Dimensional Tolerances :
 - a) In height & length - 3 mm
 - b) In height between adjacent sections - 2 mm.
 - c) Total for a group - 6 mm
 06. Doors : Double, recessed, turned back edges
 - i) Thickness of Sheet : 2 mm
 - ii) Hinges : Stainless steel
 - iii) Door latches : Three point type
 - iv) Door gaskets : Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure.
 - v) Opening of the doors : Outward
 - vi) Louvers : With removable wire mesh to ensure dust and vermin proof.
 07. Color of interior : Brilliant white
 08. Colour external : RAL 7032
 09. Painting : Epoxy powder coated or better
 10. Gland plates : Removable 4 mm thick (bottom)
 11. Cable entry : Bottom
 12. Hardware :
 - a) Anti vibration pad- 15 mm
 - b) Predrilled base channel ISMC - 100 or equivalent for all sides.

- c) Stainless steel buff- finished 2 mm thick kick plate for all sides.
- d) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws.
- e) Rubber strips to ensure air tightness between kick plate and finished floor.
- f) Lifting hook / Eye bolt
- g) Drawing pocket
- h) Door switch, lamps, thermostat, heaters and fans

13. Enclosure Protection : As per environment condition of the area of installation. Refer section-I of this vol.

5.13.00 Local Instrument Racks & Enclosure

5.13.01 General Requirements

- a) Devices located in the field shall be grouped and installed in the enclosure (Open / Closed Rack) in Boiler and TG Building.
- b) Racks and enclosure shall be factory prefabricated & painted and shall complete with internal piping, tubing, manifold, isolation valves, blowdown valves, integral junction box, illumination etc.
- c) No more than six instruments shall be grouped in a single rack / enclosure.
- d) Racks shall be installed above the tapping points for air, flue gas and coal air mixture application whereas for applications such as for water and steam, racks to be installed below the source point.
- e) Attention shall be paid in the layout to avoid air traps in liquid piping and water accumulation in air /gas piping.
- f) Welding of impulse lines shall comply with the provisions of the latest applicable ANSI Code for Pressure Piping.
- g) Instrument piping and tubing shall be hydrostatically tested at one and one-half times the maximum system pressure except for low pressure and vacuum measurement for which the test pressure will be as per piping standard.
- h) Service air connection shall be provided for continuous and intermittent purging of impulse pipe in dusty medium. Continuous purging shall be adopted for differential pressure measurement such as flue gas and coal air mixture application. Pressure measurement shall have only intermittent purging whenever required. In case of continuous purging, an air header shall be formed this shall receive service air through isolation valve and air filter regulator. Air shall be fed from the air header to both the impulse pipes near to take off points through isolation valves and flow regulators. Air header shall be constructed from stainless steel. Impulse pipe for such applications shall have a four-way valve. One port of the valve shall have an adaptor to connect flexible stainless steel braided nylon hose to the service air. Rating of the hose shall not be less than 10 Kg/sq.cm.

Four way valve shall have two position operations. One position for service and other one for purging. Required pressure gauges shall be provided for monitoring of air pressure. Complete purging arrangement shall be integral to the enclosure and racks.

- i) Gate or ball type (full ported) instrument isolation valve and globe type blow down drain valve adequate for duty requirement and for withstanding continuous design pressure and temperature of main process medium shall be provided in the hook up plumbing. For process pressure equal or above 40 kg / sq.cm single instrument isolation valve and double blowdown valves shall be used before connecting to blowdown header. Whereas for line pressure less than 40 kg/ sq.cm, single instrument isolation valve and single blow down valves can be used before connecting to blow down header. Instrument manifolds shall be non integral and shall be installed close to the instrument.
- j) Drawing K9213R-DWG-I-0200 shall be referred for typical arrangement of Local instrument enclosure and rack.

5.13.02 Closed Instrument Rack

- a) Enclosure shall be free standing type. Racks shall be adequately reinforced to ensure true surfaces and to provide support. Major load-bearing posts shall be suitably supported by gusset plates or moment members.
- b) Enclosure outer shall be constructed from at least 3 mm thick steel plate and epoxy painted to shade gray. Base frame shall be made of ISMC 100 and black colour finish.
- c) 2" NB galvanized pipes shall be laid horizontally and supported at two end channels to mount transmitters at accessible height. Center posts or any member, which would reduce access, shall be avoided.
- d) Double leaf interlocking front opening doors with three point locking shall be provided and shall be arranged for maximum possible access to the interior. Key shall be of identical for all enclosures.
- e) Doors shall have concealed quick removal type pinned stainless steel hinges and locking handles. Gaskets shall be used between all mating sections to achieve dust and weather proof enclosure rated for IP-65 including the internal junction box.
- f) Removable type bulkhead plates of thickness not less than 6 mm shall be mounted at the racks with suitable high temperature gasket. Impulse lines within the enclosures shall be properly clamped.
- g) All internal wirings between the instruments and junction box shall run through flexible conduits.
- h) Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Header shall be of 2" NB ASTM A 106, Sch-80 Gr. C installed at a slope of 1:25 and extended beyond the rack for connection to plant drain header.
- i) Each rack shall be provided with one receptacle, light fixtures each at instrument & Junction box compartments with wire guard.

5.13.03 Open Instrument Rack

- a) Rack shall be free standing type constructed from 6 mm thick steel channel frame provided with a canopy to protect the instrument from dripping water or falling objects and shall be epoxy painted. Rack Major load-bearing posts shall be suitably supported by gusset plates or moment members. Suitable protective grill shall be welded to the end-posts of the rack to outline a boundary beyond which no mounted equipment shall project. Canopy shall be of CRCA steel sheet of at least 3 mm thickness. Center posts or any member, which would reduce access, shall be avoided.
- b) 2" NB galvanized pipes laid horizontally and supported at two end channels shall be employed at working accessible height for mounting of instruments.
- c) All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings are admissible.
- d) All racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Header shall be of 2" NB ASTM A 106, Sch-80 Gr. C installed at a slope of 1:25 and extended beyond the rack for connection to plant drain header.

5.13.04 Junction Box

Junction boxes of FRP construction with protection class conforming to IP 55.

- a) Junction box shall be provided at a dry compartment at one side of the enclosure / rack with front opening type door. Earth stud shall be furnished at rack for safety grounding.
- b) Terminals shall be screwless cage clamp type of reputed make and 20% spare terminals shall be furnished in the junction box.

~~6.00.00 DISTRIBUTED CONTROL SYSTEM (DCS)~~

~~6.01.00 System Functional Description~~

- ~~6.01.01 Integrated functionally distributed and hierarchically structured real time control (both binary and modulating), Data acquisition, Man machine interface, Historization units and Management Information System (MIS) system synthesized from one general family of identical interchangeable multifunction hardware has been envisaged.~~
- ~~6.01.02 System shall be highly reliable with the availability of not less than 99.7% with adequate redundancy and fault tolerant configuration.~~
- ~~6.01.03 The system shall be unitized and connectivity with other plant control system.~~
- ~~6.01.04 Remote input output stations as a data concentrator for acquisition and monitoring of Boiler metal temperature are foreseen. RIO shall be industrially ruggedized and shall be provided with integral air conditioner considering the harsh environment.~~
- ~~6.01.05 For Power supply to system refer Volume IIE Section I.~~
- ~~6.01.06 Controls of some plant auxiliaries for CW & ACW Pumps and Fuel oil heating & pressurizing system controls shall be realized in DCS through Remote I/O (RIO) cabinets.~~
- ~~6.01.07 Off-site & BOP plants such as Coal Handling Plant, Ash Handling Plant, Raw water & Pretreatment plant, Compressed Air System, Mill Reject System and Demineralized water plant etc. having microprocessor based or PLC based~~

- 14. Indication : Processor status and fault display
- 15. Features : Power fail hold, Automatic restoration on power

7.03.07 Operator's & Engineering Station:

The specification shall be as below or the latest available at the market at the time of contract:

- a) Operator's Station / Engineering Station (PC Based)
 - 1. Intel Pentium Core 2 Duo processor with latest available speed;
 - 2. Windows XP Professional preloaded with CD media;
 - 3. 2 GB RAM;
 - 4. 320 GB HDD;
 - 5. 64 MB SVGA graphics card;
 - 6. 2 MB L2 Cache;
 - 7. 1 DVD Read / write;
 - 8. Antivirus protection software with license;
 - 9. 1 PCI Express x 1 slot 3 PCI 2.2 slot (5v, 32 bit) on Mini Tower, one PCI Express x 16 graphics slot;
 - 10. 4 x USB ports, 1 Serial Port, 1 Parallel Port, PS/2 Port for Mouse & Keyboard;
 - 11. 1 x 104 keyboard;
 - 12. Integrated sound Blaster Compatible Audio Controller 16-bit along with internal speaker;
 - 13. 10 / 100 / 1000 Mbps embedded Network Interface Card. Additional NIC with 2 nos. Intel Pro / 100S PCI Network Adapter Card;
 - 14. Minitower Chassis;
 - 15. 240 VAC 50 Hz power supply
- b) Client Server
 - In case of Client Server Architecture this shall be of the latest model / version and shall have the following minimum requirements:
 - 1. Two Intel Xeon up to 3.4 GHz Processors, 800 MHz FSB;
 - 2. Windows 2008 Server 10 user license preloaded with CD media;
 - 3. Interaction with at least 10 Clients;
 - 4. 2 GB ECC DDR (1GB Installed in two slots and two slots free) SDRAM;
 - 5. Dual 73 GB Ultra 320 SCSI internal storage; HDD partitioning C: 36 & D: 36;
 - 6. 64 MB SVGA graphics card;
 - 7. 2 MB L2 Cache;

8. DVD Read/Write;
9. Antivirus protection software with license;
10. 20 / 40 GB Internal DAT Drive;
11. 4 x 64 bit and 2 x 32 bit PCI slots;
12. 4 x USB ports, 1 Serial Port, 1 Parallel Port, PS/2 Port for Mouse & Keyboard;
13. 1 x 104 keyboard;
14. Integrated sound Blaster Compatible Audio Controller 16-bit along with internal speaker;
15. 10 / 100 / 1000 Mbps embedded Network Interface Card. Additional NIC with 2 nos. Intel Pro / 100S PCI Network Adapter Card;
16. 240 VAC 50 Hz power supply;
17. Tower Chassis;
18. 1 x 24" SVGA High Resolution TFT Monitor.

c) Monitor

- | | |
|-------------------------|---|
| 1. Type | : TFT monitor |
| 2. Screen diagonal | : 24" flat |
| 3. Display | : XGA or better |
| 4. Resolution | : 1680x1050 or better |
| 5. Degree of protection | : IP-30 |
| 6. External Controls | : Brightness, contrast, Horizontal / Vertical amplification & shift |
| 7. Power supply | : 240 V, 50 Hz, 1 phase |
| 8. Ambient temperature | : 0-50 ° C |
| 9. Humidity | : 95% non-condensing |
| 10. Version | : To suit industrial application |

d) Key Board

- | | |
|-------------------|---|
| 1. Type | : Flat spill proof membrane type or Positive depression type |
| 2. Different keys | <p>a) Soft and user defined function keys for software/ programming including text correction, scan rate alteration, zooming/ flashing color selection etc.</p> <p>b) Panel select keys for alarm summary, control loop display, overview, trend,</p> |

- graphic, operator guide message etc.
- c) Standard Alphanumeric keys
- d) Alarm acknowledge keys
- e) Cursor keys
- f) Mode/loop status switching keys
- g) Setting change keys
- h) Print-out command keys
- i) Other keys as required to operate the system
- 3. Key lock : Lockable type push button mounted on keyboard
- 4. Life Expectancy 50 million cycles per key
- 5. Version : To suit industrial application
- e) Laser Printer
 - 1. Type : Electro-photographic laser, tabletop
 - 2. Printer Memory : 256 MB (min.)
 - 3. Speed : Monochrome 24 ppm - A4, Color 6 ppm - A4
 - 4. Resolution : 1200 x 1200 DPI in color
 - 5. No. of color (Basic) : 4 (four) minimum
 - 6. Duty cycle : Monochrome 75000 pages / month
 - 7. Power supply : 240 V, 50 Hz, 1 phase
 - 8. Ambient temperature : 0-50 Deg C
 - 9. Humidity : 95% non-condensing
 - 10. Size of paper : Letter, A4, Legal, Ledger, A3
 - 11. Print media : Plain paper, transparencies, thick stock, glossy stock, envelopes
 - 12. Accessories : Adapters, Connector Cable, Multiplexer switch (4 point)

7.03.08 Stackable Managed Switch

Data highway shall be of high speed Ethernet and full duplex configuration. Network shall be built on the Stackable Managed Ethernet switches for better control of data traffic & performance and future expansion. Switch configuration shall be redundant with seamless changeover without any upset in the process or equipment. Failure reporting shall be available at HMI. MTBF of the switch shall be more than 20 Years. Configuration shall be automatic.

7.03.09 Furniture

Bidder shall include a complete set of furniture for the Control Room and computer Room of ergonomic design from reputed manufacturer especially designed for computer peripherals. The set of furniture shall include but not be limited to control desk, chair, printer table, computer tables etc, all necessary furniture for Computer Room peripherals, cabinets for storage of manuals / booklets/recorder charts, storage racks for special tools/ diskettes and Shift Charge Engineer's desk/chair/side rack etc.

7.04.00 Software Specification

7.04.01 General

The system shall utilize a readily upgradeable, public domain software platform proven for real-time operation environment at the control and monitoring level overlaid with a relational database program. The desirable features are enumerated below.

- a) The operating system shall be suitable for real-time operation both at process as well as HMI end.
- b) The software system shall be fully modular.
- c) The software shall meet the following general requirements.
 - i) Simple, easy-to-learn language for editing and on-line operation.
 - ii) Wide range of peripheral support.
 - iii) Effective task scheduling and support of multiple priority structure including event based interrupt etc.
 - iv) Effective debugging.
 - v) Provision for on-line editing and program development without interrupting on-line functions.
 - vi) Self-diagnostic routines.
 - vii) Efficient memory management and effective utilization of system time.
 - viii) Quick start-up and loading.
 - ix) Support of multiprogramming and multi-user operation.

7.05.00 Memory Management / Operating System

- a) The main memory capacity shall be adequate to minimize swapping.
- b) Individual task shall reside in partitions, which can be split into sub-partition for parallel task handling.
- c) The operating system shall automatically perform housekeeping functions including file management.
- d) Task swapping shall be dynamic.

- 8.18.01 A Portable data collector shall be provided for taking periodic collection of non critical machine data. Machine condition monitoring system shall be capable to analyze the data. Instrument shall be microprocessor based and ready for use in harsh environment. Integral LCD display shall provide the necessary display of readings & spectral data. Minimum 02 channels along with additional input for phase reference measurement shall be available with the instrument.
- 8.18.02 Instrument shall include necessary accelerometers and other devices with accessories for collection of machine parameters. A long life Ni-Cd battery pack shall be used. Replacement of battery shall not lead to loss of stored data.
- 8.18.03 Shaker table shall be provided for testing & calibration.
- 9.00.00 **INSTRUMENTATION & CONTROL CABLE**
- 9.01.00 Cables shall be flame retardant low smoke (FRLS) type. In hazardous areas cables of suitable R/L ratio shall be provided for intrinsic safety.
- 9.02.00 Durable marking shall be provided on the surface of the cable at intervals not exceeding 5 mtrs. Marking shall include Manufacturer's name, Year of manufacture, Voltage grade, Type of cables (Conductor size & no. of pairs / triads / type of compensating /extension cable), Insulation material, FRLS etc.
- 9.03.00 Sequential length marking shall also be provided at every meter interval on outer sheath of cable.
- 9.04.00 Standard seasoned wooden drum containing minimum 500 /1000 M $\pm$ 5% length. Drum shall be anti rodent, anti termite and smooth finish. Both end of cable shall be capped by means of non hygroscopic sealing material.
- 9.05.00 Thermocouple Extension & Compensating Cable
- | | | |
|-----------------------------|---|--|
| 01. Conductor | : | Solid conductor |
| 02. Conductor size | : | 0.75 sq.mm |
| 03. Type | : | KX (Extension) (Chromel Alumel)
RX (Compensating) (Copper-Copper alloy) JX (Extension) (Iron Constantan) |
| 04. Conductor Insulation | : | HR PVC Type-C (IS-5831,1984) 0.6 mm thick |
| 05. Operating Voltage | : | 300V /500V RMS (Core to earth / core to core) |
| 06. Twisting | : | Pair twisted with lay of 60 mm (max) |
| 07. Twisting Direction | : | All pairs in the same direction. Lapped to form bunch with mylar tape. |
| 08. Screen (Pair & Overall) | : | Aluminium mylar tape with a thickness of 28 μ m (min.) for individual pair screen and 60 μ m (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire. |

- | | | | |
|-----|---------------------------------|---|--|
| 09. | Drain wire | : | Annealed tinned copper wire, stranded.
Size 0.5 Sq. mm. (No. of strands / size:-
7 / 0.3mm) |
| 10. | Inner Sheath | : | Extruded FRLS PVC (anti rodent, anti
termite & moisture resistant properties)

HR PVC Type ST2 of IS-5831,1984

Thickness as per IS-1554Part-I 1976 |
| 11. | Rip Cord | : | Non metallic under sheath |
| 12. | Armouring | : | GI wire / strip as per IS 3975 |
| 13. | Outer Sheath | : | Extruded FRLS PVC (anti rodent, anti
termite & moisture resistant properties)

HR PVC Type ST2 of IS-5831,1984

Thickness as per IS-1554Part-I 1976 |
| 14. | Filler | : | Non hygroscopic with FRLS property |
| 15. | Temperature Range | : | Up to 85 °C |
| 16. | Insulation at 20 ⁰ C | : | 100 MOhms/Km [Min] |
| 17. | Capacitance at 800 Hz | : | 120 nf/km |
| 18. | Cross talk | : | 60 dB |
| 19. | Attenuation | : | 1.2 dB/Km |
| 20. | Codes & Standards | : | a) IEC 332-1
b) ANSI MC 96.1
c) IS-8784-1987 |
| 21. | Tests | : | a) Oxygen Index: Min.29 at room
temp. (ASTM-D-2863)
b) Acid Gas Gen.: Max.20% by weight
as per IEC 754 Part-I
c) Temp Index : Min 250 DEG C at
21Oxy. Ind. (ASTM-D-2863)
d) Smoke Density Rating : Max.60%
(ASTM-D-2843).
e) Flammability Test : as per IEC 332
Part-I /IEEE-383
Swedish Chimney Test - SS-424-
1475 F3
f) High voltage test
Core to core- 1.5 KV for 1 min.
Core to screen- 1.0 KV for 1 min.
g) Insulation Resistance 100 M Ohm /
Km Min |

- h) Rodent & Termite repulsion test
(Presence of lead shall be confirmed)

22. Conductor material & sheath color for thermocouple cable as per ANSI MC 96.1

CABLE TYPE	OVERALL SHEATH COLOR	WIRE	SHEATH COLOR	CONDUCTOR MATERIAL
KX	Yellow	Positive	Yellow	Nickel / Chromium
		Negative	Red	Nickel / Aluminum
JX	Black	Positive	White	Iron
		Negative	Red	Constantan
RX	Green	Positive	Black	Copper
		Negative	Red	Copper Nickel Alloy

23. Durable printed or embossed numbering at regular interval of 50mm shall be provided for identification of pairs.

9.06.00 Instrumentation multi Paired Signal Cable

01. Conductor type : Stranded (7) annealed tinned copper
02. Conductor size : 0.5 / 1.0 / 1.5 Sq.mm (as required)
03. Conductor resistance : 39 Ω/Km/18 Ω/Km/12 Ω/Km
04. Conductor Insulation : HR PVC Type-C (IS-5831,1984) 0.6 mm thick
05. Operating Voltage : 300 / 500V RMS (Core to earth / core to core)
06. Twisting : Twin twisted with lay of 60 mm
07. Twisting Direction : All pairs in the same direction. Lapped to form bunch with mylar tape.
08. Screen (Pair & Overall) : Aluminium mylar tape with a thickness of 28 μm (min.) for individual pair screen and 60 μm (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire.
 - * Analog signals- Individual pair & overall shield to be considered.
 - * Binary signals- overall shield to be considered.

- | | | | |
|-----|------------------------|---|---|
| 09. | Drain wire | : | Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm) |
| 10. | Inner Sheath | : | Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties)
HR PVC Type ST2 of IS-5831,1984
Thickness as per IS-1554, Part-I 1976 |
| 11. | Rip Cord | : | Non metallic under sheath |
| 12. | Armouring | : | GI wire / strip as per IS 3975 |
| 13. | Outer Sheath | : | Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties)
HR PVC Type ST2 of IS-5831,1984
Thickness as per IS-1554, Part-I 1976 |
| 14. | Filler | : | Non hygroscopic with FRLS property. |
| 15. | Temperature Range | : | 85 °C |
| 16. | Insulation at 20 Deg.C | : | 100 MOhms/Km [Min] |
| 17. | Capacitance at 800 Hz | : | 120 nf/km |
| 18. | Cross talk | : | 60 dB |
| 19. | Attenuation | : | 1.2 dB/Km |
| 20. | Codes & Standards | : | a) IPCEA-S-61-402
b) BS 5308
c) IEC 332-1
d) ASTM-B-33
e) IS-8130-1984
f) IS 1554 Part-1
g) IS 10810 |
| 21. | Sheath colour | : | Inner- Black and Outer- Gray |
| 22. | Tests | : | a) Oxygen Index: Min.29 at room temp. (ASTM-D-2863)
b) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I
c) Temp Index : Min 250 ° C at 21Oxy. Ind. (ASTM-D-2863)
d) Smoke Density Rating : Max.60% (ASTM-D-2843).
e) Flammability Test : as per IEC 332 Part-I
f) Swedish Chimney Test-SS-424-1475 F3
g) Insulation Resistance 100 M Ohm / Km Min |

- h) High voltage test
 - Core to core- 1.5 KV for 1 min.
 - Core to screen- 1.0 KV for 1 min.
- i) Rodent & Termite repulsion test
(Presence of lead shall be confirmed)

23. Colour of core for Instrumentation Cable (As per IS-9938)

PAIR	CORE	COLOR
1st	1st	Blue
1st	2nd	Red
2nd	1st	Gray
2nd	2nd	Yellow
3rd	1st	Green
3rd	2nd	Brown
4th	1st	White
4th	2nd	Black

Above 4 Pairs, 4 Pairs making a unit shall have indelible printed colour coded bands like Pink for 1st unit, Orange for 2nd unit and Violet for 3rd unit and so on. In addition band marking, for example single band for 1st. unit, double band for 2nd. unit and so on, shall be provided on each conductor for identification of unit. Band marking on individual core shall be provided at regular intervals not exceeding 50 mm.

9.07.00 Cables near high temperature zone shall be capable of withstanding high temperature and terminated in junction box / panel in normal temperature zone. Teflon insulated and sheathed thermocouple extension cables and copper conductor cables shall be used in high temperature zone. Conductor and sheath shall be extruded FEP (Teflon) as per VDE 0207 Part 6 and ASTM D 2116. These cables shall be pair, multipair, triad, multitriad and twisted & shielded.

9.08.00 Control & power Cable

Bidder shall refer to Volume IIF of the electrical specification for detail.

10.00.00 **ERECTION HARDWARE**

This section provides the general technical guidelines for the erection materials for instruments. All erection materials shall be of good quality and conform to the operating environment of the corresponding instrument.

10.01.00 Electrical Accessories

Electrical conduit and associated materials shall conform to the requirements of the articles which follow :

- a) Rigid Steel Conduit
 - i) Conduits up to and including 25 mm shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 19 mm.

- ii) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.
- iii) All rigid conduit couplings and elbows shall be hot dip galvanized rigid mild steel in accordance with ANSI C 80.1 and UL6. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends.
- iv) All conduit fittings shall conform to the requirements of ANSI C 80.4 and UL-514 where these standards apply.
- b) Flexible Conduit
 - i) Flexible conduit shall be of three layer construction of very high quality of lead coated steel. Outside and inside layer shall be reinforced with heat resistant material.
 - ii) Lead coating outside and inside of the conduit steel surface shall provide a non-corrosive characteristic particularly in acidic atmosphere. Besides flexibility, this shall be strong enough to stay at the desired profile without support and shall be durable and strong so as to offer sufficient mechanical protection. It shall also be fully liquid dust and air tight and shall withstand a continuous hydraulic pressure up to 2 Kg/Sq. cm and temperature up to 200 °C.
- c) Special Fittings
 - i) Conduit sealing and fittings shall be provided as required and shall be consistent with the area and equipment with which they are installed.
 - ii) Double locknuts shall be provided on all conduit terminations not provided with threaded lugs and couplings. Locknuts shall be designed to securely bond the conduit to the enclosure when tightened. Locknuts shall not loosen due to vibration.

10.02.00

Electrical Junction Box

1.	Type of Enclosure	: Dust tight & weatherproof conforming to IP 65
2.	Material	: 3 mm sheet steel
3.	Type of Cover	: Solid unhinged with retention chain
4.	Paint	: RAL 7032
5.	Mounting	: Surface
6.	Cable Entry	: 3 mm (min) Gland plate
7.	Gasket	: Neoprene
8.	Grounding	: Brass earth lug with green screw head External-2 nos , Internal-1no.M6
9.	Number of Drain Holes	: Two at bottom capped
10.	Identification	: Label for JB and Tags for cable

11.	Accessories	: Rail mounted cage clamp type screwless terminals with markers, Cable gland, Ferrules, Canopy at top
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10.03.00 Cable Gland

1.	Type	: Double compression
2.	Entry Thread	: NPT
3.	Material	: Brass
4.	Finish	: Cadmium Plated.
5.	Protection	: IP 54 or better
6.	Accessories	: Neoprene gasket, locknuts, reducers etc

10.04.00 Cable Tray

1. Material : Mild steel, slotted
2. Thickness : not less than 2.0 mm
3. Finish : Hot dip galvanized
4. Perforation : As per MFR standard
5. Cover : Suitable for tray

10.05.00 Process Hook Up Accessories & specification

Material and rating of the hook up items shall suit the piping and fluid condition. Hook up materials shall be IBR certified for applicable cases. Bidder shall furnish hook up drawings and the drawings for open racks & closed racks for owner's approval.

10.05.01 Seamless Stainless Steel Pipe

1. Reference : ASTM A-312 TP 316
2. Material Grade : TP 316
3. Type : Seamless /Plain end
4. Size : ½" NB
5. Schedule : 40
6. Standard Length : 5 meter

10.05.02 Stainless Steel Pipe Fittings

1. Reference : ASTM A-182 F 316 / ANSI B16.11

2. Type : Forged
3. Rating : 3000 lbs / 6000 lbs / 9000 lbs
4. Size : ½" NB
5. End connection : Generally socket weld
6. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

10.05.03 Seamless Stainless Steel Tube

1. Reference : ASTM A-213 TP 316
2. Material Grade : TP 316
3. Size : ½" OD X 2.1 MM Thick
4. Type : Cold drawn annealed, pickled, passivated, de-scaled,hydraulically cleaned seamless tube.
5. Properties : The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.
6. Test Pressure : 400 Kg/Sq. cm (minimum)
7. Tolerance : ± 0.13 mm for outside diameter
: ± 15 % for wall thickness
8. Standard Length : 5 meter
9. Test : Flare, Hardness, Ball and Bubble Test

10.05.04 Stainless Steel Tube Fittings

1. Reference : ASTM-A-182
2. Type : Double ferrule double compression
3. Material : 316 Stainless steel forged
4. Ferrule : 316 Stainless Steel
5. Type of Fittings : Male / female connector, elbow, cross /equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation.
6. Size : To suit SS tubing and NPT end connection

10.05.05 C.S. Pipe

1. Reference : ASTM-A 106 Gr. C
2. Material : Cold drawn seamless black C.S.
3. Type : Seamless / Plain ends
4. Size : ½" NB
5. Schedule : 80, 160, XXS as required
6. Standard Length : 5 meter

10.05.06 C.S. Pipe Fittings

1. Reference : ASTM-A 105 / ANSI B16.11
2. Type : Forged
3. Rating : 3000 lbs / 6000 lbs / 9000 lbs
4. Size : ½" NB
5. End connection : Generally socket weld
6. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

10.05.07 A.S. Pipe

1. Reference : ASTM-A 335 P22 AS PER ANSI B 36.10
2. Material : Cold drawn seamless A.S.
3. Type : Seamless / Plain ends
4. Size : ½" NB
5. Schedule : XXS
6. Standard Length : 5 meter

10.05.08 A.S. Pipe Fittings

1. Reference : ASTM-A 182 F22 AS PER ANSI B 16.11
2. Type : Forged
3. Rating : 9000 lbs
4. Size : ½" NB
5. End connection : Generally socket weld

	6. Type of Fittings	: Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.
10.05.09	Carbon Steel Globe Valve	
	1. Reference	: ASTM A-105
	2. Type	: Globe
	3. Construction	: Forged Body Cadmium Plated
	4. End Connection	: ½" Socket Weld
	5. Rating	: Cl. 800 / CL. 2500
	6. Material	: Body - Carbon steel
		: Stem - Hardened Steel
		: Plug - AISI 316 SS
		: Seat- Stainless steel stellited
	7. Packing	: Teflon / Grafoil as required
	8. Yoke	: ASTM A105
	9. Hand wheel	: Carbon steel
	10. Design standard	: As per ANSI B 16.34
10.05.10	Stainless Steel Globe Valve	
	1. Reference	: ASTM A-182 F316
	2. Type	: Globe
	3. Construction	: Forged Body
	4. End Connection	: Socket Weld
	5. Proof Pressure	: 400 Kg/Cm2
	6. Material	: Body - Stainless steel
		: Stem - Hardened Steel
		: Plug - AISI 316 SS
		: Seat- Stainless steel stellited
	7. Packing	: Teflon as required
	8. Yoke	: ASTM A182 F316

- | | | | |
|----------|---------------------------|-----------------|---|
| | 9. | Handwheel | : Carbon steel |
| | 10. | Design standard | : As per ANSI B 16.34 |
| 10.05.11 | Alloy Steel Globe Valve | | |
| | 1. | Reference | : ASTM A-182 F22 |
| | 2. | Type | : Globe |
| | 3. | Construction | : Forged Body |
| | 4. | End Connection | : ½" Socket Weld |
| | 5. | Rating | : CL. 2500 |
| | 6. | Material | : Body - Alloy steel |
| | | | : Stem - Hardened Steel |
| | | | : Plug - AISI 316 SS |
| | | | : Seat- Stainless steel stellited |
| | 7. | Packing | : Grafoil as required |
| | 8. | Yoke | : ASTM A182 F22 |
| | 9. | Handwheel | : Carbon steel |
| | 10. | Design standard | : As per ANSI B 16.34 |
| 10.05.12 | Condensate Pot | | |
| | 1. | Reference | : ASTM A182 F22 /ASTM A105 |
| | 2. | Material | : Alloy steel / carbon steel as per application |
| | 3. | Construction | : Drilled from barstock |
| | 4. | End connection | : 3 nos. ½" socket weld end |
| | 5. | Accessories | : Vent valves |
| 10.05.13 | Instrument Valve Manifold | | |
| | 1. | Type | : Two valve manifold |
| | | | : Five valve manifold |
| | 2. | Mounting | : Remote 2" Pipe Mounting |
| | 3. | Construction | : Single block (bar stock) |
| | 4. | Material | : Forged body and bonnet AISI 316 stainless |

		steel
5.	Ports	: 1/2 " NPT (F)
6.	Rating	: 420 Kg/Sq. cm at ambient
7.	Operating Temperature	: (-)30 to (+)170 Deg C
8.	Packing	: PTFE Wafer
9.	Seat & Stem	: AISI 316 SS
10.	Plug	: AISI 316 SS free to turn on stem / 17-4 PH
11.	Handle Bar	: AISI 316 SS
12.	Connection	: Straight
13.	Accessories	: Plugs for all ports, Mounting Bracket , bolts , nuts

10.06.00 Pneumatic Hook Up Accessories

10.06.01 Air Header

Technical Particulars	For Panel	For Field
Material of Construction	: Stainless steel	: Stainless steel
Inlet Connection	: 2" NPT (M)	: 1" NPT (M)
Header Take-off Material	: stainless steel	: stainless steel
Take off connection	: 1 / 2" NPT (M)	: 1/ 2" NPT (M)
Take-off Valves Material	: stainless steel	: stainless steel
Tube Take-off	: Tube adapter on valve	: Tube adapter on valve
Drain	: SS drain valve at lowest point	: SS drain valves at lowest point

10.06.02 Seamless Stainless Steel Tube

- Reference : ASTM A-269 TP 316
- Material Grade : TP 316
- Size : 1/4" OD X 0.049" wall thickness

- | | | |
|----|-----------------|--|
| 4. | Type | : Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube. |
| 5. | Properties | : The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80. |
| 6. | Test Pressure | : 400 Kg/Sq. cm |
| 7. | Tolerance | : ± 0.13 mm for outside diameter
: ± 15 % for wall thickness |
| 8. | Standard Length | : 5 meter |
| 9. | Test | : Flare, Hardness, Ball and Bubble Test |
- 11.00.00 **SPECIAL TOOLS & TACKLE AND TEST EQUIPMENT FOR AND OTHER SYSTEMS**
- 11.01.00 Bidder shall supply a complete set of new, unused and reliable type of special tools and tackle and test equipment which are necessary or convenient for erection, commissioning, maintenance and overhaul of the plant and equipment provided under this specification.
- 11.02.00 The tools & tackle and Test Equipment shall be shipped in separate container, clearly marked with names of the equipment for which they are intended.
- 11.03.00 Bidder shall furnish list of tools & tackle and test equipment proposed to be supplied along with the bid.

material with suitably colored lettering engraved on the back.

- c) The nameplates shall be held by self-tapping screws. The size of nameplate shall be approximately 20 mm x 75 mm for equipment and 40 mm x 150 mm for the panels.
- d) Items of plant such as valves, which are subject to handling, are to be provided with an engraved chromium plated nameplate or label with engraving filled with enamel, suitably mounted or affixed with strong rustproof chain.
- e) All such nameplates, instruction plates, lubrication charts etc. shall be with English inscriptions.

8.00.00 METERING BASES AND CHART UNITS

The following system of units shall be followed for various displays and scales unless otherwise mentioned:

- i) Pressure : Kg/cm²
Differential Pressure : mm of H₂O column / Kg/cm²
- ii) Draught : mm of H₂O column
- iii) Vacuum : Kg/cm² (abs)/mm of Hg column
- iv) Temperature : Degree Celsius (° C)
- v) Flow (Steam, Water) : Tonnes / hr, M³/Hr
- vi) Flow (Oil) : M³ / Hr, Litter/Hr
- vii) Flow Air : Tonnes / hr / M³ / Hr.
- viii) Density : gms / c.c.
- ix) Level : mm /%
- x) Conductivity : μS / cm or mS/cm
- xi) Gas Analyzer : Percentage by weight or as specified in respective case.
- xii) Dissolved Oxygen / Silica / Sodium : ppm /ppb

9.00.00 PROCESS CONNECTION & INSTRUMENT HOOK UP

- 9.01.00 Instrument connection to the process system (piping, vessel etc.) shall be according to the process & piping specification upto and including the root valves. Root valves shall be installed as close as possible to the piping or vessel.

- 9.02.00 Each instrument shall have its own independent connection to the process except for instruments located on standpipe. Each instrument shall be connected independently to the standpipe through isolation valve.
- 9.03.00 Isolation and blowdown drain valves adequate for duty and capable of withstanding continuous design condition of main process shall be provided. Instrument blow down valve near to the instrument shall be of gradual opening type. For process pressure equal or above 40 kg/ sq.cm double blowdown valves shall be used connecting to blowdown header. Instrument manifold / gauge valve shall be installed close to the instrument.
- 9.04.00 The nominal size of the takeoff connections on line shall not be less than NPS ½" for source conditions not in excess of either 900 psi or 425OC and NPS ¾" (for adequate physical strength) for design conditions exceed either of these limits. Where the size of the main is smaller than the limits given above, the takeoff connections shall not be less than the size of the main line.
- 9.05.00 Process connection for instruments lines and vessels shall be in accordance to standards such as ASME or other recognized international standards. Table below indicates the type of connection generally to be used.

INSTRUMENTS	EQUIPMENT / PIPE SIDE	INSTRUMENT SIDE
Level Instruments		
Internal Displacer	4" - Flanged	4" - Flanged
External Displacer	2" - Flanged	2" - Flanged
Level gauge	¾" -Flanged	¾" - Flanged
DP Type	½" (min.)-welded 1" – welded for vessel like HP heaters, LP heaters, De-aerator etc. application	½"- NPT
External cage Level switch	1"- welded	1"- welded
Flow Instruments		
DP Type	½" - welded in general 1" – welded for high pressure / temperature main steam, feed water, PRDS etc. application	½" - NPT
Pressure Instruments		
Conventional	½" (min.)-welded 1"- welded for high pressure/	½" - NPT

INSTRUMENTS	EQUIPMENT / PIPE SIDE	INSTRUMENT SIDE
	temperature main steam, feed water, PRDS etc. application	
Diaphragm type-HFO application	3"- Flanged	3"- Flanged
Temperature Instruments		
Thermowell	Generally - M 33 X2 (M); 1½" Flanged- For air/FG path application	½" NPT
Analyzer		
Liquid analyzer	½" - 1" - welded	½"

- 9.06.00 Size of impulse pipe for pressure measurement in air and flue gas duct path of boiler shall not be less than ¾" NB.
- 9.07.00 Separate stubs and take-off points with thermo well / root vlves shall be provided for performance guarantee test.
- 9.08.00 Impulse pipes shall be clamped at suitable interval not exceeding 1.5 meter. Process pipe shall not be used for supporting the impulse pipe.
- 9.09.00 Fittings shall conform to ANSI B 16.11. Threads of piping component shall be of tapered construction.
- 9.10.00 Instrument blowdown header shall in no case be lower than the material grade ASTM A 106 Gr. C.
- 9.11.00 Impulse pipe shall be laid at least with slope of gradient 1:10 to avoid any air pocket or water accumulation.
- 9.12.00 Expansion loop shall be provided at least at every 2.5 meter interval without affecting the gradient of slope in long run impulse pipe to avoid stress on the piping.
- 9.13.00 Siphon shall be provided in the impulse pipe or tube to protect the instruments where fluid temperature is 100 OC or more.
- 9.14.00 Orientation of tappings shall be as follows :
- For liquid service within 45 ° at lower half of the pipe horizontal plane.
 - For gas service within 90 ° at upper half of the pipe horizontal plane.
 - For steam service within 45 ° at upper half of the pipe horizontal plane.

- As a rule tap orientation of high and low pressure side should be parallel and symmetrical.
- 9.15.00 Pressure & Differential pressure instruments in steam and liquid services shall be located below the taps and the piping shall be sloped to avoid formation of air pocket.
- 9.16.00 Pressure & Differential pressure instruments in air and flue gas service shall be located above the taps and the piping shall be sloped back to process to avoid formation of any liquid.
- 9.17.00 Impulse pipe including taps for furnace, flue gas and coal mill application shall be provided with air purge connection. Differential instruments for such application shall have continuous and as well as intermittent purging. Whereas, pressure measurement shall have only intermittent purging.
- 9.18.00 Material of impulse pipe for the instruments mounted on rack and enclosure shall be same as that of main process pipe except stainless steel tube of Gr. 316 or better shall be provided for connection in between impulse pipe (from tee connection on impulse pipe) and instrument manifold valve & instruments. Impulse pipe, tubes, fittings and accessories shall have the same design pressure and temperature applicable for the related main pipe.
- ~~10.00.00 **POWER SUPPLY SYSTEMS**~~
- ~~10.01.00 Instrumentation power supply system shall include all conditioning equipment required to accommodate normal variations in the electrical supply. All panels and cabinets shall accept redundant power feeds from two different sources.~~
- ~~10.02.00 Type of power supply systems envisaged for the various I & C system including DCS are as follows:~~
- ~~a) 240V AC Redundant UPS system HMIs, Main Plant Field devices / equipment, CCTV, EWLI, CEMS, SWAS etc. and PLC of package System~~
- ~~b) 24V / 48 VDC Supply for DCS~~
- ~~11.00.00 **ENVIRONMENTAL CONSIDERATIONS**~~
- ~~I & C components should operate properly with no degradation in expected lifetime or in operation parameter in the normal power plant environment. I & C system shall be designed considering all the operating conditions which may be encountered during installation and operation.~~
- ~~11.01.00 Temperature~~
- ~~11.01.01 Where the environmental extreme exceeds the capabilities of the selected system, Bidder should take appropriate steps to control the environment.~~
- ~~11.02.00 Humidity~~
- ~~11.02.01 I & C system shall be designed to withstand the humidity limits specified for the project. Condensation shall not be allowed to form in the cabinets nor~~



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	
	1.1 MODEL NO/TAG NO						
	1.2 RANGE						
	1.3 END CONN						
	1.4 NO. OF CONTACT						
2	CALIBRATION			P	V	V	
	2.1 REPEATABILITY						
	2.2 SET POINT ADJUSTMENT						
	2.3 DIFFERENTIAL						
3	OVER PR & LEAK TEST				P	V	V
4	ELECT. INSULATION/HV TEST	ONE		P	V	V	
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V	
	5.1 SENSOR						
	5.2 MOVEMENT						
	5.3 PROCESS CONNECTION						
	5.4 HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	REVIEW OF TC OF MICROSWITCH	FOR LOT		V	V	V	

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and the same alongwith test certificates to be verified by BHEL



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TRANSMITTER

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECKS FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	VISUAL.						
	MODEL/TAG No						
2	PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	REPEATABILITY			P	W	V	
5	HYSTERESIS			P	W	V	
6	EFFECT OF TEMP VARIATION ON ACCURACY			P	W	V	
7	SPAN / ZERO ADJUSTMENT	ONE / TYPE		P	W	V	
8	EFFECT OF SUPPLY VOLTAGE VARIATION			P	W	V	
9	EFFECT OF LOADING (500 OHM METERS)			P	W	V	
10	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
11	BURN-IN TEST	ONE / TYPE		P	W	V	
12	DEGREE OF PROTECTION			P	W	V	
13	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

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Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- When material correlation are not available manufacturer's compliance to be provided.
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE & DP GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	SENSOR TYPE						
	DIAL SIZE						
	MODEL NO/TAG NO						
	RANGE/SCALE						
	SWITCH CONTACT RATING & NOS.						
	END CONNECTION						
2	CALIBRATION			P	W	V	
	ACCURACY						
	REPEATABILITY						
	SET POINT ADJUSTMENT						
3	OVER PRESSURE & LEAK TEST		P	W	V		
4	OPERATION OF PRESSURE. RELIEF DEVICE	ONE	P	W	V		
5	REVIEW OF TC FOR	FOR LOT	V	V	V		
	MATERIALS OF SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST	V	V	V		
7	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW	V	V	V		

Legend :

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Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- When material correlation is not available, MFR's compliance to be provided
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR LEVEL GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS / DRWGS	P	W	V	
	TYPE						
	MODEL/ TAG NO.						
	DAIL SIZE						
	RANGE/SCALE						
	END CONNECTION						
2	DIMENSIONS, PROCESS CONNECTION	ONE / LOT		P	W	V	
3	ACCURACY			P	W	V	
4	MATERIAL TC FOR			P	V	V	
	BODY ISO.						
	VALVE						
	GAUGE GLASS						
5	HYD. TEST	SEE NOTE-1 BELOW		P	W	V	
6	ACCESSORIES AS APPLICABLE			P	W	V	

Legend :

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Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR ANNUNCIATORS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE/ MODEL						
	DIMENSIONS OF HARDWARE						
	MODULARITY						
	SEQUENCE						
	FACIA DETAILS						
2	FUNCTIONAL TEST	100%		P	W	V	
3	IMMUNE TO STEP VARIATIONS IN THE POWER SUPPLY	SEE NOTE-1 BELOW		P	W	V	
4	DEGREE OF PROTECTION FOR ENCLOSURE	TYPE TEST		P	W	V	
5	I/R CHECK	SEE NOTE-1 BELOW		P	W	V	
6	RESPONSE			P	W	V	

Legend :

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Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 11 of 18
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
PLC SPECIFICATION		

- 3.12.07 Individual gauge board (as per manufacturer's standard) shall be provided near each Air Drying plant for local indication of all important parameters such as pressure, temperature, flow related to the driers.
- 3.12.08 Bidder shall provide all measuring instruments with required accessories for control, monitoring, protection and interlock of the compressors and driers. Electronic analog signal transmission from field transmitters to area control rooms shall be 4-20 mA DC. All process switches, limit switches and drive feed back signals shall be provided with potential free contact. Temperature detector will be provided at each stage of the compressed air system and cooling water system of compressors for monitoring in the local control panel.
- a) The control system shall meet the requirement of monitoring, sequential starting/stopping of drives, interlock and protection, individual/sequential control metering, annunciation and on-line and all other routine functions with minimum operator's intervention.
- b) In line flow gauge & flow switch shall be provided on the cooling water line of the compressed air system.
- 3.12.09 Dew point measurement shall be provided for each Air drying plant of compressed air system. The output of the instrument shall be 4-20 mA DC to be connected to the master controller panel.
- 3.13.00 Fuel Oil Unloading System
- 3.13.01 The Fuel Oil Unloading System shall be controlled from PLC based local control system or relay based system. No operator work station has been envisaged for this system. The system shall be operated from Lamp / Pushbuttons, selector switches etc located on the panel. Integral type hardware annunciation system shall be provided at the top of the panel for alarm monitoring. Important parameters i.e. tank levels, oil flow, oil temperature etc. from this panel shall be monitored in the station DCS via RIO considered for Fuel Oil Pressurising & Heating System. Facility shall be provided in the PLC for connecting laptop for programming.
- 3.13.02 Level signals from HFO/LDO day tank shall be connected to DCS via hardwired link for control of HFO/LDO transfer pumps. Bidder shall keep these signals terminated in suitable terminal blocks of the local panel.
- 3.14.00 Ventilation And AC System
- 3.14.01 For detail Instrumentation systems, operation & control philosophy refer Vol IIB.
- 4.00.00 **TECHNICAL SPECIFICATION – CONTROL SYSTEM**
- 4.01.00 Brief technical specification of the PLC based control systems are delineated below.
- 4.01.01 Programmable Logic Controller (PLC) based control system shall have 1:1 hot redundant configuration. Central Processing Units (CPUs) shall have word length of 32 bits minimum.

- 4.01.02 Following components shall be redundant as well : communication processors, memory modules, rack power supply units, bulk IO power supply units, IO communication modules, data highway and high speed (100Mbps) data network connecting the operator stations.
- 4.01.03 Two CPUs shall operate on fault tolerant mode with continuous self and cross-monitoring. Failure of the active CPU shall not affect the operation of the plant. In the event of failure of active CPU, tasks shall be transferred to the standby CPU within fastest possible transfer time (< 5m sec.) without causing any relays to drop out during the transfer.
- 4.01.04 CPUs shall not be loaded to over 60% of their capacity even under worst data loading conditions. It shall be possible to make a manual transfer from the active to the back-up CPU from engineering station and as well as from the front panel of CPU module.
- 4.01.05 Modules shall have adequate status and diagnostic indication on the front panel.
- 4.01.06 System shall be of modular construction and expandable by adding hardware modules. Bidder shall provide at least 20% or a minimum of one off, spare channels as hot-on-rail spares in each configured cards / modules. In addition to this, 10% or minimum of one off, extra assigned complete spare modules mounted on rails in racks for each type of I / O modules shall also to be provided. The spare channel and cards shall be fully wired and terminated.
- 4.01.07 Memory unit of the CPU shall be field expandable at least by 25%. Operating system / application program / sequence logic etc. shall be stored in nonvolatile memory for automatic re-booting. Dynamic memories shall be provided with battery back up at least for 360 hours.
- 4.01.08 Number of input / output points per card shall not exceed 16 (sixteen) for digital and 8 (eight) for analog / thermocouple / RTD signals. Individual input and Output channels shall have galvanic / optical isolation. Merely fusing of individual or a group of channels is not acceptable.
- 4.01.09 Data communication system of the PLC shall not be limited to the following:
- a) Internal bus and external data network loading shall in no case be more than 60% of its capacity.
 - b) Disrupted message shall be automatically retransmitted when the system is restored.
 - c) Failure or physical removal of any module connected on the system bus shall not lead to any loss of communication.
 - d) Diagnostics message shall be issued on fault detection.
 - e) Bus change over from active bus to stand by bus, during failure of active bus, shall be performed automatically and bumplessly. Such event shall be suitably logged or alarmed.

- f) Noise immunized and reliable highspeed dual fault tolerant optic fiber cable communication with standard communication protocol shall be provided between PLC s and remote or extended I/O modules.
 - g) Main data network shall comply with the International Standard IEEE-802.3 (Ethernet) for data exchange and communication.
- 4.02.00 Operator workstation shall be complete with latest user friendly operating system, 24" colour LCD monitor, membrane KB, mouse, colour laser printer and dot matrix printer. In addition, a laptop unit loaded with engineering software shall be furnished.
- 4.02.01 The functions performed from the HMIs shall not be limited to the following:
 - a) Selection of auto/Manual, open/close, sequence auto, start/stop operation.
 - b) Dynamic Mimic display depicting the process.
 - c) Alarm monitoring, report & log generation, printing of trends etc.
 - d) On line / historical trending, historical storage and retrieval of data.
- 4.03.00 Software
 - a) Necessary software for implementation of the control logics, operational displays & logs, data storage, retrieval and other functional requirements, shall be provided.
 - b) Licensed version of required software including operating system, configuration and HMI software shall be provided.
 - c) Detail documentation on the programming softwares as part of the O&M manual.
- 4.04.00 Power Supply
 - a) Power supply to the PLC system shall be provided from solid-state 240V AC $\pm$ 1% packaged UPS (Uninterruptible Power Supply) units to be placed local to the control systems. UPS system shall be complete Ni-Cd type battery & battery chargers. UPS shall have adequate capacity to cater 100% load without overloading. UPS system shall be adequate to provide back up power for not less than 30 minutes.
 - b) UPS shall be complete with AC Distribution board. Two feeders shall be extended from ACDB to PLC.
 - c) Bulk power supply units for interrogation, relay and solenoid voltage shall be separate from system power supply units and shall be redundant.
- 4.05.00 System shall have MTBF better than 99.7% and shall be hot maintainable. System hardware shall be designed to be 'fault avoidant' by selecting high-grade components of proven quality and properly thermally de-rated design. The network shall have extensive fault monitoring, self-surveillance & on-line self-diagnostic capability so that failure is immediately detected.

- 4.06.00 System shall automatically check & correct gain & drift for ADCs on-line.
- 4.07.00 Data exchange in a bus shall be fully monitored and checked for validity.
- 4.08.00 Response time consisting of IO scan time, data communication time, processing time etc. shall be equal to or less than the following :
- a) OLCS & sequence control inputs : 100 ms.
 - b) CLCS inputs : 250 ms.
 - c) Monitoring analog parameters : 500 ms.
 - d) Monitoring digital parameters : 100 ms.
- 4.09.00 Following operations will be performed on I/Os, as required:
- a) Square root extraction
 - b) Pressure & temperature compensation
 - c) Reasonability check of all inputs, validation and quality tagging like good, bad, suspect etc.
 - d) Channel wise engineering unit conversion
 - e) Contact bounce filtering with adjustable time constant.
- 4.10.00 The controllers shall be time synchronized to GPS master clock via IRIG-B or Ethernet port. Software capability shall be provided to implement closed loop control functions as follows:
- a) PID control and their variations.
 - b) On-off control
 - c) Cascade control
 - d) Ratio and bias control
- 4.11.00 Features for Open Loop Control shall not be limited to following:
- a) Logic functions like AND/OR/NOT gates, timers (on-delay, off-delay), shift registers, counters, latches, flip-flops, mono-shots etc.
 - b) Automatic sequence control for start up and shutdown of auxiliaries / equipment in functional groups initiated by command from operator's console. A sequence shall be made of steps executed in predetermined order according to logic criteria. For each step there shall be a provision for 'waiting time' and 'monitoring time'. System shall have the capability to bypass a step, if desired, from the operator's station. Such action however shall be registered as an exception.
 - c) Inputs for protection system shall be of high priority. In the event of either loss of control power or control signal input to the drive, the drive shall remain in its last position unless specifically required otherwise. The

system shall be designed such that no upset occurs either to process or to the drive when the power is restored.

- 4.12.00 Interface of the system with M.C.C / Switchgears shall be in the form of potential free contacts via interposing relay modules mounted in the respective switchgear or MCC unit. Other interfacing relays shall be mounted in a cabinet separate from the system cabinet. 10% wired additional interposing relay modules shall be provided as installed spare. Freewheeling diodes shall be provided across the coil of DC solenoid and contactors / relays. For AC solenoids and contactors directly driven from output cards, arc suppressors shall be provided across the coil.

Each I / O rack shall have 10% spare rack space for future upgradation.

- 4.13.00 Single programming instruction / command shall be sufficient to delete a program rung from memory. Similarly, any rung can be inserted into the existing program. The active and the stand-by CPU programs shall equalize automatically, once the new program is permitted to 'RUN'.

- 4.14.00 Updating time and reaction time shall be as follows:

- | | | |
|------------------------------------|---|------------------|
| a) Calling up a mimic | : | 2 sec or better |
| b) Updating status signal in mimic | : | 1 sec or better |
| c) Updating variables in a mimic | : | 1 sec. or better |
| d) Issuance of command to output | : | 1 sec. or better |

(without considering process lag)

- 4.15.00 Displays shall be classified into overview display, group display, point display and trend display.

- 4.16.00 Printing of logs shall be initiated automatically at prescribed time intervals, or initiated on demand by the occurrence of predefined events.

System shall permit the operator to specify minimum of 5 summary logs each with minimum of 25 points to be printed on demand.

- 4.17.00 Salient features of the PLC system for I/O handling shall be as follows:

- a) Input filters to attenuate noise.
- b) Isolation of 1500V AC for the input & output module.
- c) Comm. Mode Noise rejection for analog inputs of 120 db at 50 Hz.
- d) Normal mode noise rejection for analog inputs of 60 db at 50 Hz.
- e) LED indicators on each card to show status of input.
- f) All the outputs shall be with individual fuse.
- g) J/K type thermocouple mV input where applicable.

- h) Pt-100 three / four wire resistance thermometer input where applicable.
- i) 24 V DC power supply to field mounted two wires transmitters.

4.18.00 Salient hardware/ software features of the CPUs shall be as follows:

- a) Watch dog timer : Periodical reset. Alarm and interruption, if not reset within stipulated time.
- b) Max. scan time for inputs: 1 sec. max.
- c) Maximum Scan Rate : 1 ms (Per K Word) or better
- d) Memory capacity : 25% spare capacity after full utilization. Expandable in multiples of 16 K.
- e) Comm. processor : Separate
- f) Battery back up for RAM : 360 hrs continuous operations.
- g) Diagnostic feature : Periodic, automatic self- diagnostic.

4.19.00 Salient features of the Input / Output modules are as follows:

- a) All modules
 - 1. Surge withstand capability : IEC-255.4
- b) Digital General
 - 1. No. of channels / module : 16
 - 2. Interrogation voltage : 24V DC or 48 V DC
 - 3. Status indicator : LED type.
 - 4. Isolation : Optical
- c) Digital Input Module
 - 1. Contact bounce filtering : Adjustable time constant of 15 m. sec.
 - 2. Diagnostic : Module fault
- d) Digital Output Module
 - 1. Output protection : Short ckt. Proof & Individual fuse
 - 2. Diagnostic : Module fault
- e) Analog General
 - 1. No. of channels / module : 8
 - 2. Isolation : Galvanic/Optical

f) Hi-level Analog Input Module

- | | | |
|----------------------------|---|----------------------------|
| 1. Type of input | : | 4-20 mA DC / 1-5V DC |
| 2. A/D Converter | : | 11 bits + Sign (or better) |
| 3. Accuracy | : | 0.1% or better |
| 4. Diagnostic | : | Module fault |
| 5. Powering of transmitter | : | 24 V DC 2 W type |

g) Low Level Analog Input Module

- | | | |
|------------------|---|----------------------------|
| 1. Type of input | : | PT-100; T/C(As required) |
| 2. C-J-C | : | On Module |
| 3. Accuracy | : | 0.1% or better |
| 4. A/D converter | : | 15 bits + Sign (or better) |
| 5. Diagnostic | : | Module fault |

h) Analog Output Module

- | | | |
|-------------------|---|----------------------------|
| 1. Type of output | : | 4-20 mA DC |
| 2. Accuracy | : | + 0.1% or better |
| 4. A/D Converter | : | 11 bits + Sign (or better) |
| 5. Load | : | 600 OHM |
| 6. Diagnostic | : | Module fault |

5.00.00 **OPTICAL FIBRE CABLE**

5.01.00 This specification defines the minimum general requirements for the Design, manufacture, supply, inspection, installation, testing & commissioning of optical fiber cables and accessories, such as fiber distribution (patch) panels, adapters, connectors, joint boxes, pigtails and other components, as required to complete the system. Bidder shall consider all related activities, such as cable stripping, cable entry in boxes and panels, cable fiber splicing/fusion, cable performance testing and other services, to achieve a properly documented and operational cable network.

5.02.00 Fiber Optic Cables shall be installed on cable tray, duct bank, cable trench, as necessary. For outdoor applications the cable shall be armoured with Poly Ethylene sheathing. Cable shall be routed through suitable grade permanently lubricated HDPE protection pipe as per IS 4984, IS 12235 & TEC.G/CDS-08 /01of suitable size @ 53% fill factor.

5.03.00 The Optical Fiber core shall be of ultra pure fused silica glass coated with UV-cured acrylate suitable to withstand temperature of about 80°C (continuous).

- 5.04.00 Fiber optic cable shall be of loose tube design. Typically, fibers shall be housed in-groups of 6 (minimum) within gel-filled buffer tubes to protect against ingress of moisture and vibration. The tubes shall be manufactured with industry standard material like Poly-Butelene Terathylate (PBT). They shall be colored for easy identification. Buffer tubes shall be approachable with industry standard tools and 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. 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.
- 5.05.00 The central strength member of the cable shall be Fiberglass Reinforced Plastic (FRP) or other material with equivalent mechanical strength to provide both tensile and anti buckling strength to the cable.
- 5.06.00 In addition to central strength member, additional strengthening substance like aramid yarns shall be helically applied over the cable core to provide additional tensile strength to the cable.
- 5.07.00 The cable shall be of dual jacket & armoured. Inner sheath consists of a medium density polyethylene (MDPE) jacket extruded over the cable core. 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 rodent protection. The armor is covered with an outer black FRLS MDPE jacket. A ripcord is also placed underneath the armor for easy outer jacket removal.
- 5.08.00 Minimum bending radius shall be equal or more to 15 D. A continuous strength member shall be provided for the entire length of the cables. Every tube and fiber shall be colour coded to provide easy identification. The outer sheath shall be marked to show fiber type and cable classification at suitable intervals.
- 5.09.00 Entire length of the cable shall be marked with the following at regular intervals:
- a) Manufacturer's Name
 - b) Month and year of manufacturer
 - c) Coded description of the cable based on Telcordia's (Bellcore) SR-2014 Suggested Optical Cable Code (SOCC).
 - d) Sheath Identification Number
 - e) Sequential Length Marking in meter
 - f) A Telephone Handset symbol to distinguish communication from power cable as per NESC section –35 G.
- 5.10.00 Fiber optic cable shall provide a long life expectancy of minimum 25 years and shall meet the industrial standard of continuous operation at temperature

of 55 O C and humidity to 100% without degradation to optical or mechanical performance.

- 5.11.00 Optical fiber used in the plant shall generally conform to the following specification:

ATTRIBUTES		
a)	Cladding Diameter	125 $\mu\text{m} \pm 1.0 \mu\text{m}$
b)	Cladding non-circularity	$\leq 1.0\%$
c)	Attenuation Coefficient at	
	(a) 1290 nm to 1340 nm (b) 1525 nm to 1575 nm	$< 0.36 \text{ dB/km}$ $< 0.25 \text{ dB/km}$
d)	Chromatic Dispersion Coefficient at	
	(a) 1310 nm (b) 1550 nm	$< 3.5 \text{ ps/nm.km}$ $< 18 \text{ ps/nm}$
e)	Polarization Mode Dispersion (PMD)	$\leq 0.5 \text{ ps}/\sqrt{\text{km}}$
f)	Mode Field Diameter at	
	(a) 1310 nm (b) 1550 nm	$9.2 \pm 0.4 \mu\text{m}$ $10.50 \pm 1.0 \mu\text{m}$
g)	Mode Field Concentricity Error	$\leq 0.5 \mu\text{m}$
h)	Proof Test	$\geq 1\%$
i)	Fiber Curl (ROC)	$\geq 4.0 \text{ m}$
j)	Macro-bend Test on Fiber at 1550 nm	$\leq 0.1 \text{ dB}$

- 5.12.00 Cable Assembly

- 5.13.00 Optical Fiber Environmental Splice Enclosure

Optical fiber environmental splice joint enclosures shall be re-enterable and rack / wall mountable. The interior splice case shall be equipped to mechanically accommodate single-mode optical fibers connected by the

fusion method. Splice case shall be equipped to organize the splice trays and the required service loops of buffered incoming optical fibers and outgoing 'pigtails' in such a way that allows each completed splice and associated optical fiber to be maintained in an unstrained configuration. Splice enclosure shall be dust and weather proof.

5.14.00 Fiber Optic Distribution Patch Panel

Fiber optic distribution panels shall be provided as required. Fiber optic distribution panels shall be of a standard wall mounted sheet metal enclosure type. Fiber optic distribution panels shall be equipped to secure optical fiber patch cables and pigtails to prevent damage during all operation and maintenance functions. In general splice enclosure are envisaged. However, if no optical fiber splice enclosures are implemented, then the fiber optic distribution panels shall be equipped with splice trays for storage and protection of fusion splice connections of single-mode fiber optic cable and pigtails. Each fiber optic distribution panel shall be fully equipped with 'SC' type bulkhead connector sleeves or equivalent. Unused sleeve ports shall be equipped with reusable caps to prevent the intrusion of dust.

5.15.00 Pigtail and Patch Cord

All pigtails shall be factory SC-connectorized, and satisfy specified performance for optical links. All unused pigtails (including spares) shall be terminated with the connector to a bulkhead connector sleeve, protected by a reusable cap on the opposite sleeve port, to prevent the intrusion of foreign material or dust. All necessary connectorized pigtails shall be provided in the lengths required.

5.16.00 Fiber Optic Tool Kit

5.16.01 Optical Time Domain Reflectometer

- a) A recording optical time domain reflectometer (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:
 - Fiber Identification (ID) with a minimum of 10 characters
 - Cable ID with a minimum of 10 characters
 - OTDR location with a minimum of 20 characters
 - Far End location with a minimum of 20 characters
 - Test Operator initials with a minimum of 3 characters
- c) The printer shall preferably be internal. The printer shall be able to print data traces within 30 seconds or less. The machine settings 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, date 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 diskette 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 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) Contractor shall provide all mounting accessories, cables and connectors required to establish data communication.

5.16.02 Fiber Optic Splicer, Terminator And Tool Kit Box

Bidder shall provide new unused tools comprise of Splicer and Fusion Joiner and tool kit comprise of cutter, stripper, polishing tool, handheld microscope, heat shrinkable sleeve, scissor, knife etc. as required for maintenance and commissioning.

5.16.03 Tests

Following minimum test as per any approved standards shall be carried out on the cables:

- a) Attenuation And Dispersion Characteristics Tests
- b) Proof Tests
- c) Macro-Bend Resistance Test
- d) Mechanical Tests
- 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) Color Permanence Test Cable Aging Test
- n) Water Penetration Test
- o) Lightning Test
- p) Routine Test / Sample Test
- q) Site Test (Like Continuity & Attenuation)

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										VOLUME IIB		SECTION D		REV. NO. 01		DATE: 24.08.2007						
										SHEET 1		OF 8										
										Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
																			P	W	V	
1.0	Materials /Components																					
1.1	Panels & Control Desks	Physical Inspection for Dimensions, Painting, Cutouts, Lifting / Locking Arrangements, Components, Drawing Pocket, Mounting accessories, Plinth & AV Pads, Cable Gland Plates, Hardwares, Hinges, Louvers & Filters, Fans & Panel Lamps	MA	Visual	100%	Contract specifications, Approved GA Drawings, BOQ	As per ref documents. No physical damage.	BHEL Quality Inspection Report.	3/2	2	1											
1.2	Power Supply/Packs, Battery & Battery charger, Transformer, UPS.	Physical Inspection Physical Damages Dimensions Mounting Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per reference documents, Test Report	BHEL Quality Inspection Report.	3/2	2	1											
1.3	Indicating Lamp, Annunciator, Meters, Transducers, Signal Converters, Single Instruments, Single Loop Controllers	Physical Verification Physical Damages Dimensions Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per ref documents No physical damage. Test/ Calibration report.	BHEL Quality Inspection Report	3/2	2	1											
1.4	PLC processors, I/O modules, Power Supply modules, Communication modules, Mounting Racks, Ethernet	Physical Inspection - Identification Labels - Physical Damages - Quantity - Spare Capacity	MA	Visual	100%	Product Catalogue, Data sheets, Approved Configuration diagram, BOQ	As per ref documents. Test Certificates	BHEL Quality Inspection Report.	3/2	2	1											

LEGEND:		* CR		- Critical characteristics													
		MA		- Major characteristics													
		MI		- Minor characteristics													

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks			
									P	W	V				
1.5	CPU, Monitor, Keyboard, Mouse, CD Drives, Printers, OS, System Software, Engineering software in the form of Licensed CD.	Physical Inspection Identification Labels, Tech. Specification Physical Damages Accessories Installation arrangements for Computers & Printers	MA	Visual	100%	Contract specifications, Product Catalogue, Approved GA / Configuration drawing, BOQ.	As per reference documents.	BHEL Quality Inspection Report.	3/2	2	1				

LEGEND:	* CR	- Critical characteristics		P	- Agency Performing the Test.	1	- BHEL
	MA	- Major characteristics		W	- Agency Witnessing the Test.	2	- Vendor
	MI	- Minor characteristics		V	- Agency Verifying the Test.	3	- Sub-vendor



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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	

2.0	Assembly											
2.1	Functional Test for HMI/OWS devices such as Monitors, Keyboards, Mouse, Printers etc.	Operation	MA	Functional	100%	Approved Configuration Diagram & BOQ and FAT	Correct Operation of interconnected Devices of HMI system.	BHEL Quality Inspection Report.	2	1	1	
2.2	Hardware Functional Verification.	Physical arrangement, Wiring check & labeling, Continuity Checking, IR & HV test	MA	Visual/ Electrical	100%	Approved GA Drawing, Panel Wiring Diagram, IR & HV as per relevant International standard	Test Certification	BHEL Quality Inspection Report.	2	2	1	
2.3	Powering Up	Healthiness of all the modules/equipment, associated with Powering of PLC system	MA	Visual /Electrical	100%	Approved power supply scheme	All equipment to be healthy on power ON	BHEL Quality Inspection Report.	2	1	1	
2.4	Burn in test for PLC modules	Healthiness of PLC modules on Continuous Energisation, Temperature maintenance	MA	Visual/ Electrical	100%	FAT Procedure	Test certification as per FAT	BHEL Quality Inspection Report.	2	2	1	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

\$ P W V

- Agency Performing the Test.
- Agency Witnessing the Test.
- Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor

</											
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3.0	Factory Acceptance Test (FAT)											
3.1	Input Output Functional Verification	I/O configuration, I/O operation	MA	Visual/ Eletrial	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.2	Processor Verification	Processor configuration, Powering up, standby operation (as applicable) and Loading	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.3	Power Supply Module Verification	Redundancy Operation	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.4	Communication System Verification	Redundancy operation of Communication System, Measurement of Response Time, Communication with third party system	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.5	Diagnostic Verification	Self Diagnostic features of PLC system	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.6	Control Panel/Desk Verification	Operation of PLC driven annunciation system, Mosaic, Push buttons & selector switches, Indicating lamps	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.7	Software Verification	(i) Control Logics (ii) Engineering Features (iii) HMI Features	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	

LEGEND: * CR		- Critical characteristics		\$		P		- Agency Performing the Test.		1		- BHEL	
MA		- Major characteristics		W		W		- Agency Witnessing the Test.		2		- Vendor	
MI		- Minor characteristics		V		V		- Agency Verifying the Test.		3		- Sub-vendor	

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FACTORY ACCEPTANCE TEST (FAT) PROCEDURE

This document covers procedure to conduct/witness PLC system functional tests in order to demonstrate conformity to purchase specifications and related engineering documents. The test shall be conducted at the system suppliers works. The system supplier shall conduct all functional tests before commencing FAT and test results shall be made available during FAT. Vendor must furnish following relevant drawings, duly approved by BHEL Engineering, for reference during FAT.

- a) Technical Specification of PLC.
- b) PLC System Configuration
- c) General Assembly Drawings.
- d) Panel Wiring Diagrams.
- e) Bill of Quantity for PLC System.
- f) Logic Diagram.
- g) HMI Schematics.
- h) Input / Output List.

Further the vendor shall furnish applicable product specification, datasheets, catalogues, test-certificates, and internal inspection records to enable FAT. Vendor shall also submit, [to the inspecting agency](#), his standard test procedure, for clauses given below; where vendor's standard practice has been referred.

APPLICABLE TEST PROCEDURE:

1. Input/Output Functional Verification.

Check for correctness of addressing of racks, slots and I/O modules as per applicable PLC configuration diagram. Appropriate signal generators shall be used to simulate Inputs and outputs to check operation and SCAN time. [Check online replacement of cards, processors, power supply etc.](#)

2. Processor Verification

PLC Configuration drawing to be referred for ascertaining

- i) Redundancy

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ii) Type (Hot or Cold)

Both the processors are to be checked for healthiness in case of redundant configuration as per vendor's standard practice. In case of hot redundancy, switchover of control from primary processor to standby processor shall be demonstrated for uninterrupted control and data processing as per vendor's standard practice. Switchover shall be witnessed, by manual power off or resetting the Primary CPU or simulating failure of primary processor. Checking should be by witnessing the lighting up of Processor's LEDs as per manufacturer's product standard.

Vendor shall demonstrate, as per Vendor's standard practice, adequate Loading (Spare Capacity) of Processors, as mentioned in contract specs. This shall be done, by simulating worst load operation of fully integrated PLC system.

3. Power Supply Module Verification

Check if PSM is in redundant mode as per specification. Check the healthiness of power supply from both the modules' lamp indication/measurement. Simulate failure of one PSM and verify that standby PSM has taken over without any interruption.

4. Communication System Verification

Communication system has to be in line with approved PLC Configuration Diagram. Verify that both the communication buses are intact and connected. Communication between PLC processors, I/O rack, OWS etc. is to be checked through simulation of input data. Simulate the bus failure by disconnection of working bus. Check that the communication continues without interruption or loss of data.

Following response times are to be demonstrated as per vendor's standard practice for conformance to contract specifications:

1. Screen update time
2. I/O scan time
3. SOE resolution time
4. Data transfer time with third party system using Communication Protocol as per Contract specification and as per quantum of data as per approved signal exchange list.

5. Diagnostic Verification

Product Catalogue/Literature shall be referred for checking of all diagnostic features. Hardware failure to be simulated by removing an I/O

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6. Control Panel /Desk Verification

- i) PLC driven annunciation system should be checked by alarm signal simulation.
- ii) Push Button and selector switch operation should be checked by verification of corresponding change of status of Data Base point.
- iii) Indicating lamp / MIMIC should be checked by corresponding Data Base point simulation.

7. Software Verification

- i). Control Logics:– Software switches, lamps and Analog sources shall be used for simulation of field conditions .Control logics shall be checked for its correct functionality as per approved logic schemes
- ii). Engineering features:-
 - a) Online changing of parameters, set points.
 - b) Online modification in Control Logic Diagrams.
 - c) Online configuration of Graphics, Trends, Logs, HSR.
- iii). HMI features:-
Check for configuration & operation of Graphics, Trends, Logs, HSR and Alarms, in the form of Displays and Printouts, by simulation of Inputs as per approved documents.

8. Burn in Elevated Temperature test

Electronic equipments shall be subjected to Burn in elevated temperature test as per the procedure detailed below:

- a) (i) PLC modules are kept at 50 Deg c under continuous energized condition for 48 hours.

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ii) 48 hours test period shall be divided into 4 equal time segment of 12 hours duration each. For every 12 hours duration segment, after lapse of first 11 hours 110% of nominal voltage shall be applied to the panel under test for a period of 30 minutes followed by application of 90% of nominal voltage for the next 30 minutes.

b) Assembled Panels with complete wiring shall be kept under continuous energized condition for 120 hours at ambient temperature. Temperature rise in panels should be below 10 Deg C above ambient.

Checklist for Serial Communication between maxDNA Systems and Foreign Device :BHEL
A Device Specific :

SN	Parameters	Options available	Remarks if any
1	Modle No.& Make of Device		
2	Communications Link Options	☐ Multidrop ☐ Peer to Peer ☐ N/w topology attached	
3	Protocol Mode (Device is a)	☐ Master ☐ Slave ☐ Master/Slave	
4	Protocol	☐ RTU ☐ ASCII ☐ Other -----	
5	Master	☐ System maxDNA ☐ Other -----	
6	Dist.bet.maxDNA System & Device*	☐ ----- Feet ☐ ----- Meters	

B Electrical Specific :

1	Interface Type	☐ RS232 ☐ RS422 ☐ RS485	
2	Wiring at Device end	☐ 2 Wire ☐ 4 Wire	
3	Transmission Channel	☐ Half Duplex ☐ Full Duplex	
4	Baud Rates (bps)	☐ 1200 ☐ 2400 ☐ 4800 ☐ 9600 ☐ 19200	
5	Databits	☐ 8 ☐ 7	
6	Stopbits	☐ 1 ☐ 2	
7	Parity	☐ None ☐ Odd ☐ Even	
8	H/w & Software Handshake	☐ Yes ☐ No	
9	Response Timeout time (Sec)	☐ ----- ☐ Configurable timeout	
10	Data Formats Supported	☐ Boolean ☐ Real ☐ Char ☐ Sn.Int ☐ UnSn.Int	
11	Transmission mode	☐ Asynchronous ☐ Synchronous	

C Application Specific : *

1	Primary Function*	☐ Data Acquisition ☐ Data Acquisition & Control	
		☐ Download parameter sets	
2	Analog Points to read	-----Nos. ☐ Details attached ☐ Details not attached	
3	Analog Points to write	-----Nos. ☐ Details attached ☐ Details not attached	
4	Digital Points to read	-----Nos. ☐ Details attached ☐ Details not attached	
5	Digital Points to write	-----Nos. ☐ Details attached ☐ Details not attached	
6	Memory / Flag Points to read	-----Nos. ☐ Details attached ☐ Details not attached	
7	Memory / Flag Points to write	-----Nos. ☐ Details attached ☐ Details not attached	

D Hardware Specific :

1	Cable type	☐ Boolean cable ☐ Twisted pair cable	
2	Cable Details Enclosed	☐ Yes ☐ No	
3	Any specific Converter required	☐ Yes ☐ No ☐ Details enclosed	

E Device Documents :

1	Manufacturer's Documents*	☐ Tech., Spec. ☐ Operating Manual	

***Notes:**

A6 To identify converter requirement and cable length.

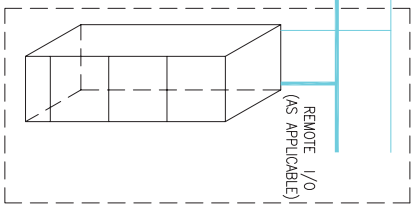
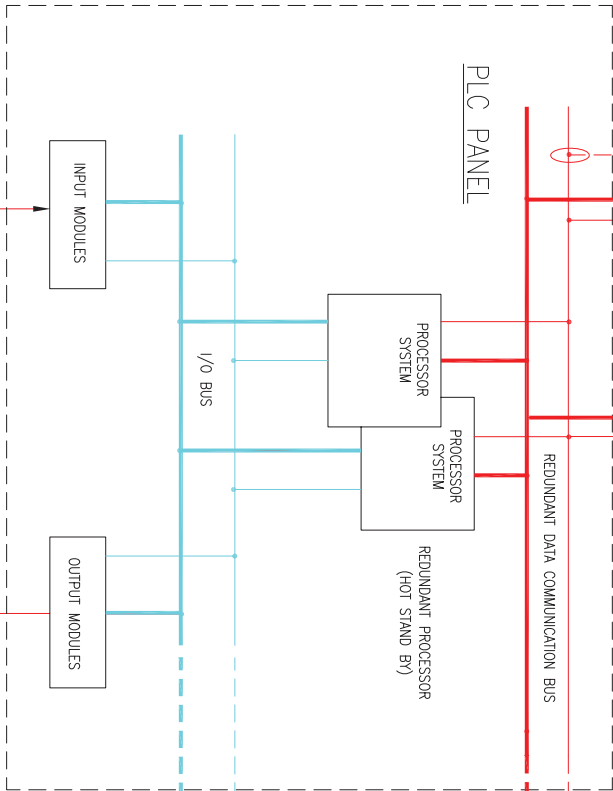
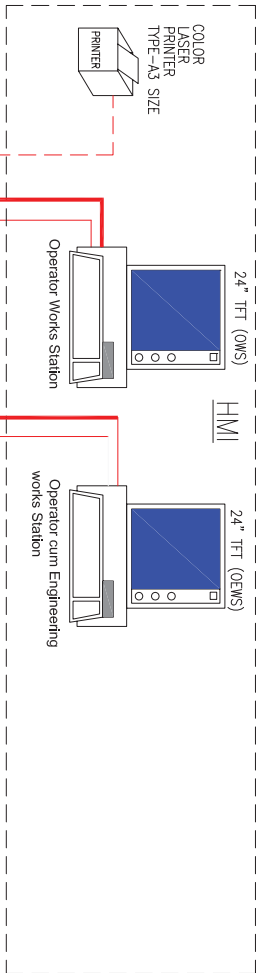
C The sr.no.1 to 7 are reqd.to be furnished for interface impl. :such as Tagname,Description,point type, modbus(Register) address,EU,range & device (dlave) address

C1 What is the primary purpose of the communications link?

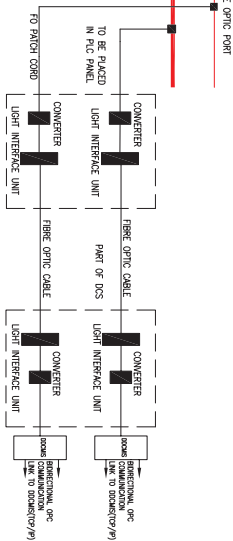
E1 Reqd. Contents : This document must provide an overview of the device including its intended use(a general technical,communication & electrical details)

Format for vendor to furnish signal
Exchange list between DCS-PLC

[illegible]



- NOTES:**
- 1) PLC SYSTEM SHALL HAVE REDUNDANCY IN PROCESSOR, COMMUNICATION SYSTEM, POWER SUPPLY, MEMORY MODULES, RACK POWER SUPPLY UNITS, BULK IO POWER SUPPLY UNITS, IO COMMUNICATION MODULES, DATA HIGHWAY AND HIGH SPEED (100Mbps) DATA NETWORK CONNECTING THE OPERATOR STATIONS.
 - 2) UPS POWER SUPPLY SHALL BE PROVIDED FOR PLC PANEL(S), OWES, NETWORK COMPONENTS.
 - 3) PLC PANEL SHALL HAVE PROVISION TO ACCEPT TIME SYNC. SIGNAL (IRIG-B) FROM MASTER CLOCK SYSTEM (PLANT AREA).
 - 4) PLC PANEL SHALL HAVE PROVISION FOR REDUNDANT DATA EXCHANGE (OPC) WITH PLANT DCS.
 - 5) INTERNAL BUS AND EXTERNAL DATA NETWORK LOADING SHALL IN NO CASE BE MORE THAN 60% OF ITS CAPACITY.
 - 6) MAIN DATA NETWORK SHALL COMPLY WITH THE INTERNATIONAL STANDARD IEEE-802.3 (ETHERNET) FOR DATA EXCHANGE AND COMMUNICATION.



LEGEND:-

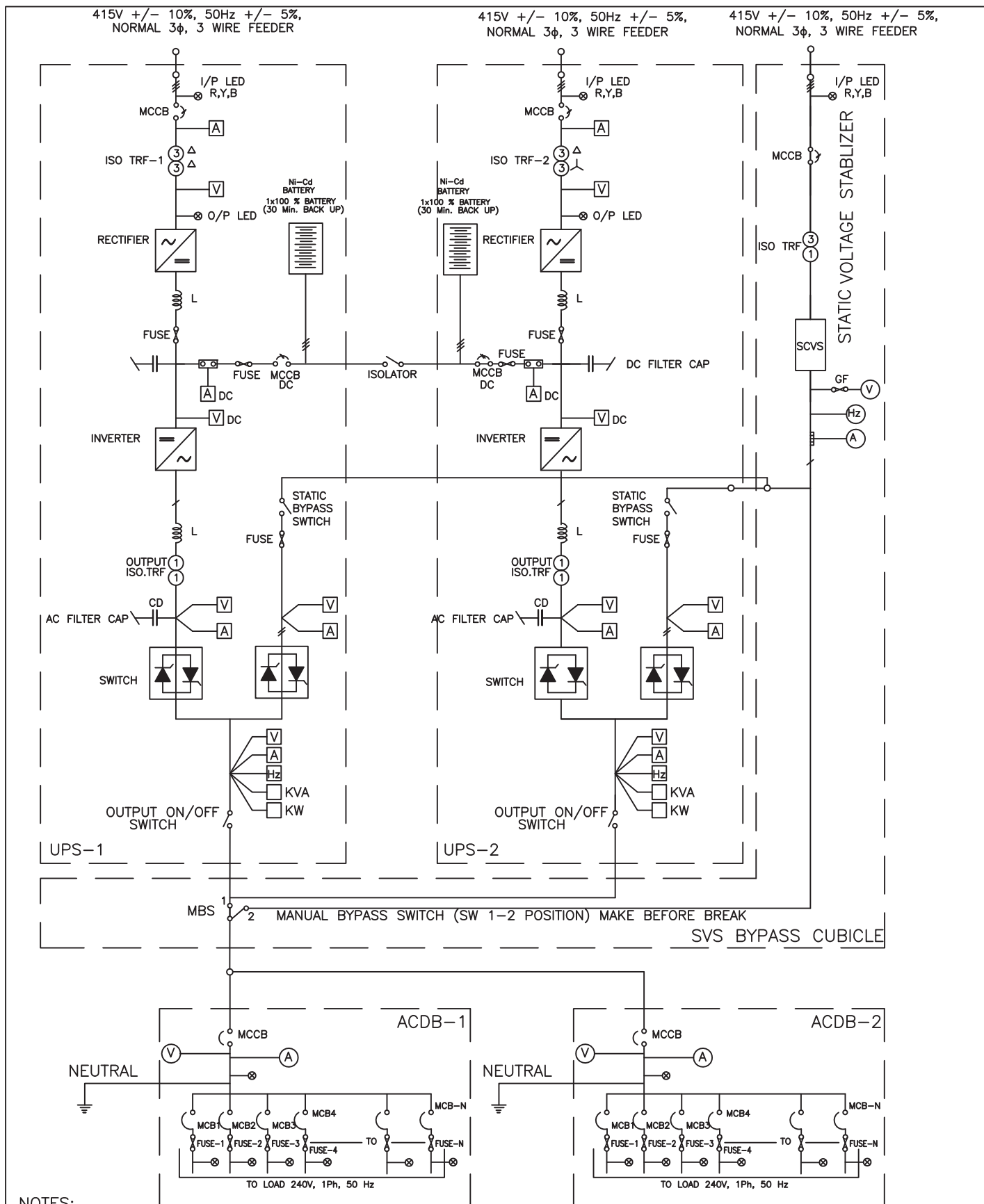
- PROGRAMMABLE LOGIC CONTROLLER
- DISTRIBUTED CONTROL SYSTEM
- UNINTERRUPTED POWER SUPPLY
- OPERATOR WORK CUM ENGINEERING WORK STATION
- HUMAN MACHINE INTERFACE
- NETWORK TIME PROTOCOL
- OLE PROCESS CONTROL
- REMOTE PROCESSING UNIT



PLC SYSTEM CONFIGURATION

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	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 12 of 18
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
UPS SPECIFICATION		



NOTES:

- ACDB-1&2 NEUTRAL TO BE GROUND TO A DEDICATED GROUND.
- ALL OUTPUT FEEDERS OF ACDB SHALL BE PROVIDED WITH AN LED AFTER THE FUSE FOR FEEDER ON INDICATION WITH FEEDER DESCRIPTION.
- REDUNDANT FEEDERS SHALL BE LOCATED IN DIFFERENT ACDBs.



1x800 MW WANAKBORI THERMAL POWER STN

TITLE:-

UPS SCHEME

DRG.
No.

REV.
No.

DATE

SHEET

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 13 of 18
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
CONTROL PANELS SPECIFICATION		

7.12.00 Panels, Cubicles and Enclosures

7.12.01 General

- a) All panels, cubicles and enclosures shall be furnished complete with integral piping, internal wiring, convenience outlets, internal lighting, grounding, ventilation, space heating, vibration isolating pads and other accessories.
- b) Unless otherwise specified cable entry for panels / desks / cabinets shall be through bottom via glanding plate. Fireproof seal shall be used to seal the bottom to prevent entry of dust.
- c) Panels and cabinets shall be constructed from steel sheet reinforced as required to provide true surface and adequate support for devices mounted thereon. Thickness of the steel plate shall conform to the requirements of UL 50 or equivalent standard. Panels and cabinets shall be of adequate strength to support mounted components during shipment and to support a concentrated load of 100 Kilograms on their top after erection.
- d) Panel /cabinet shall have eyebolt on top for lifting.

7.12.02 Surface Preparation and Painting

Sheet metal exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below:

- a) Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale. Oil, grease and salts etc. shall be removed from by one or more solvent cleaning methods prior to blasting.
- b) Two spray coats of epoxy primer surfacer shall be applied to all exterior and interior surfaces, each coat of primer surfacer shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colors for exterior and interior surfaces shall conform to the following shades:
 - i) Exterior – RAL 7032.
 - ii) Interior - Brilliant White.
- c) Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections shall not be acceptable.

7.12.03 Wiring

Wiring within the panels shall conform to NEC standards and shall be factory installed and tested at the works. All interior wiring shall be installed neatly. Features shall not be limited to the following :

- a) All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks.
- b) Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized print shall be used with cross- identification.
- c) Wire termination shall be made with insulated sleeve and crimping type lugs. All external connections shall be made with one wire per terminal. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs shall not be used.
- d) Internal wiring should be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables.
- e) Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low milli volt or micro volt shall be electrically and physically isolated from other AC and DC wiring.
- f) All low-level signal cables shall be separately bundled from control cable.
- g) Wires shall be dressed and run in troughs with clamp-on type covers. Wirings shall be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.
- h) Shield wires shall be terminated on separately.
- i) Common connections shall be limited to two wires per terminal.
- j) Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings will not cause fatigue to the conductor.
- k) Wiring shall be arranged to enable instruments or devices to be removed and/or serviced without disturbing the wiring. No wire shall be routed across the face or rear of any device in a manner, which will impede the opening of covers or obstruct access to leads, terminals or devices.
- l) Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.
- m) Panels /cabinets /desks shall be provided with removable gasketed cable gland plates and cable glands. Split type grommets shall be used for prefab cables.
- n) Wire shall be multistranded annealed flexible high purity copper conductor with heat resistant FRLS PVC insulation and shall pass vertical flame test per IPCEAS-1981.

- o) Wire sizes used for internal wiring shall not be lower than the followings :
- Control wiring (switches, pushbuttons etc.) : 1.5 Sq.mm
- Power supply/receptacle /illumination wiring : 2.5 sq. mm or higher as per load
- 4-20mA DC current and low voltage signal upto 48V DC : 1.0 Sq. mm
- p) Identification of conductors shall be done by insulation color-coding identified on drawings or by printed wiring lists.

7.12.04 Grounding

- a) System cabinet AC and DC ground shall be electrically isolated from each other and also electrically isolated from the Instrumentation signal ground. All the above ground shall be individually connected to the single point on the ground pit. Dedicated redundant earth pit shall be provided which shall be away from the HV equipment. This earth pit shall not be shared with other electrical equipment ground and shall also be insulated from other electrical system ground to ensure single point grounding of the system. Grounding resistance shall be better than 1.0 ohm. IEEE guideline shall be followed while designing the grounding system.
- b) Panels and cabinets shall be provided with a continuous tinned copper ground bus bar of minimum 25 mm x 3 mm cross section, extending along the entire length of the panel / desk / cabinet assembly. The ground bus shall be bolted to the panel structure and effectively ground the entire structure.
- c) The panel /desk /enclosure /JB ground shall have two (2) bolt drilling with GI bolts and nuts at each end to connect to GI/ copper flat ground riser by means of insulated copper ground cable of required cross section with lug.
- d) Circuits requiring grounding shall be individually and directly connected to the panel ground bus.
- e) For electronic system cabinets, the electronic system ground bus shall be similar but insulated from the cabinet and shall be separately connected to the system ground. Signal cable shields shall be grounded at the panel end only and shall not be left open. The ground in between panels of a shipping section shall be firmly looped.
- f) Electrical meters, relays, transmitters and switching devices, operating at a voltage less than 50V may be grounded through the steel structure.

7.12.05 Panel / Cabinet/ Desk/Enclosures Environmental Protections

- a) Panels, cabinets, desks, distribution boxes, junction boxes, terminal boxes and all other field mounted equipment / enclosures shall suit the environmental condition of the area and shall not be inferior than the requirement indicated in the following table.

SL. NO.	LOCATION	ENCLOSURE TYPE
1.	Indoor type non- ventilated enclosure in non-hazardous area	IP-54
2.	Indoor type ventilated enclosure in non-hazardous area	IP -42
3.	Enclosure in Air conditioned area	IP-22 with suitable canopy at top to prevent ingress of dripping water.
4.	Outdoor type in non-hazardous areas	IP-55
5.	Outdoor in hazardous areas	As per requirements of the NEC Code for the location

- b) The construction of electrical enclosures located in areas subject to conditions classified in the National Electrical Code (NEC) as hazardous shall be of a type designated suitable for the environment in which they are located.

7.12.06 Terminal Blocks

- a) Terminals shall be chromated galvanized DIN rail mounted screwless cage clamp type. Terminals shall have screwed connection for conductor cross-section above 2.5 mm². Terminal blocks shall conform to IEC 947-7-1.
- b) The characteristics of the terminal blocks shall be as follows.
- High contact force, independent of conductor cross-section and large contact surface area.
 - Self-loosening protection.
 - Resistant to thermal aging and vibration.
 - Low and constant voltage drop
- c) Tension spring shall be made of high quality, non-rusting, acid-resistant steel. The current bar shall be of tin-lead plated copper or brass.

- d) Terminals shall be of non flammable suitable thermoplastic material such as polyamide.
- e) Terminal blocks shall be mounted vertically in panels and cubicles with clearance for at least 100 mm between two sets and between wall and terminal block.
- f) Terminal blocks shall be provided with white marking strips / self-adhesive marker cards. Power terminals shall have protection covers.
- g) At least 10%percent spare unwired terminals shall be provided for all panels /cabinets /desks /junction box etc.. This shall be in addition to 10%spare wired terminals of spare IO channels and 10% wired spare modules.
- h) Bottom of the terminal block shall be at least 200 mm above the cable gland plate for bottom entry type panels.
- i) For extending 24 V / 48 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current.
- j) Other requirements of the terminal blocks are as follows:
 - i) The last block in a rail-mounted assembly shall be closed with an end plate and end bracket.
 - ii) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.
 - iii) Design shall permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections.
 - iv) It shall be possible to use jumper plugs through the test plug socket to connect adjacent terminals.
 - v) Where more than one connection to a terminal block is required, two tier terminals shall be used.
 - vi) Terminal blocks shall be of different colors depending on voltage levels.

7.12.07 Nameplates and Labels

- a) Each item shall have permanently attached to it, in a prominent position, a rating plate of non-corrosive material upon which is to be engraved the manufacturer's name, equipment, type / model number, range, serial number, together with details of the loading conditions under which the item of plant in question has been designed to operate.
- b) Such nameplates or labels are to be of white non-hygroscopic material with engraved black lettering, or alternatively of transparent plastic

material with suitably colored lettering engraved on the back.

- c) The nameplates shall be held by self-tapping screws. The size of nameplate shall be approximately 20 mm x 75 mm for equipment and 40 mm x 150 mm for the panels.
- d) Items of plant such as valves, which are subject to handling, are to be provided with an engraved chromium plated nameplate or label with engraving filled with enamel, suitably mounted or affixed with strong rustproof chain.
- e) All such nameplates, instruction plates, lubrication charts etc. shall be with English inscriptions.

8.00.00 METERING BASES AND CHART UNITS

The following system of units shall be followed for various displays and scales unless otherwise mentioned:

- i) Pressure : Kg/cm²
Differential Pressure : mm of H₂O column / Kg/cm²
- ii) Draught : mm of H₂O column
- iii) Vacuum : Kg/cm² (abs)/mm of Hg column
- iv) Temperature : Degree Celsius (° C)
- v) Flow (Steam, Water) : Tonnes / hr, M³/Hr
- vi) Flow (Oil) : M³ / Hr, Litter/Hr
- vii) Flow Air : Tonnes / hr / M³ / Hr.
- viii) Density : gms / c.c.
- ix) Level : mm /%
- x) Conductivity : μS / cm or mS/cm
- xi) Gas Analyzer : Percentage by weight or as specified in respective case.
- xii) Dissolved Oxygen / Silica / Sodium : ppm /ppb

~~9.00.00 PROCESS CONNECTION & INSTRUMENT HOOK UP~~

- ~~9.01.00 Instrument connection to the process system (piping, vessel etc.) shall be according to the process & piping specification upto and including the root valves. Root valves shall be installed as close as possible to the piping or vessel.~~

As a rule tap orientation of high and low pressure side should be parallel and symmetrical.

9.15.00 Pressure & Differential pressure instruments in steam and liquid services shall be located below the taps and the piping shall be sloped to avoid formation of air pocket.

9.16.00 Pressure & Differential pressure instruments in air and flue gas service shall be located above the taps and the piping shall be sloped back to process to avoid formation of any liquid.

9.17.00 Impulse pipe including taps for furnace, flue gas and coal mill application shall be provided with air purge connection. Differential instruments for such application shall have continuous and as well as intermittent purging. Whereas, pressure measurement shall have only intermittent purging.

9.18.00 Material of impulse pipe for the instruments mounted on rack and enclosure shall be same as that of main process pipe except stainless steel tube of Gr. 316 or better shall be provided for connection in between impulse pipe (from tee connection on impulse pipe) and instrument manifold valve & instruments. Impulse pipe, tubes, fittings and accessories shall have the same design pressure and temperature applicable for the related main pipe.

10.00.00 **POWER SUPPLY SYSTEMS**

10.01.00 Instrumentation power supply system shall include all conditioning equipment required to accommodate normal variations in the electrical supply. All panels and cabinets shall accept redundant power feeds from two different sources.

10.02.00 Type of power supply systems envisaged for the various I & C system including DCS are as follows:

- a) 240V AC Redundant UPS system HMIs, Main Plant Field devices / equipment, CCTV, EWLI, CEMS, SWAS etc. and PLC of package System
- b) 24V / 48 VDC Supply for DCS

11.00.00 **ENVIRONMENTAL CONSIDERATIONS**

I & C components should operate properly with no degradation in expected lifetime or in operation parameter in the normal power plant environment. I & C system shall be designed considering all the operating conditions which may be encountered during installation and operation.

11.01.00 Temperature

11.01.01 Where the environmental extreme exceeds the capabilities of the selected system, Bidder should take appropriate steps to control the environment.

11.02.00 Humidity

11.02.01 I & C system shall be designed to withstand the humidity limits specified for the project. Condensation shall not be allowed to form in the cabinets nor

should water be allowed to be admitted through conduit entering the cabinets from top or sides.

11.03.00 Atmospheric Contamination

11.03.01 Particulate contamination from fly ash and coal dust and gaseous contaminants such as SO₂ and other flue gas constituents in the coal fired plant are foreseen. This hazard shall be taken into design considerations.

11.04.00 Vibration

11.04.01 Design of the systems shall include features such as locking devices, anti vibration pads etc, to withstand vibration. In general, I&C equipment shall be installed away from the vibration zone.

11.05.00 Lightning

11.05.01 Protection against lightning shall be considered by providing proper grounding, metal oxide varistors, spark gap lightning arrestor, optical isolator and isolation transformer.

12.00.00 **SECURITY**

12.01.00 Door lock shall be provided in all Panels, Cabinets and Enclosures.

12.02.00 System mode key switch or password to prevent tampering of system program.

12.03.00 Redundant elements of the system shall not be exposed to the common hazards. For example routing of the redundant network cable through separate cable raceway, using separate cabinet / separate rack for redundant controller and redundant IO modules.

13.00.00 **ACCEPTANCE TESTS**

The Bidder shall be required, as part of his Tender, to fully integrate and test all the equipment, included in his Tender, at site and respective Control packages at the manufacturer's works. Owner / Consultants shall witness these tests.

However, for DCS the Bidder shall consider in his Tender the following tests:

(a) Factory Acceptance Test (FAT)

After completion of manufacture of DCS and prior to delivery to Site, the manufacturer shall functionally test the assembled system. The test shall be carried out with all input / output cubicles, control processors, data highway, operator's consoles, Engineer's console and peripheral devices connected in the specified configuration. The fully configured software shall also be loaded and tested at the same time.

The FAT shall include the following activities:

- Complete hardware inspection;

- Heat cycle run test as per the prevailing standards;
- Functional test of a minimum 25 % of all configured points, logic routines, control functions, graphic displays, reports and logs;
- Demonstration of special calculations (e.g. efficiency calculation, performance calculations etc.);
- Testing of redundancy facilities to demonstrate automatic change over to standby data highway, power supply and control processor etc.;
- Demonstration of system diagnostic facilities;

The FAT shall be witnessed by the Owner / Engineer who shall be notified at least three (3) weeks before the commencement of the tests. The system shall have been fully pre-tested by the manufacturer at his works prior to notifying the Owner / Engineer to ensure any component, equipment or system fault have been identified and cleared. The test procedure for the FAT shall be issued to the Engineer and agreed prior to notification. All documents / drawings and test equipment shall be available at the manufacturer's works during the FAT.

The FAT shall include a 72 hour continuous operational run, any equipment fault or failure during this time shall make this part of the test null and void and the test run shall be re-started after rectification of the fault. A test certificate, accompanied by the relevant test results, shall be issued after successful completion of the tests.

(b) Site Acceptance Test (SAT)

After installation, connection, integration with other systems and all pre-commissioning checks have been carried out on the complete system, the SAT shall be performed and witnessed by the Engineer. The SAT shall include the following as a minimum:

- a) Complete hardware and installation inspection;
- b) Testing of redundancy facilities by simulating data highway, power supplies and control processor failures. All such units shall be tested to demonstrate of the automatic operation of the standby units and initiation of the relevant system alarms;
- c) Demonstration of system diagnostic facilities; by the simulation of the appropriate fault conditions. The system fault reporting techniques shall also be demonstrated;
- d) Testing of data highway integrity using continuity test equipment based on signal injection / reflection techniques;
- e) Demonstration of data logging, sequence of events and trending system operation.
- f) Pre-commissioning checks shall include the following:

- i) Calibration of all field instruments, analysers and equipment, in the scope of supply of this package, at site;
- ii) Loop checking, for all open and close loops, between source and destination with manual signal injection as well as from Operating Consoles for entire DCS I/Os;
- iii) Logic sequence check with the manual signal injection at signal source as well as checking of feed back signals.

All individual configured data points, logic routines, control functions, graphic displays and reporting facilities shall be verified as part of the loop tests.

The Owner shall be notified at least 2 weeks before the commencement of the test. The procedures shall be issued and agreed before notification.

A test certificate accompanied by the relevant test results shall be issued after successful completion of the calibration and test.

Similar tests shall also be applicable for other control system i.e. plant utility system PLC / Microprocessor based control systems.

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$				Remarks		
									P	W	V				
1.0	INCOMING Sheet Steel (CRCA & HR)	1. Chemical Composition 2. Bend Test 3. Surface finish 4. Waviness 5. Thickness 6. Mill marking	MA CR MA MA MA MA	Chemical analysis Mech. test Visual Visual Measurement Visual	Sample Sample 100% 100% 100% 100%	IS:1079 IS:513 IS:1079 IS:513 Factory Standard / Sample Factory Standard BHEL Spec. Factory Standard	IS:1079 IS:513 IS:1079 IS:513 Factory Standard / Sample No Waviness BHEL Spec. Factory Standard	Test Certificate Log Book Log Book Log Book Log Book Log Book Log Book	3 2 2 2 2 2	--- --- --- --- --- 1	2 --- --- --- --- ---				
2.0	Flats / Angles / Channels	1. Dimensions 2. Surface Defects 3. Straightness 4. Mill marking	MA MA MA MA	Measurement Visual Measurement Visual	Sample 100% 100% 100%	IS:2062 Factory Standard / Sample Factory Std. IS:2062	IS:2062 Factory Standard / Sample Factory Std. IS:2062	Log Book Log Book Log Book Log Book	2 2 2 2	--- --- --- 1	--- --- --- ---				
3.0	Cables / Wires	1. Visual / Surface defects 2. IR and HV	MA MA	Visual Electrical	100% 100%	BHEL Spec. and IS:1554 or IS:694 BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694 BHEL Spec. and IS:1554 or IS:694	Log Book Log Book	2 2	--- ---	--- ---				
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics															
\$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. 1 - BHEL 2 - Vendor 3 - Sub-vendor															

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									P	W	V					
		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---					
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	3	---	2					
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type	CR	Visual	Sample	BHEL Spec. and BOM	BHEL Spec. and BOM	Log Book	2	---	---					
		2. Verification of Test Certificates	CR	Scrutiny of Type / Routine T.Cs.	100%	Relevant IS	Relevant IS	Log Book	2	---	---					
		3. Operation / Functional check	CR	Electrical	Sample+ 100%@	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---		+ for relay & contactors only			
		4. I.R.	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---		@ for all components except relays & contactors.			
		5. H.V.	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---					
		6. Calibration	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	1					
		7. Pick up / Drop off Voltage	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---					
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics														1 - BHEL 2 - Vendor 3 - Sub-vendor		

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks		
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5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make 2. Surface defects 3. IR / HV on Terminal Blocks	MA MA MA	Visual Visual Electrical	Sample Sample Sample	BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue	Log Book Log Book Log Book	2 2 2	--- --- ---	--- --- ---			
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions 2. Surface defects after bending	MI MA	Measurement Visual	100% 100%	Approved Mfr. drgs. Factory Standard	Approved Mfr. drgs. Factory Standard	Log Book Log Book	2 2	--- ---	--- ---			
7.0	Nibbling / Punching	1. Cutout Sizes 2. Deburring	MI MA	Measurement Visual	100% 100%	Approved Mfr. drgs. Approved Mfr. drgs.	Approved Mfr. drgs. Approved Mfr. drgs.	Log Book Log Book	2 2	--- ---	--- ---			
8.0	ASSEMBLY Frame Assembly & Sheet fixing	1. Dimensions 2. Alignment 3. Welding Quality 4. Surface defects	MA MA MA MA	Measurement Measurement Visual Visual	100% 100% 100% 100%	Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards	Log Book Log Book Log Book Log Book	2 2 2 2	--- --- --- ---	2 2 2 2			
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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks			
									P	W	V				
9.0	Pre-treatment and Painting	1. Pretreatment Process 2. Process parameters like bath temp. concentration etc. 3. Dipping / Removal Time 4. Surface quality after every dip 5. Primer after phosphating 6. Putty Application & Rubbing after primer 7. Paint first coat 8. Putty Application and Rubbing after first coat of paint 9. Paint second coat	MA MA MA MA MA MA	Visual Measurement Measurement Visual Visual, Thickness Visual Visual, Thickness Visual Visual, Thickness, Scratch test Colour adhesion	100% Periodic 100% 100% 100% 100% 100% 100%	Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005	Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005 Factory Standard & IS: 6005	Log Book Log Book Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2 2 2	--- --- --- --- --- --- --- ---	1 1 1 1 1 1 1 1				
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Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks				
									P	W	V					
10.	Panel Wiring	1. Wiring Layout 2. Wiring Termination (Crimped Lugs) 3. Ferrule numbers 4. Colour of wiring 5. Size of Conductor	MA MA MA MA MA	Visual Visual Visual Visual Measurement	100% 100% 100% 100% 100%	Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs.	Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs.	Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2	--- --- --- --- ---	--- --- --- 1 1					
11.	Component Mounting	1. Correct components 2. Fixing	MA MA	Visual Visual	100% 100%	Approved drgs., Specs. & BOM Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM Approved drgs., Specs. & BOM	Log Book Log Book	2 2	--- ---	--- ---					
12.	FINAL Final Inspection	1. Workmanship 2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components 3. Components identification Marking / Name plates	MA MA MA	Visual Visual Visual	100% 100% 100%	Factory Standard BHEL approved drg. / Spec. BHEL approved drg. / Spec.	Factory Standard BHEL approved drg. / Spec. BHEL approved drg. / Spec.	Inspection Report Inspection Report Inspection Report	2 2 2	1 1 1	1 1 1	At Random by BHEL, based on 100 % internal test reports by Mfr.				
LEGEND:		* CR - Critical characteristics MA - Major characteristics MI - Minor characteristics	P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.	\$												

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1 - BHEL
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												REV. NO. 01 DATE: 22-02-2008				
												SHEET 6				
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks				
									P	W	V					
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.				
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1					
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1					
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1					
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1					
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1					
		11. Wire Termination	MA	Pulling manually	Sample	----	Firm termination	Inspection Report	2	1	1					
		12. Continuity	MA	Electrical	100%	----	Continuity OK	Inspection Report	2	1	1					

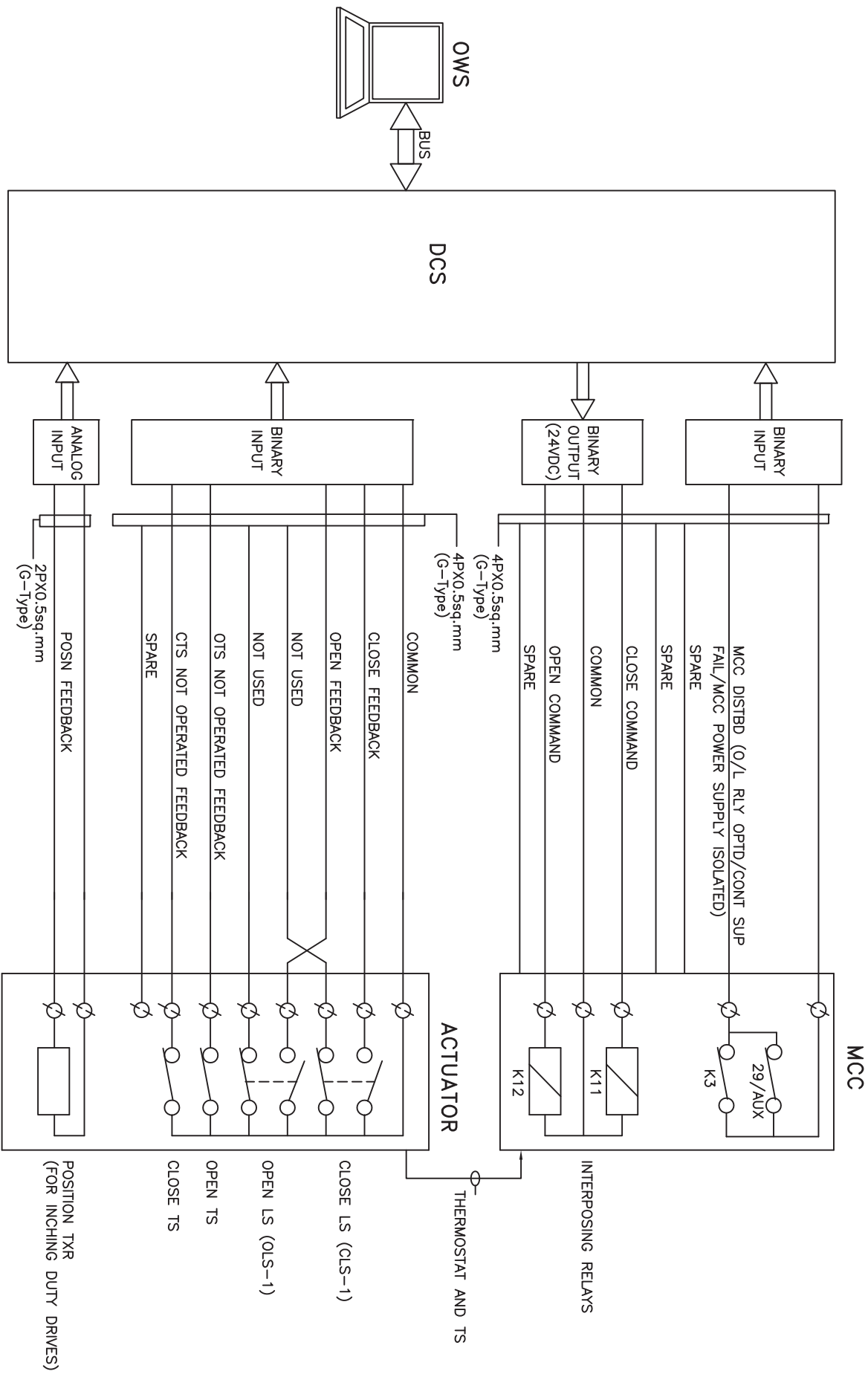
LEGEND: * CR - Critical characteristics		\$		P - Agency Performing the Test.		1 - BHEL	
MA - Major characteristics		W		V - Agency Witnessing the Test.		2 - Vendor	
MI - Minor characteristics		V		- Agency Verifying the Test.		3 - Sub-vendor	

 STD QUALITY PLAN NO.: PE-QP-999-145-1056		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-145-1056				
		PEM :: C&I						Acceptance Norms		Format of Records		Agency \$			Remarks	
												P	W	V		
												Sl. No.	Component / operation	Characteristics Checked		
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.		Type Test Certificate	3	---	1				
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant IS.	BHEL approved spec., drg., BOM & relevant IS.		Test Report	2	1	1				
15	FUNCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.		Inspection Report	2	1	1				
		2. Instrument Calibration	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.		Inspection Report	2	1	1				
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant IS.	BHEL approved spec/drg & relevant IS.		Inspection Report	2	1	1				

LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics		\$ P W V - Agency Performing the Test. - Agency Witnessing the Test. - Agency Verifying the Test.		1 - BHEL 2 - Vendor 3 - Sub-vendor	
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	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 14 of 18
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
DRIVE CONTROL PHILOSOPHY		

DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH MCC)



PROJECT: 1X800MW WANAKBORI THERMAL POWER STN.
FYTN UNIT-8

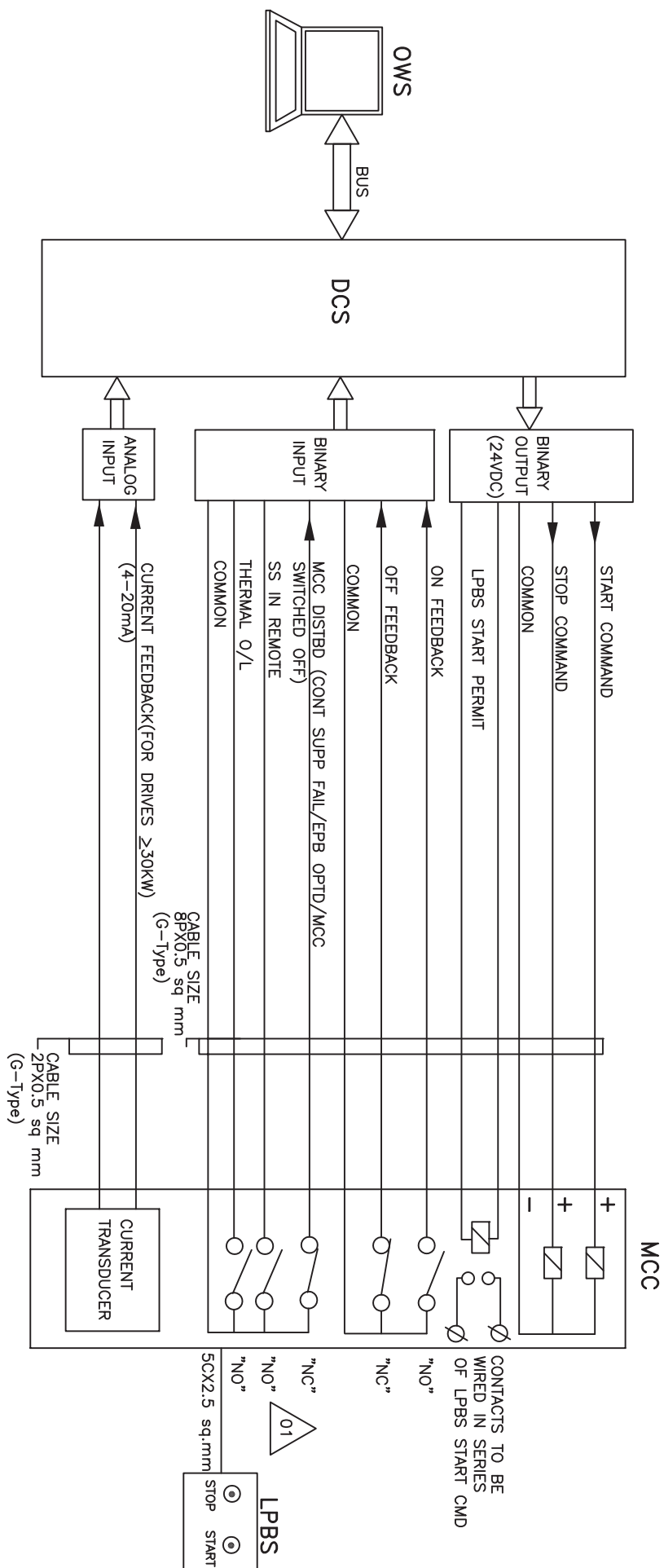
EXTN. UNIT-B

TITLE :

DCS INTERFACE FOR BIDIRECTIONAL DRIVE

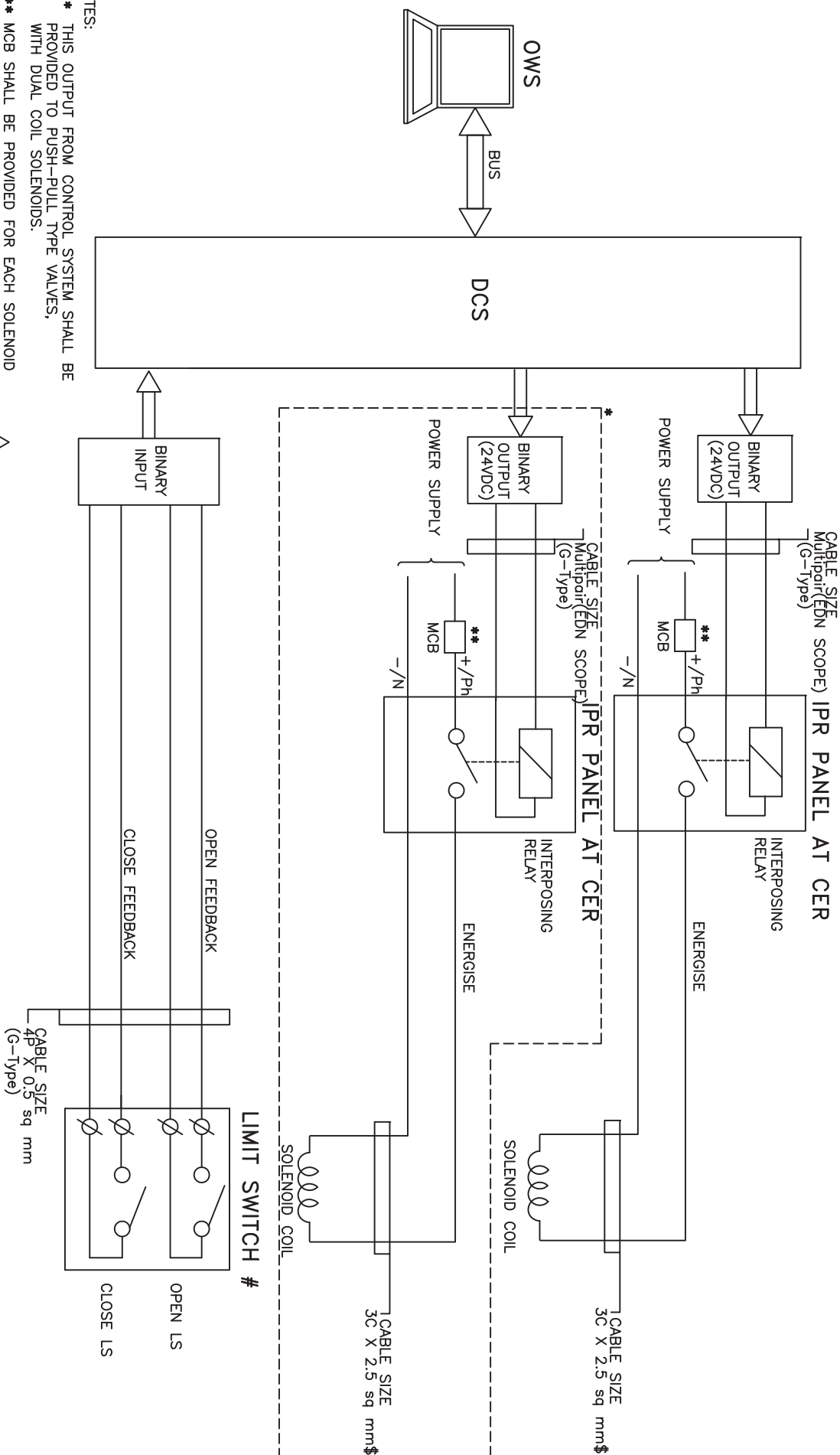
DRG. NO.	PE-DM-408-145-1002
DATE	16.02.15
REV. NO.	01
SHT	7 OF 11

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE



PROJECT: 1X800MW WANAKBORI THERMAL POWER STN. EXTN. UNIT-8	
TITLE : DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE	DRG. NO. PE-DW-408-145-1002 DATE 16.02.15 REV. NO. 01 SHT 8 OF 11

DCS INTERFACE FOR SOLENOID DRIVE (24V DC/220V DC/ 240V AC UPS)



01



PROJECT: 1X800MW WANKABORI THERMAL POWER STN.

EXTN. UNIT-8

TITLE : 01 DCS INTERFACE FOR SOLENOID DRIVE

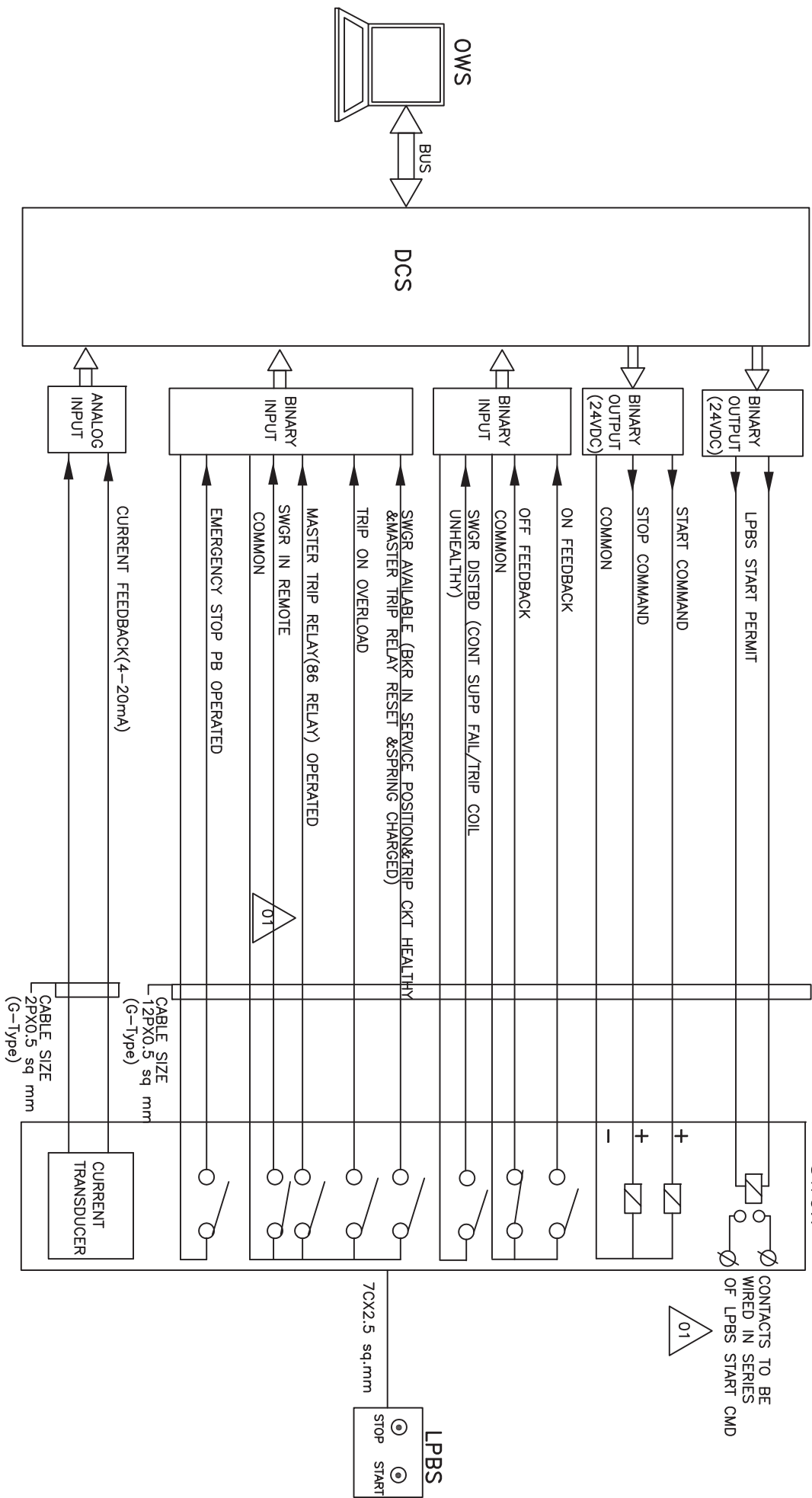
DRG.NO. PE-DM-408-145-1002

DATE 16.02.15

REV.NO. 01

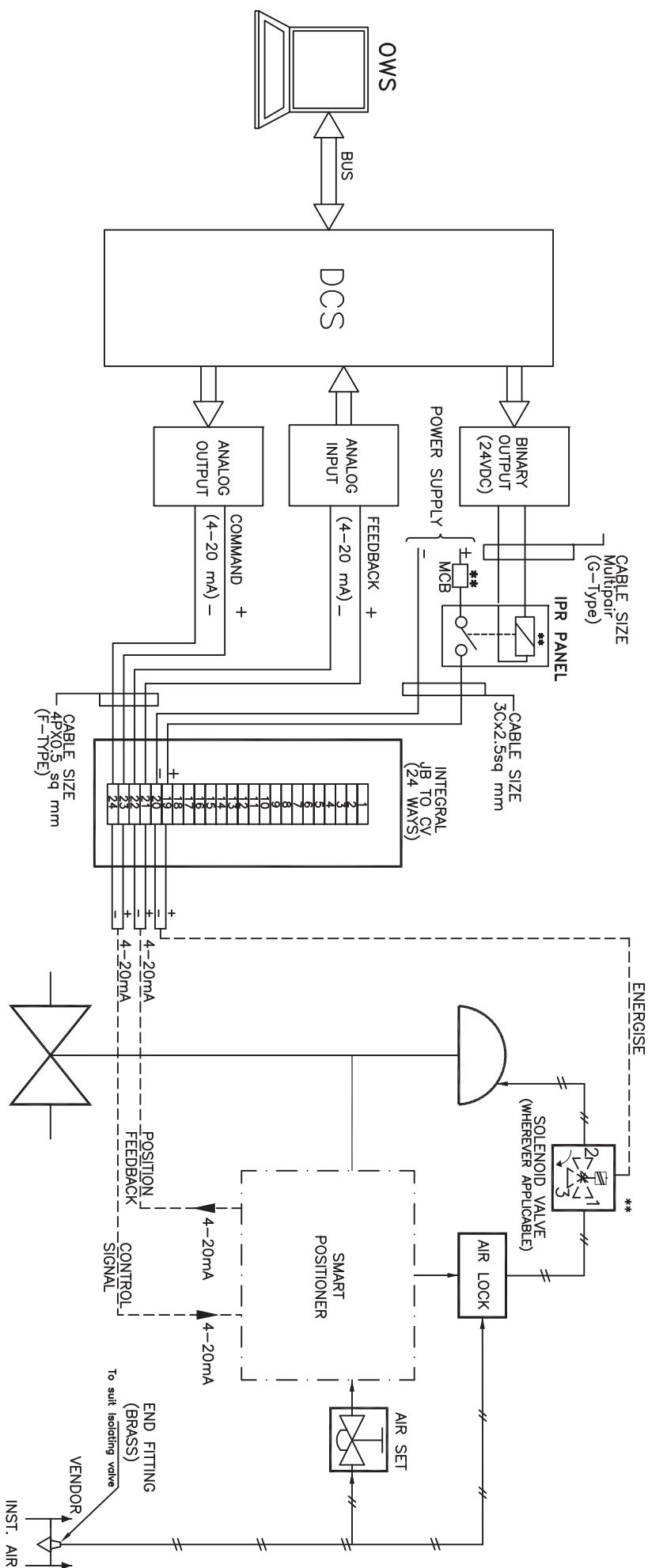
SHT 9 OF 11

DCS INTERFACE FOR HT/LT UNIDIRECTIONAL DRIVES(BREAKER OPERATED)



		PROJECT: 1X800MW WAKABORI THERMAL POWER STN.		DRG.NO. PE-DM-408-145-1002
TITLE : 01 DCS INTERFACE FOR UNIDIRECTIONAL HT DRIVE		EXTN. UNIT-8		DATE 16.02.15
				REV.NO. 01
				SHT 10 OF 11

DCS INTERFACE FOR ANALOG DRIVE (WITH SMART POSITIONER)



NOTES:

**** APPLICABLE TO THOSE VALVES ONLY WHERE PROTECTION OPEN/CLOSE ACTION FOR CONTROL DEMAND OVERRIDING IS REQUIRED.**

	
PROJECT: 1X800MW WANAKBORI THERMAL POWER STN. EXTN. UNIT-8	
TITLE : TYPICAL HOOK-UP DIAGRAM ANALOG DRIVE (WITH SMART POSITIONER)	
DRG. NO.	PE-DM-408-145-1002
DATE	16.02.15
REV. NO.	01
SHT	11 OF 11

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 15 of 18
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
APPLICABLE CODES AND STANDARDS		

box or enclosure shall leave from terminal blocks and not from other devices in the enclosure.

The required quantities of cable accessories shall be similarly estimated on the basis of number of terminations and proposed routing of the cables. Any shortfall in the quantity of accessories observed during actual laying shall be compensated at no extra cost.

5.00.00 **PROVEN PRODUCT**

If Bidder is offering their own system or through their collaborator, then same is acceptable subject to satisfactory performance in last 3 years for at least one unit of not less than 600 MW capacity.

If DCS is bought out for bidder then same shall be from following vendors meeting specification and satisfactory performance in last 3 years for at least one unit of not less than 600 MW capacity.

Latest system from following vendors

M/s Siemens

M/s Yokagawa

M/s Honeywell

M/s ABB

Ovation.

5.01.00 Similarly, all other I & C equipment / systems / sub-systems / instruments and accessories in the power cycle shall also be of make and model whose guaranteed and trouble-free performance has been proven at least for two (2) years in not less than two (2) different reheat type pulverized coal fired units of unit size not less than 600 MW.

5.02.00 Bidder shall furnish required information to fully satisfy Owner regarding successful operation and high reliability of products / systems furnished.

6.00.00 **CODES AND STANDARDS**

6.01.00 Items such as thermowells, control valves, flow elements and other in line devices in high and medium pressure steam, feed water and similar services, which fall under the purview of Indian Boiler Regulation Act shall be either certified by IBR or shall be certified by authorities acceptable to IBR. It shall be responsibility of Bidder to obtain the necessary approval of the concerned Authority / Chief Inspector of Boilers for the design and design calculations, manufacturing and erection procedure as called for under the IBR Act for all items requiring such certification.

6.02.00 Generally, the following latest edition of codes and standards prevailing at the time of award of contract shall be applicable.

- 1) Temperature Measurement

- a) Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974).
 - b) Temperature Measurement - Thermocouples - ANSI - MC 96.1 - 1982.
 - c) Temperature Measurement by electrical resistance thermometers - IS: 2806
 - d) Thermometer-element-Platinum resistance - IS: 2848 / DIN 43760.
- 2) Pressure Measurement
- a) Instrument and apparatus for pressure measurement - ASME PTC 19.2 (1964).
 - b) Bourdon tube pressure and vacuum gauges - IS: 3624/1996.
- 3) Flow Measurement
- a) Instruments and apparatus for flow measurement - ASME PTC 19.5 (1972) Interim supplement, Part-II
 - b) Measurements of fluid flow in closed conduit - BS 1042.
- 4) Electronic Measuring Instruments and Control Hardware
- a) Automatic null balancing electrical measuring instruments -ANSI C 39.4 (Rev. 1973), IS 9319
 - b) Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5 / 1974.
 - c) Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1: ANSI MC 12.1 / 1975.
 - d) Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975) - ISA -S26 (1968).
 - e) Surge withstand capability (SWC) tests - ANSI C 37.90A (1989), IEC-255.4.
 - f) Printed circuit boards - IPC TM-650, IEC 326C.
 - g) General requirements and tests for printed wiring boards - IS-7405 (Part-I)/1973.
 - h) Edge socket connectors - IEC 130-11.
 - i) Requirements and methods of testing of wire wrap terminations--DIN 41611 Part-2.
 - j) Dimensions of attachment plugs and receptacles- ANSI C73-1973.(Supplement ANSI C73a – 1980)
- 5) Instrument Switches and Contacts

- a) Contact Rating - AC services NEMA ICS Part-2 125, A-600
- b) Contact Rating - DC services NEMA ICS Part-2 125, N-600
- 6) Enclosures
 - a) Enclosures for Industrial Controls and Systems—NEMA ICS-6-110.15 through 110.22
 - b) Racks, panels and associated equipment -EIA: RS-310-B-1983 (ANSI C83.9 - 1972).
- 7) Apparatus, Enclosures and Installation Practices in Hazardous Area
 - a) Classification of hazardous area - NEMA Article 500, Volume-6, 1978.
 - b) Electrical Instruments in hazardous dust locations - ISA-RP 12.11.
 - c) Intrinsically safe apparatus - NFPA Article 493 Volume-4 1978.
 - d) Purged and pressurized enclosure for electrical equipment in hazardous location - NFPA Article 496 Volume-4, 1978.
- 8) Sampling System
 - a) Stainless Steel material of tubing and valves, for sampling system - ASTM A 269-79 GRTO-316.
 - b) Submerged helical coil heat exchangers for sample coolers -- ASTM D11-98.
- 9) Annunciators
 - a) Specifications and guides for the use of general-purpose annunciators - ISA RP 18.1.
 - b) Surge withstand capability tests -ANSI C37.90 a -1971 and IEEE Standard 472-1974.
- 10) Interlocks, Protections
 - a) Relays and relay system associated with electric power apparatus - IEEE Standards 3.13.
 - b) Surge withstand capability tests - ANSI C37.90 a - 1971 and IEEE Standard 472-1974.
 - c) General requirements and tests for switching devices for control and auxiliary circuits including contactor relays - IS-6875 (Part-I)/1973.
 - d) Turbine water damage prevention - ASME-TDP-1-1980.
 - e) Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F, 85G.
- 11) UPS System

- a) Practice and requirements for semi-conductor power rectifiers - ANSI C34.2.
- b) Relays and relay systems associated with electrical power apparatus IEEE Standard - 3.13.
- c) Surge withstand capability tests - ANSI C 70.90 A/1971, IEC-255.4.
- d) Recommended practice for sizing large lead storage batteries for generating stations and sub-stations - -IEEE-485.

12) Control Valves

- a) Control valve sizing (Incompressible fluids) - ISA-S39.2 / 1972.
- b) Control valve sizing (Compressible fluids) - ISA-S39.4 / 1972.
- c) Control Valve seat leakage – ANSI / FCI 70.2
- d) Face to face dimensions of Control Valves - ANSI B16.10
- e) Control Valve Capacity Test Procedure – ISA – S75.02

13) Instrument Tubing

- a) Seamless Carbon Steel Pipe - ASTM-A-106.
- b) Forged carbon steel fittings - ASTM-A-105.
- c) Dimensions of fittings - ANSI-B16.11.
- d) Code for pressure piping, welding, hydrostatic testing - ANSI-B 31.1.
- e) Nomenclature for instrument tube fittings - ISA-RP 42.1 / 1982.
- f) Seamless Stainless Steel Tube ASTM A-213 TP 316 / ASTM A-269 TP 316
- g) Seamless Alloy Steel Pipe ASTM A 335 P22
- h) Seamless Stainless Steel Pipe ASTM A-312 TP 316

14) Cables

- a) Thermocouple extension wires / cables - ANSI MC96.1.
- b) Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy-IPCEA S-61-402
- c) Guide for design and installation of cable system in power generating station (insulation, jacket materials) -IEEE Standard 422.
- d) Requirements of vertical tray flame test - IEEE 383
- e) Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B33.

15) Electronic Cards, Subassemblies and Components

a) Unpackaged

- i) Vibration : IEC-68.2.6
- ii) Shock : IEC-68.2.27
- iii) Drop & Topple : IEC-68.2.31

b) Packaged

Vibration, Drop & Static Compression - NSTA.

c) Electromagnetic Compatibility

- i) Electrical Fast Transient : IEC-801.4
- ii) Surge Withstand : IEC-255.4
- iii) Radiated Electromagnetic Field : IEC-801.3
- iv) Electrostatic Discharge : IEC-801.2
- v) Electromagnetic Emissions : VDE 0871, Class-B

16) Cable Trays, Conduits

- a) Guide for the design and installation of cable system in power generating station (cable trays, support systems, conduits)- IEEE Standard 422, NEMA VE-1, NEC-1981. Test Standards NEMA VE-1-1979.
- b) Galvanizing of carbon steel cable trays - ASTM A-386.

7.00.00 **DESIGN CRITERIA**

This section lays down the general design criteria to be adapted in designing the instrumentation and control system of the plant.

7.01.00 General Requirements

7.01.01 Instrumentation, control and automation devices and accessories shall be designed with the following considerations:

- a) Stable in spite of temperature fluctuations.
- b) Able to withstand high humidity.
- c) Weather proof.
- d) Dust proof.
- e) Corrosion resistant.
- f) Erosion resistant.

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 16 of 18
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
SPECIFICATION FOR QUALITY ASSURANCE & TESTING		

should water be allowed to be admitted through conduit entering the cabinets from top or sides.

11.03.00 Atmospheric Contamination

11.03.01 Particulate contamination from fly ash and coal dust and gaseous contaminants such as SO₂ and other flue gas constituents in the coal fired plant are foreseen. This hazard shall be taken into design considerations.

11.04.00 Vibration

11.04.01 Design of the systems shall include features such as locking devices, anti vibration pads etc, to withstand vibration. In general, I&C equipment shall be installed away from the vibration zone.

11.05.00 Lightning

11.05.01 Protection against lightning shall be considered by providing proper grounding, metal oxide varistors, spark gap lightning arrestor, optical isolator and isolation transformer.

12.00.00 **SECURITY**

12.01.00 Door lock shall be provided in all Panels, Cabinets and Enclosures.

12.02.00 System mode key switch or password to prevent tampering of system program.

12.03.00 Redundant elements of the system shall not be exposed to the common hazards. For example routing of the redundant network cable through separate cable raceway, using separate cabinet / separate rack for redundant controller and redundant IO modules.

13.00.00 **ACCEPTANCE TESTS**

The Bidder shall be required, as part of his Tender, to fully integrate and test all the equipment, included in his Tender, at site and respective Control packages at the manufacturer's works. Owner / Consultants shall witness these tests.

However, for DCS the Bidder shall consider in his Tender the following tests:

(a) Factory Acceptance Test (FAT)

After completion of manufacture of DCS and prior to delivery to Site, the manufacturer shall functionally test the assembled system. The test shall be carried out with all input / output cubicles, control processors, data highway, operator's consoles, Engineer's console and peripheral devices connected in the specified configuration. The fully configured software shall also be loaded and tested at the same time.

The FAT shall include the following activities:

- Complete hardware inspection;

- Heat cycle run test as per the prevailing standards;
- Functional test of a minimum 25 % of all configured points, logic routines, control functions, graphic displays, reports and logs;
- Demonstration of special calculations (e.g. efficiency calculation, performance calculations etc.);
- Testing of redundancy facilities to demonstrate automatic change over to standby data highway, power supply and control processor etc.;
- Demonstration of system diagnostic facilities;

The FAT shall be witnessed by the Owner / Engineer who shall be notified at least three (3) weeks before the commencement of the tests. The system shall have been fully pre-tested by the manufacturer at his works prior to notifying the Owner / Engineer to ensure any component, equipment or system fault have been identified and cleared. The test procedure for the FAT shall be issued to the Engineer and agreed prior to notification. All documents / drawings and test equipment shall be available at the manufacturer's works during the FAT.

The FAT shall include a 72 hour continuous operational run, any equipment fault or failure during this time shall make this part of the test null and void and the test run shall be re-started after rectification of the fault. A test certificate, accompanied by the relevant test results, shall be issued after successful completion of the tests.

(b) Site Acceptance Test (SAT)

After installation, connection, integration with other systems and all pre-commissioning checks have been carried out on the complete system, the SAT shall be performed and witnessed by the Engineer. The SAT shall include the following as a minimum:

- a) Complete hardware and installation inspection;
- b) Testing of redundancy facilities by simulating data highway, power supplies and control processor failures. All such units shall be tested to demonstrate of the automatic operation of the standby units and initiation of the relevant system alarms;
- c) Demonstration of system diagnostic facilities; by the simulation of the appropriate fault conditions. The system fault reporting techniques shall also be demonstrated;
- d) Testing of data highway integrity using continuity test equipment based on signal injection / reflection techniques;
- e) Demonstration of data logging, sequence of events and trending system operation.
- f) Pre-commissioning checks shall include the following:

- i) Calibration of all field instruments, analysers and equipment, in the scope of supply of this package, at site;
- ii) Loop checking, for all open and close loops, between source and destination with manual signal injection as well as from Operating Consoles for entire DCS I/Os;
- iii) Logic sequence check with the manual signal injection at signal source as well as checking of feed back signals.

All individual configured data points, logic routines, control functions, graphic displays and reporting facilities shall be verified as part of the loop tests.

The Owner shall be notified at least 2 weeks before the commencement of the test. The procedures shall be issued and agreed before notification.

A test certificate accompanied by the relevant test results shall be issued after successful completion of the calibration and test.

Similar tests shall also be applicable for other control system i.e. plant utility system PLC / Microprocessor based control systems.

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET ~~18 of 18~~
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
DRAWINGS		

							GA. DRAWING-TRANSMITTER RACK			
							1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WAMANGORI THERMAL POWER STATION, GUJARAT)			
SB	SR	SD			0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT			
APPROVED	CHECKED	DRAWN		DESCRIPTION	REV.	DATE				

				DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI			
JOB NO. DCPL-K9213R		SCALE NIL		SHT. 1 OF 10			
DWG. NO. K9213R-DWG-I-0200				REV. 0			

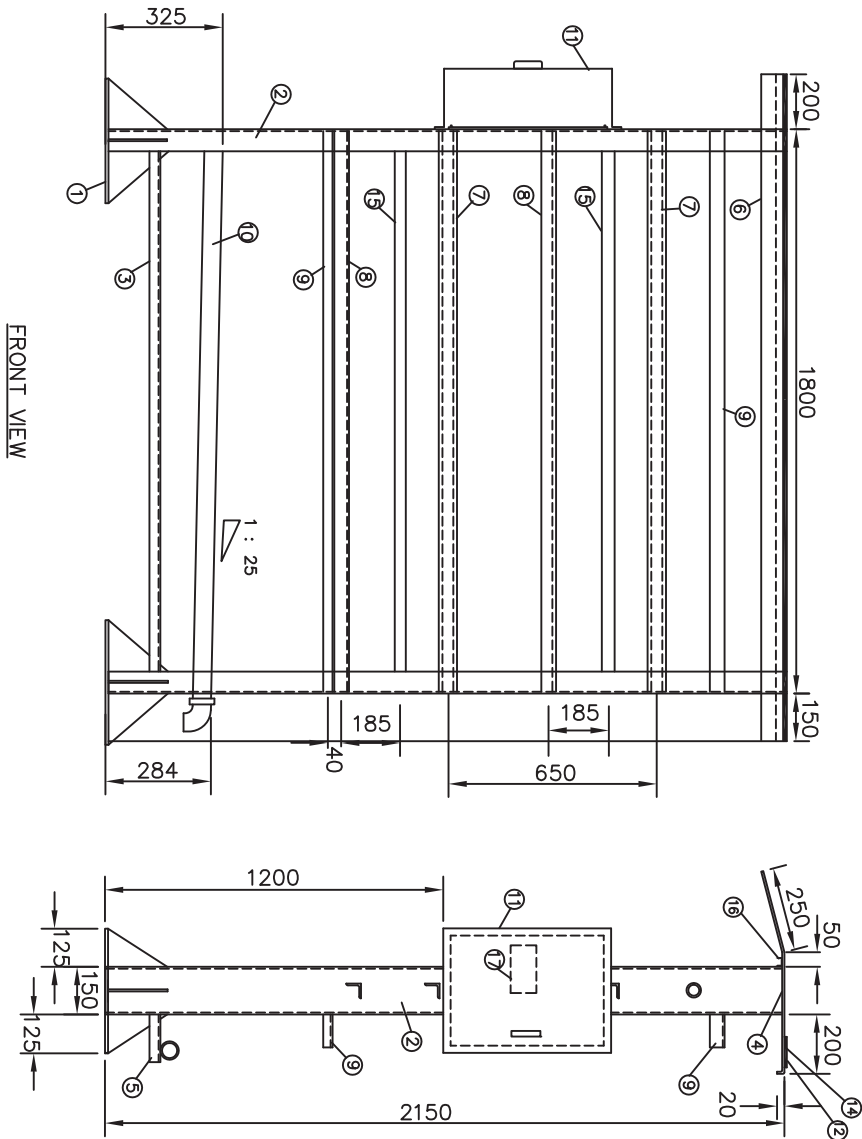
GA DRAWING
TRANSMITTER RACK

PRELIMINARY
TENDER PURPOSE ONLY



DEVELOPMENT CONSULTANTS PVT. LTD.
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DGPL-K9213R SCALE NIL SHT. 1 OF 10
DWG. NO. K9213R-DWG-I-0200 REV. 0



LEGEND:

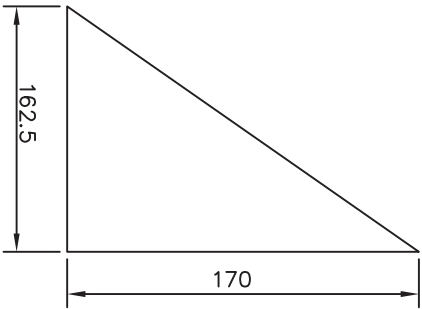
- 1..M.S. PLATE 400 X 400 X 10 mm.
- 2..ISMC 150 X 75 X 6 mm.
- 3..ISMC 75 X 40 X 5 mm.
- 4..CANOPY MOUNTING PLATE 5 mm THICK.
- 5..BRACKET FOR DRAIN PIPE.
- 6..CANOPY ASSEMBLY 3.0 mm THICK CRCA SHEET.
- 7..GI PIPE 2' NB CLASS B FOR TRANSMITTER MOUNTING.
- 8..M.S.ANGLE 40 X 40 X 5 mm.
- 9..BRACKET FOR IMPULSE PIPE SUPPORT.
- 10..DRAIN PIPE MATERIAL ASTM A106 GR. 'C' SIZE 2" NB SCH 80.
- 11..JUNCTION BOX SIZE: 480 (H) X 360 (W) X 180 (D).
- 12..BULKHEAD M.S. PLATE 5 mm THICK.
- 13..COMPACT FLUORESCENT LAMP FOR RACK ILLUMINATION.
- 14..XLPE GASKET IN BETWEEN BULKHEAD PLATE & CANOPY.
MOUNTING PLATE.
- 15..PVC CABLE TRAY/FLEXIBLE CONDUIT FOR CABLE.
- 16..'C' CHANNEL FOR LIGHT FITTING.
- 17..TAG PLATE.

NOTES:

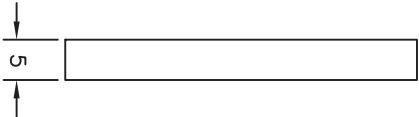
- 1..POWER SOCKET & TB SHALL BE PROVIDED IN JB.
- 2..COLOUR: GREY IS5-631. OVERALL THICKNESS > 100 MICRONS.
- 3..TAG PLATES SHALL BE PROVIDED FOR EACH INSTRUMENT.
- 4..20% TERMINALS SHALL BE PROVIDED AS SPARE.
- 5..ANTIVIBRATION PAD & FOUNDATION BOLTS SHALL BE PROVIDED.
- 6..DIMENSIONS SHOWN ARE TENTATIVE AND SHALL BE FINALISED AT DETAILING.

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN MM

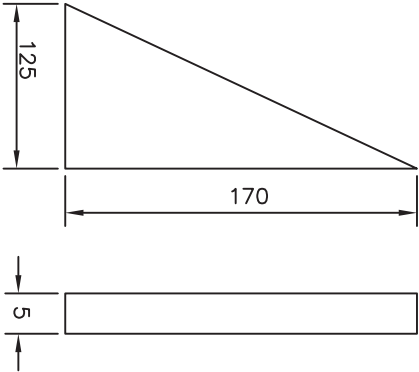
					G.A.DRAWING FOR LOCAL INSTRUMENT RACK	DEVELOPMENT CONSULTANTS PVT. LTD.					
					1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WAMAKBORI THERMAL POWER STATION, GUJARAT)	CONSULTING ENGINEERS					
					GUJARATI STATE ELECTRICITY CORPORATION LIMITED	KOKKATA, MUMBAI, CHENNAI, NEW DELHI					
					VADODARA, GUJARAT	JOB NO.	DCPL-K9213R	SCALE	NIL	SHT.	2 OF 10
						DWG. NO.	K9213R-DWG-I-0200			REV.	0



DETAIL OF-1



DETAIL OF-2



DETAIL OF-3

NOTES:

- 1..RIB M.S. PLATE 162.5 X 170 X 5 mm THICK.
- 2..RIB M.S. PLATE 125 X 170 X 5 mm THICK.
- 3..RIB M.S. PLATE 134 X 165 X 5 mm THICK.

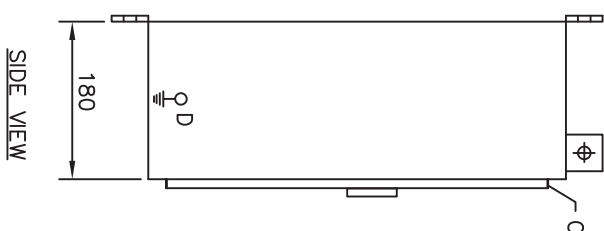
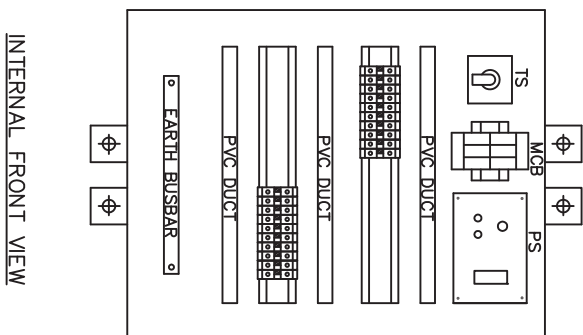
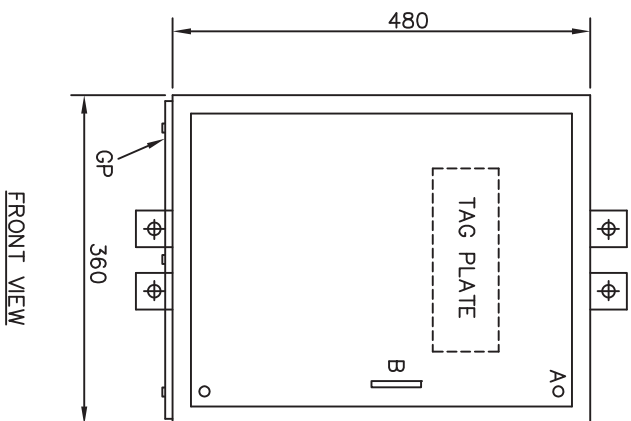
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN MM

						G.A. DRAWING OF CLEATS FOR LOCAL INSTRUMENT RACK		
						1x800MM SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WAMKANORI THERMAL POWER STATION, GUJARAT)		
SB	SR	SD		0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT		
APPROVED	CHECKED	DRAWN		REV.	DATE	JOB NO.	DCPL-K9213R	SCALE NIL
						DWG. NO.	K9213R-DWG-I-0200	SHT. 4 OF 10
								REV. 0



DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

PRELIMINARY
TENDER PURPOSE ONLY



LEGEND:

- A – DOOR LOCK
- B – DOOR HANDLE
- C – HINGES
- D – EARTH STUD
- GP – GLAND PLATE
- PS – POWER SOCKET
- TS – TOGGLE SWITCH
- TBS – TERMINAL BLOCKS
- MCB – MINIAITURE CIRCUIT BREAKER

NOTES:

- 1..JB WILL BE MADE OUT OF 2.0 mm CRCA SHEET.
- 2..PROTECTON CLASS IP-65.
- 3..COLOUR EXT-GREY IS5-631, INTERNAL-BRILLIANT WHITE.
- 4..NUTS FOR MOUNTING THE JUNCTION BOX SHALL BE PROVIDED.
- 5..3 MM THICK CRCA GLAND PLATE (GP) AT BOTTOM SHALL BE PROVIDED.

- 6..SCREWLESS CAGE CLAMP TERMINALS SHALL BE USED.
- 7..EARTH BUS BAR SHALL BE OF 25X6 MM TINNED COPPER.
- 8..INSTRUMENT TAG VIS-A-VIS SERVICE AND TERMINAL DETAILS SHALL BE PRINTED ON PHENOLIC BOARD MOUNTED ON BACK SIDE OF DOOR.
- 9..COLOUR CODE FOR POWER SUPPLY- PHASE-RED,
NEUTRAL-BLACK & EARTH-GREEN
- 10..CABLE FOR PANEL LIGHTING SHALL BE 1.5 SQ.MM,1100V GRADE
- 11..SIGNAL WIRING SHALL BE 4 PAIR X 0.5 SQ.MM ANNEALED TINNED COPPER, TWISTED PAIR, OVERALL SHIELDED 500V GRADE UNARMoured FRLS PVC.

			G.A. DRAWING OF JUNCTION BOX FOR LOCAL INSTRUMENT RACK					
			1x800MM SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT MANABORI THERMAL POWER STATION, GUJARAT)					
S8	SR	SD		0	21.04.10	GUJARATI STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT		
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE			
			JOB NO.	DCPL-K9213R	SCALE	NIL	SHT.	5 OF 10
			DWG. NO. K9213R-DWG-I-0200				REV.	0
			 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI					

NOTES:

- 1..DIMENSIONS SHOWN ARE TENTATIVE AND SHALL BE FINALIZED AT DETAILING.
- 2..ALL SHEETS SHALL BE 3 mm THICK CRCA SHEET.
- 3.. ALL DOORS SHALL BE FLUSH/CONCEALED TYPE.
- 4..COLOUR : —

EXTERIOR : GREY 1S5-631

INTERIOR : BRILLIANT WHITE

OVER ALL THICKNESS WILL BE > 100 MICRONS

5..BASE FRAME WILL BE MADE OUT OF ISMC 100 AND COLOUR WILL BE BLACK PAINT FINISH.

6..BULKHEAD PLATE FOR TOP AND BOTTOM SHALL BE 1150 X 650 X 6 MM.

7..CABLE GLAND PLATE OF THICKNESS 3 mm CRCA SHEET SHALL BE PROVIDED AT BOTTOM OF JUNCTION BOX.

8. ENCLOSURE PROTECTION CLASS SHALL BE IP-65.

9.. TERMINALS INSIDE JUNCTION BOX SHALL BE SCREWLESS CAGE CLAMP TYPE.

10..DOORS SHALL BE PROVIDED WITH CONCEALED HINGES, THREE POINT LOCKING FOR FRONT, REAR AND SIDE DOOR HINGES SHALL BE OF STAINLESS STEEL.

11..XLPE GASKET SHALL BE PROVIDED BETWEEN BULKHEAD PLATE & ENCLOSURE

12..EARTH BUSBAR 25 X 6 mm TINNED COPPER.

13..DRAIN PIPE SLOPE SHALL BE 1:25 APPROX.

14..COMMON LOCK/KEY SHALL BE PROVIDED FOR ALL LIE'S & JB'S.

15. FOUNDATION BOLTS SHALL BE PROVIDED.

16..TAG PLATES SHALL BE PROVIDED FOR EACH INSTRUMENT.

17. INSTRUMENT TAG VS-A-VIS SERVICE AND TERMINAL DETAILS SHALL BE
PRINTED ON PHENOLIC BOARD MOUNTED ON BACK SIDE OF JUNCTION
BOX DOOR.

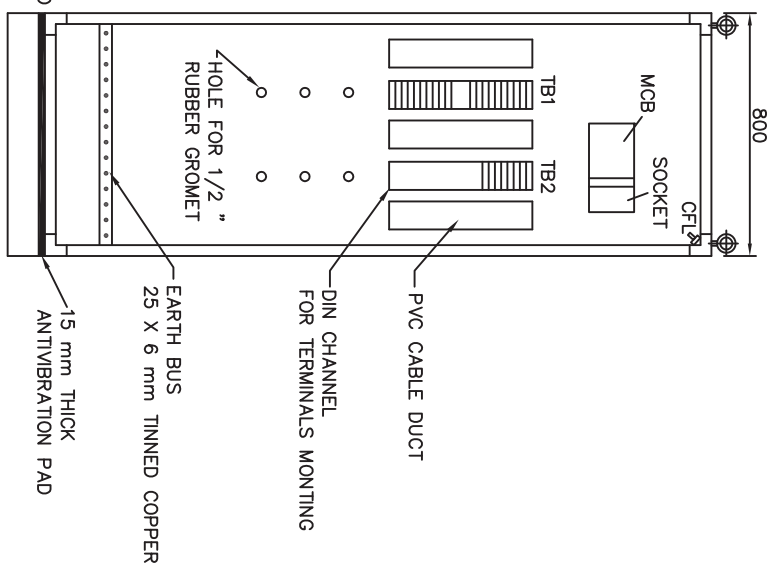
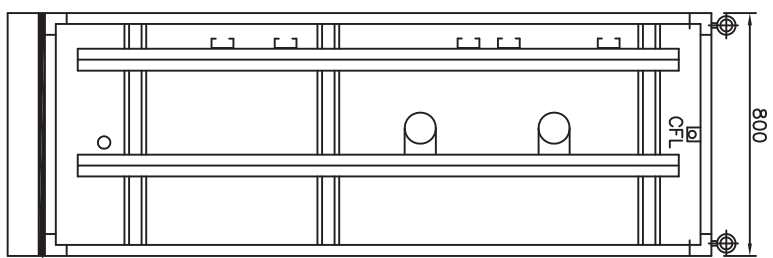
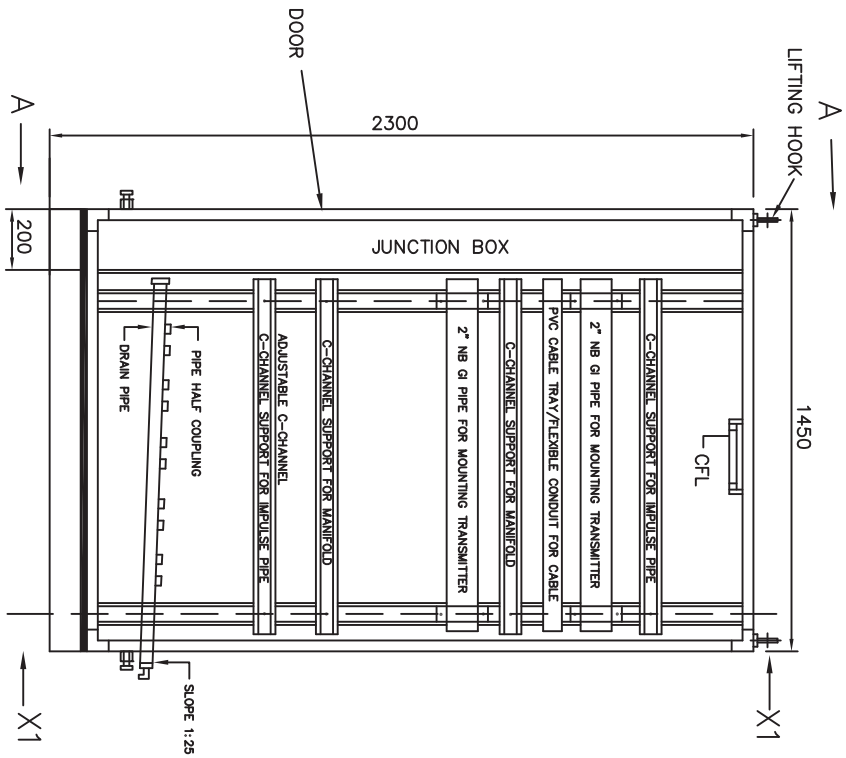
18..20% TERMINALS SHALL BE PROVIDED AS SPARE.

19..NAME PLATE OF PANEL SHALL BE FIXED ON FRONT DOOR.



UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN MM

						G.A. DRAWING FOR LOCAL INSTRUMENT ENCLOSURE	 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI
						1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANKABORI THERMAL POWER STATION, GUJARAT)	
						GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT	
SB	SR	SD		0	21.04.10		
APPROVED	CHECKED	DRAWN		REV.	DATE		
JOB NO.		DCPL-K9213R		SCALE	NIL	SHT.	6 OF 10
DWG. NO.		K9213R-DWG-I-0200				REV.	0



NOTES: 1..PVC WIRE DUCT WITH COVER SHALL BE PROVIDED.

2..FOR ILLUMINATION COMPACT FLUORESCENT LAMP IN LIE AND IN JOB SHALL BE PROVIDED.

3. DRAIN HEADER IS APPLICABLE FOR STEAM/WATER PROCESS IMPULSE LINES ONLY.

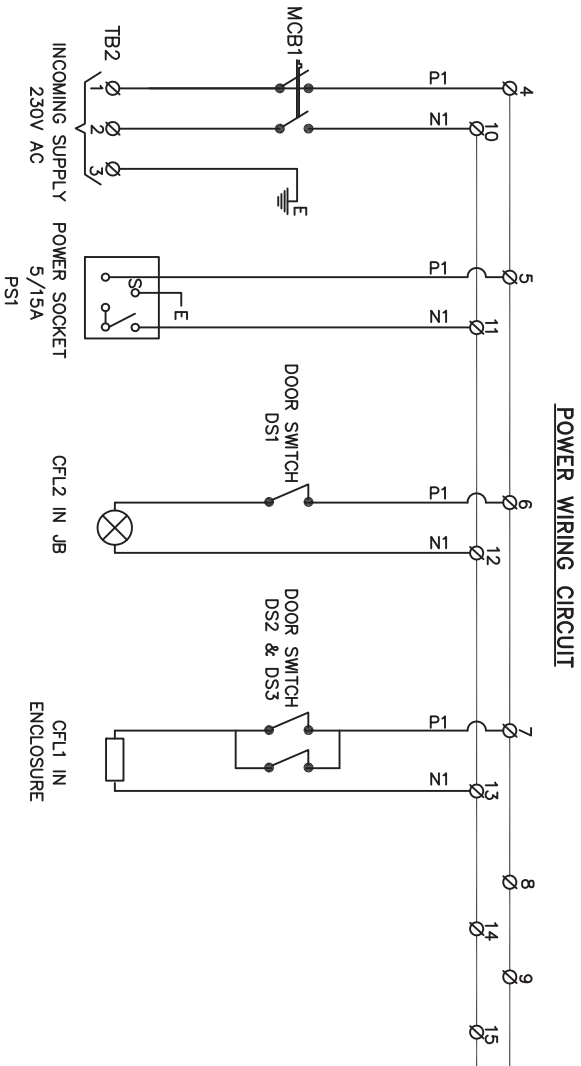
4..DRAIN PIPE SHALL BE 2" NB ASTM A106 GRC SCH.80.

						INNER G.A. DRAWING FOR LOCAL INSTRUMENT ENCLOSURE
S8	SR	SD		0	21.04.10	1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT MANAKBORI THERMAL POWER STATION, GUJARAT)
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT
 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI						
JOB NO.		DCPL-K9213R		SCALE	NIL	SHT. 7 OF 10
DWG. NO. K9213R-DWG-1-0200						REV. 0

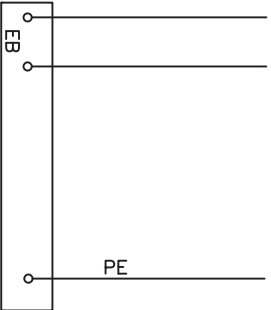


**PRELIMINARY
TENDER PURPOSE ONLY**

- 1..BULK HEAD PLATE DIMENSION ARE AS FOLLOWS: 1150 X 650 X 6 mm.
- 2..IMPULSE PIPE ENTRY : BOTTOM ENTRY FOR AIR/FLUE GAS APPLICATIONS.
- 3..IMPULSE ENTRY : TOP ENTRY FOR STEAM/WATER APPLICATIONS.



- NOTES :**
- 1.. COLOUR CODING FOR POWER SUPPLY : PHASE – RED, NEUTRAL – BLACK, EARTH – GREEN
 - 2.. CABLE ROUTING FROM TB TO PANEL LIGHT WILL BE 1.5 Sq.mm 1100V AC GRADE.
 - 3.. SIGNAL WIRING WILL BE DONE BY 4 PAIR X 0.5 Sq.mm ANNEALED TINNED COPPER, PAIR TWISTED OVERALL & SHIELDED, VOLTAGE GRADE 1100V, UNARMoured FRLS PVC SHIELDED CABLE.

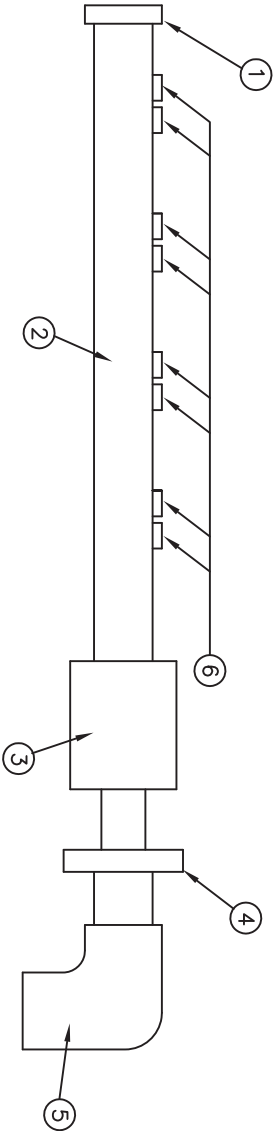


							ELECTRICAL WIRING AND TERMINATION DRAWING FOR LOCAL INSTRUMENT ENCLOSURE		
							1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WAMAGBORN THERMAL POWER STATION, GUJARAT)		
SB	SR	SD		0	21.04.10		GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT		
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE		JOB NO. DCP-L-K9213R SCALE NIL SHT. 9 OF 10 DWG. NO. K9213R-DWG-I-0200		



DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

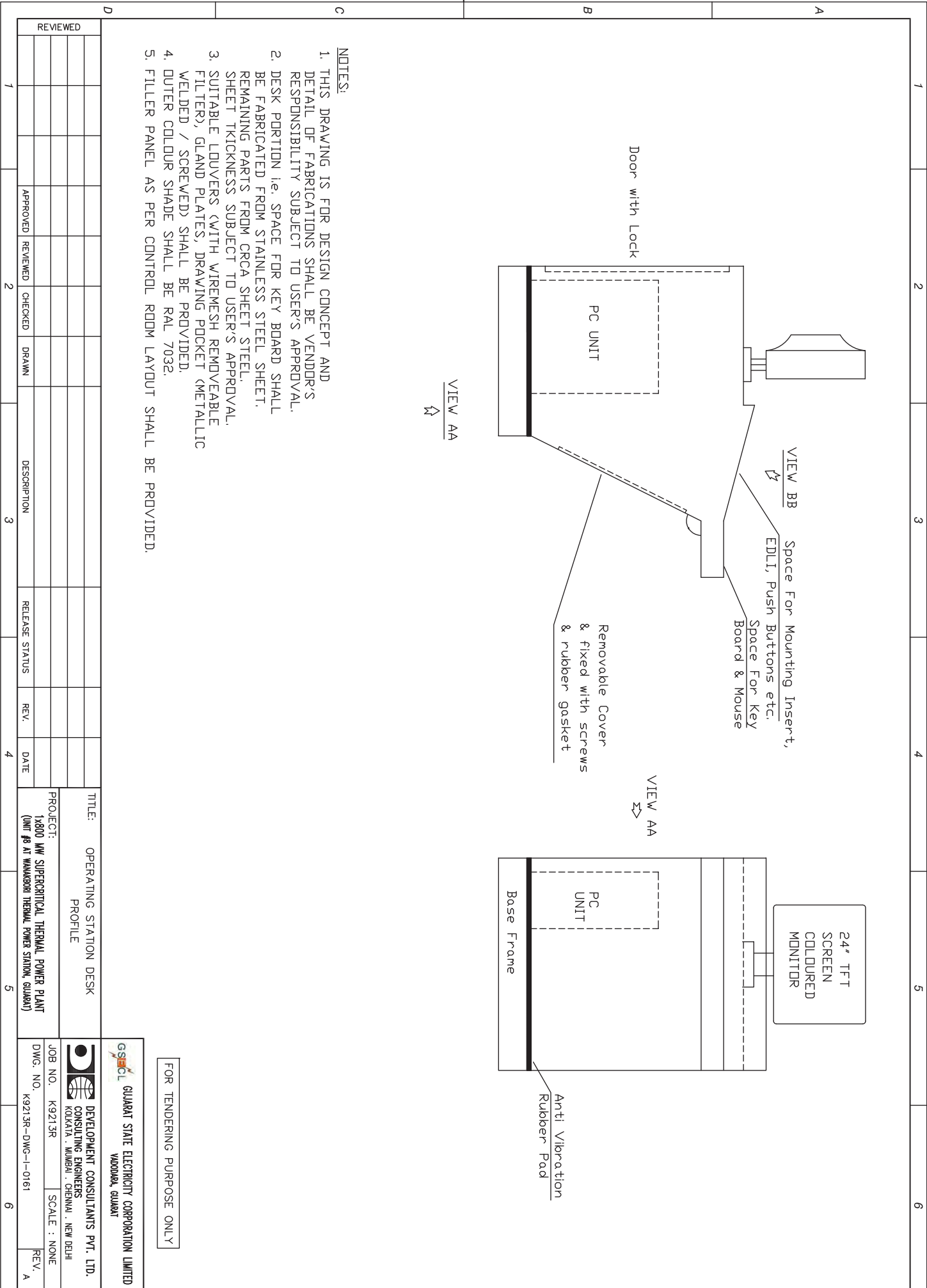
PRELIMINARY
TENDER PURPOSE ONLY



BILL OF MATERIAL		
SL.NO.	DESCRIPTION	QTY
1	2" S.W. CAP, CS	1
2	2" NB, ASTM A-106, SCH 80/Gr. C	1
3	2" SW X 1" NPT(F) COUPLING CS	1
4	1" NPT(M) X 1" BSP(M) HEX. NIPPLE WITH FITTING, CS	1
5	1" BSP(F) ELBOW, CS (BOTH ENDS THREADED)	1
6	HALF COUPLING; SIZE:1/2" NB SW	AS REQD

				DRAIN HEADER DETAILS FOR LOCAL INSTRUMENT ENCLOSURE				 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI				
				1x800MM SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAABORI THERMAL POWER STATION, GUJARAT)								
SB	SR	SD		0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADDARA, GUJARAT						
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE	JOB NO.		DCPL-K9213R	SCALE	NIL	SHT.	10 OF 10
						DWG. NO.		K9213R-DWG-I-0200			REV.	0

PRELIMINARY
TENDER PURPOSE ONLY



- NOTES:
1. THIS DRAWING IS FOR DESIGN CONCEPT AND
DETAIL OF FABRICATIONS SHALL BE VENDOR'S
RESPONSIBILITY SUBJECT TO USER'S APPROVAL.
 2. DESK PORTION i.e. SPACE FOR KEY BOARD SHALL
BE FABRICATED FROM STAINLESS STEEL SHEET.
REMAINING PARTS FROM CRCA SHEET STEEL.
SHEET THICKNESS SUBJECT TO USER'S APPROVAL.
 3. SUITABLE LIDUVERS (WITH WIREMESH REMOVEABLE
FILTER), GLAND PLATES, DRAWING POCKET (METALLIC
WELDED / SCREWED) SHALL BE PROVIDED.
 4. OUTER COLOUR SHADE SHALL BE RAL 7032.
 5. FILLER PANEL AS PER CONTROL ROOM LAYOUT SHALL BE PROVIDED.

REVIEWED					APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE
1	2	3	4	5								

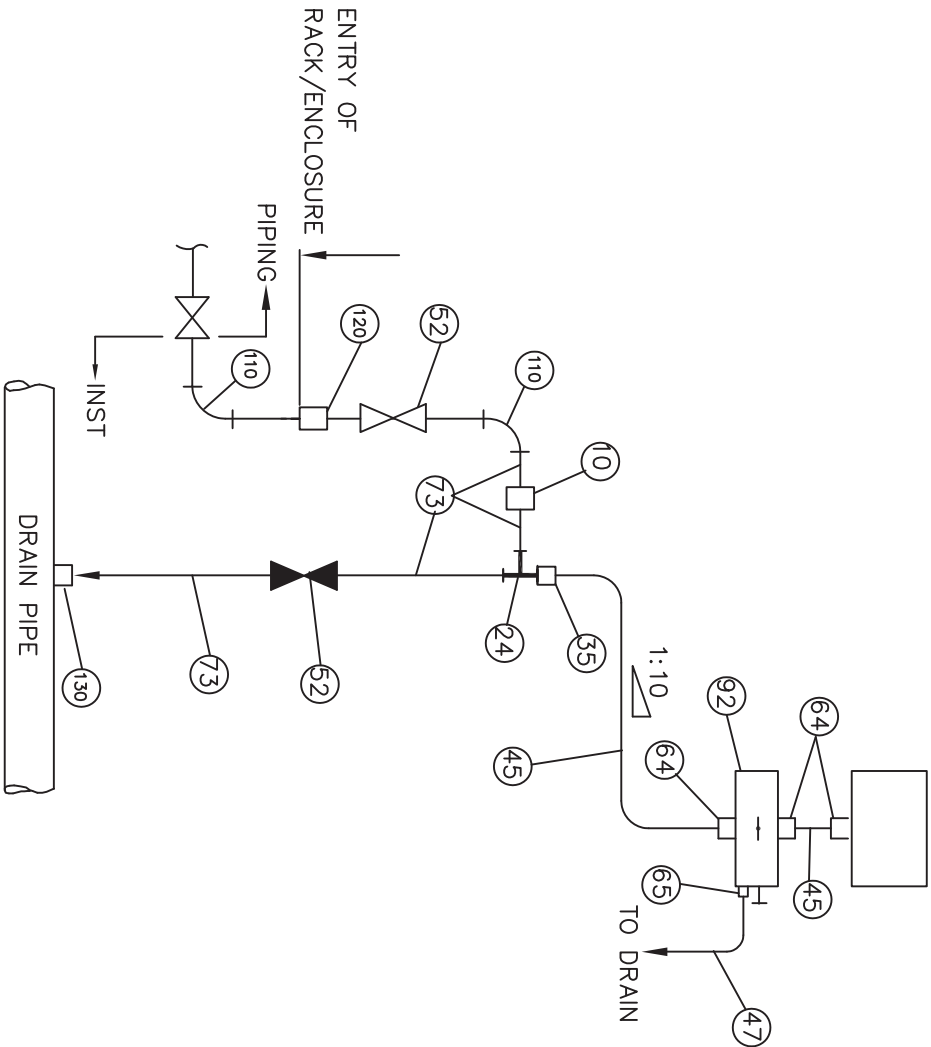
TITLE: OPERATING STATION DESK PROFILE	
PROJECT:	1800 MW SUPERCritical THERMAL POWER PLANT (UNIT #8 AT WANDKORI THERMAL POWER STATION, GUJARAT)

 GUJARAT STATE ELECTRICITY CORPORATION LIMITED WANDKORI, GUJARAT	
 DEVELOPMENT CONSULTANTS PVT. LTD. KOLAKATA . MUMBAI . CHENNAI . NEW DELHI	
JOB NO. K9213R	SCALE : NONE
DWG. NO. K9213R-DWG--0161	REV. A

FOR TENDERING PURPOSE ONLY

PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED ABOVE SOURCE POINT

PRESSURE TRANSMITTER/
SWITCH

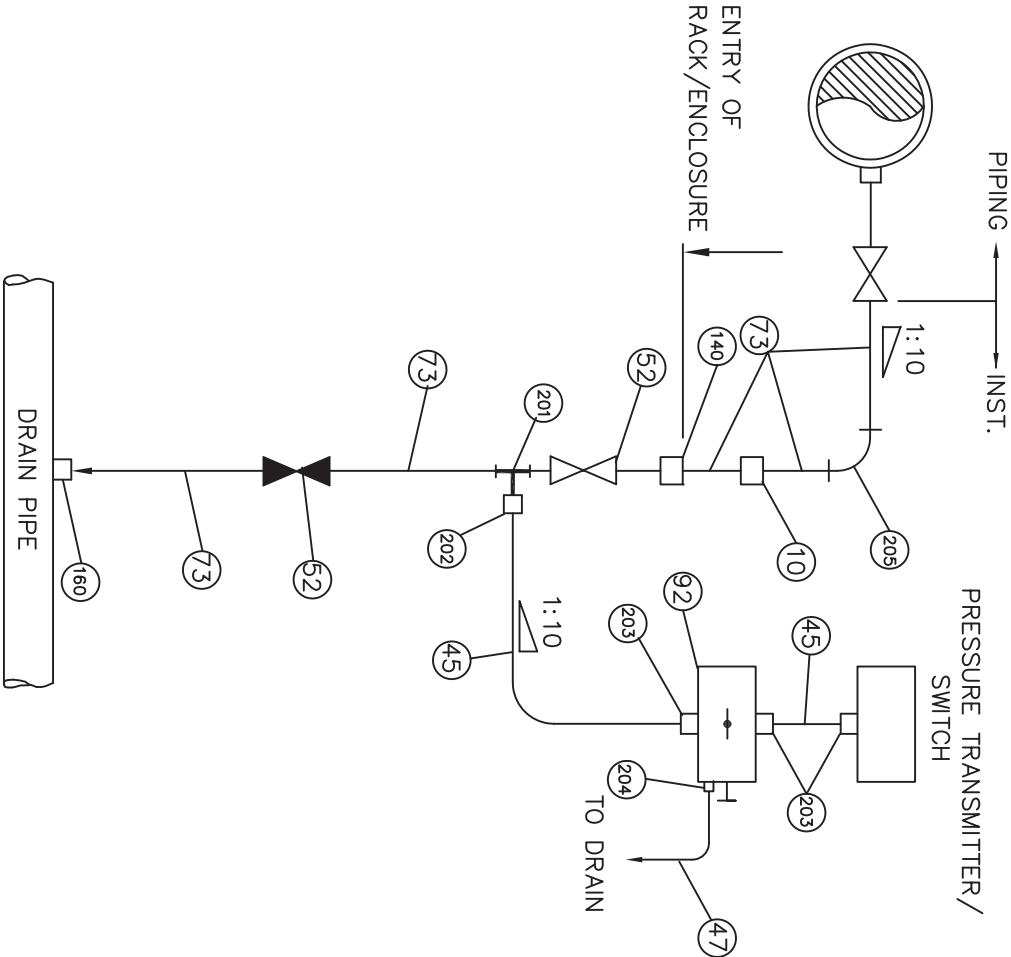


BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
24	1	EQUAL TEE (FEMALE) 1/2" SW 3000lbs
35	1	MALE CONNECTOR 1/2" PE X 1/2" OD 3000 lbs
52	2	GLOBE VALVE 1/2" SW 600lbs
45	3Mtrs.	TUBE 1/2" OD 2.1 MM THICK
64	3	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 3000 lbs
73	2Mtrs	IMPULSE PIPE 15 NB SCH 80
92	1	2 VALVES MANIFOLD 1/2" NPT(F)
10	1	FULL COUPLING 1/2" SW 3000lbs
47	0.15Mtrs	TUBE 8 MM OD 1.0 MM THICK
65	1	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 3000 lbs
110	2	90° ELBOW 1/2" SW 3000lbs
120	1	BULK HEAD UNION/COUPLING CL: 3000 LBS/ 1/2" NB-SW/AS PER ANSI B16.11
130	1	HALF COUPLING CL: 3000 LBS/ 1/2" NB-SW/AS PER ANSI B16.11

SERVICE : CONDENSER PRESSURE, INSTRUMENT AIR ETC.

							TYPICAL INSTRUMENT INSTALLATION DIAGRAM				 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI			
							1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WAAKARBON THERMAL POWER STATION, GUJARAT)				JOB NO. DCP/L-K9213R			
							GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT				SCALE NIL			
							APPROVED				SHT. 3 OF 20			
							CHECKED				REV. 0			
							GP				DWG. NO. K9213R-DWG-I-0060			
							AT							
							SD							
							0							
							21.04.10							
							REV.							
							DATE							

PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED BELOW SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./INST.	DESCRIPTION
201	1	EQUAL TEE (FEMALE) 1/2" SW 6000lbs
202	1	MALE CONNECTOR 1/2" PE 1/2" OD 6000 lbs
52	2	GLOBE VALVES 1/2" SW 600lbs
45	3 Mtrs	TUBE 1/2" OD 2.1 MM THICK
203	3	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 6000 lbs
73	15Mtrs.	IMPULSE PIPE 15 NB GRB SCH 80
92	1	2 VALVES MANIFOLD 1/2" NPT(F)
10	1	FULL COUPLING 1/2" SW 6000lbs
47	0.15Mtrs	TUBE 8 MM OD 1.0 MM THICK
204	1	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 6000 lbs
205	1	90° ELBOW 1/2" SW 6000lbs
140	1	BULK HEAD UNION/COUPLING CL: 6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11
160	1	HALF COUPLING CL: 6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11

SERVICE : CONDENSATE, FEED WATER ETC.

APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE
GP	AT	SD		0	21.04.10

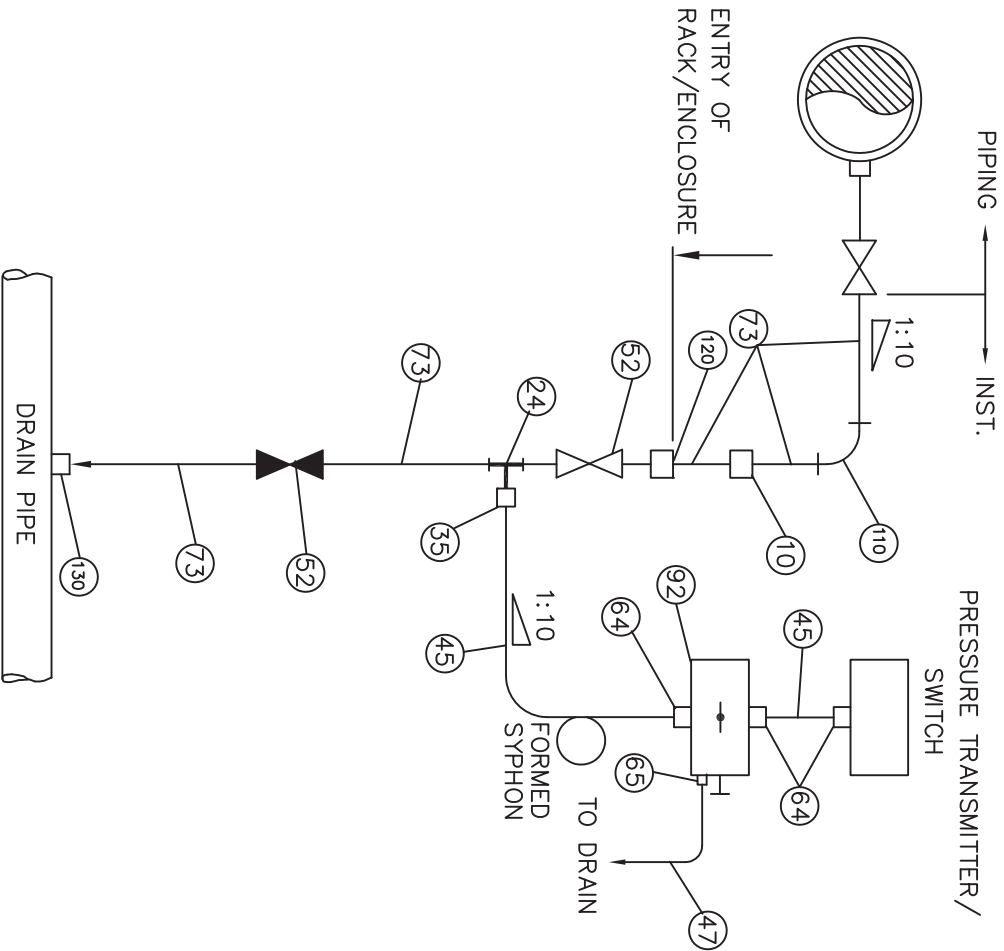
TYPICAL INSTRUMENT INSTALLATION DIAGRAM			1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)		
			GUJARATI STATE ELECTRICITY CORPORATION LIMITED		
			VADODARA, GUJARAT		
			JOB NO.	DCPL-K9213R	SCALE
			DWG. NO.	K9213R-DWG-I-0060	REV. 0



DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

PRELIMINARY
TENDER PURPOSE ONLY

PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED BELOW SOURCE POINT(WITH SYPHON)



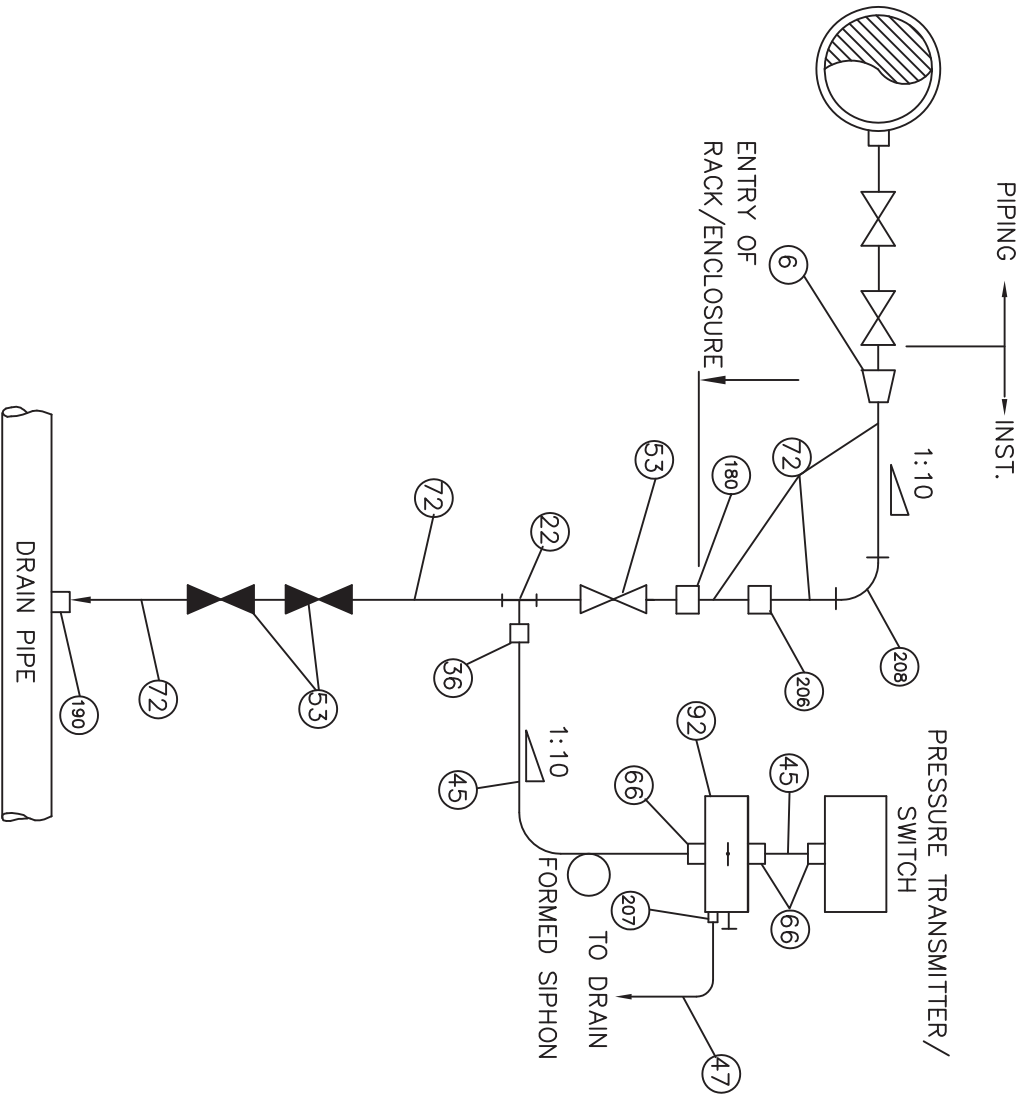
SERVICE : LOW PRESSURE STEAM

BILL OF MATERIAL		
ITEM NO.	QTY./INST.	DESCRIPTION
24	1	EQUAL TEE (FEMALE) 1/2" SW 3000lbs
35	1	MALE CONNECTOR 1/2" PE 1/2" OD 3000 lbs
52	2	GLOBE VALVES 1/2" SW 600lbs
45	3 Mtrs	TUBE 1/2" OD 2.1 MM THICK
64	3	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 3000 lbs
73	15Mtrs.	IMPULSE PIPE 15 NB SCH 80
92	1	2 VALVES MANIFOLD 1/2" NPT(F)
10	1	FULL COUPLING 1/2" SW 3000lbs
47	0.15Mtrs.	TUBE 8 MM OD 1.0 MM THICK
65	1	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 3000 lbs
110	1	90° ELBOW 1/2" SW 3000lbs
120	1	BULK HEAD UNION/COUPLING CL: 3000 LBS/ 1/2" NB-SW AS PER ANSI B16.11
130	1	HALF COUPLING CL: 3000 LBS/ 1/2" NB-SW AS PER ANSI B16.11

				TYPICAL INSTRUMENT INSTALLATION DIAGRAM				 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI					
GP	AT	SD		0				21.04.10					
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT				JOB NO. DCPL-K9213R SCALE NIL SHT. 5 OF 20 DWG. NO. K9213R-DWG-I-0060			

PRELIMINARY
TENDER PURPOSE ONLY

PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED BELOW SOURCE POINT(WITH CONDENSATE POT)



BILL OF MATERIAL	
ITEM NO.	QTY / INST
6	1
22	1
36	1
53	3
45	3 Mtrs
66	3
72	15Mtrs
92	1
206	1
47	0.15Mtrs
207	1
180	1
190	1
208	1

DESCRIPTION
REDUCER 1"SW X 1/2"SW 9000lbs
EQUAL TEE (FEMALE)1/2" SW 9000lbs
MALE CONNECTOR 1/2" PE X 1/2" OD 9000 lbs
GLOBE VALVES 1/2" SW 1500 lbs
TUBE 1/2" OD 2.1 MM THICK
MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 9000 lbs
IMPULSE PIPE 15 NB SCH. 80
2 VALVES MANIFOLD 1/2" NPT(F)
FULL COUPLING 1/2" SW 9000lbs
TUBE 8 MM OD 1.0 MM THICK
MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 9000 lbs
BULK HEAD UNION/COUPLING CL: 9000 LBS-AS PER ANSI B16.11,1/2" NB-SW
HALF COUPLING CL: 9000LBS/ 1/2" NB-SW AS PER ANSI B16.11
90° ELBOW 1/2" SW CL: 9000 lbs

SERVICE : MEDIUM & HIGH PRESSURE STEAM

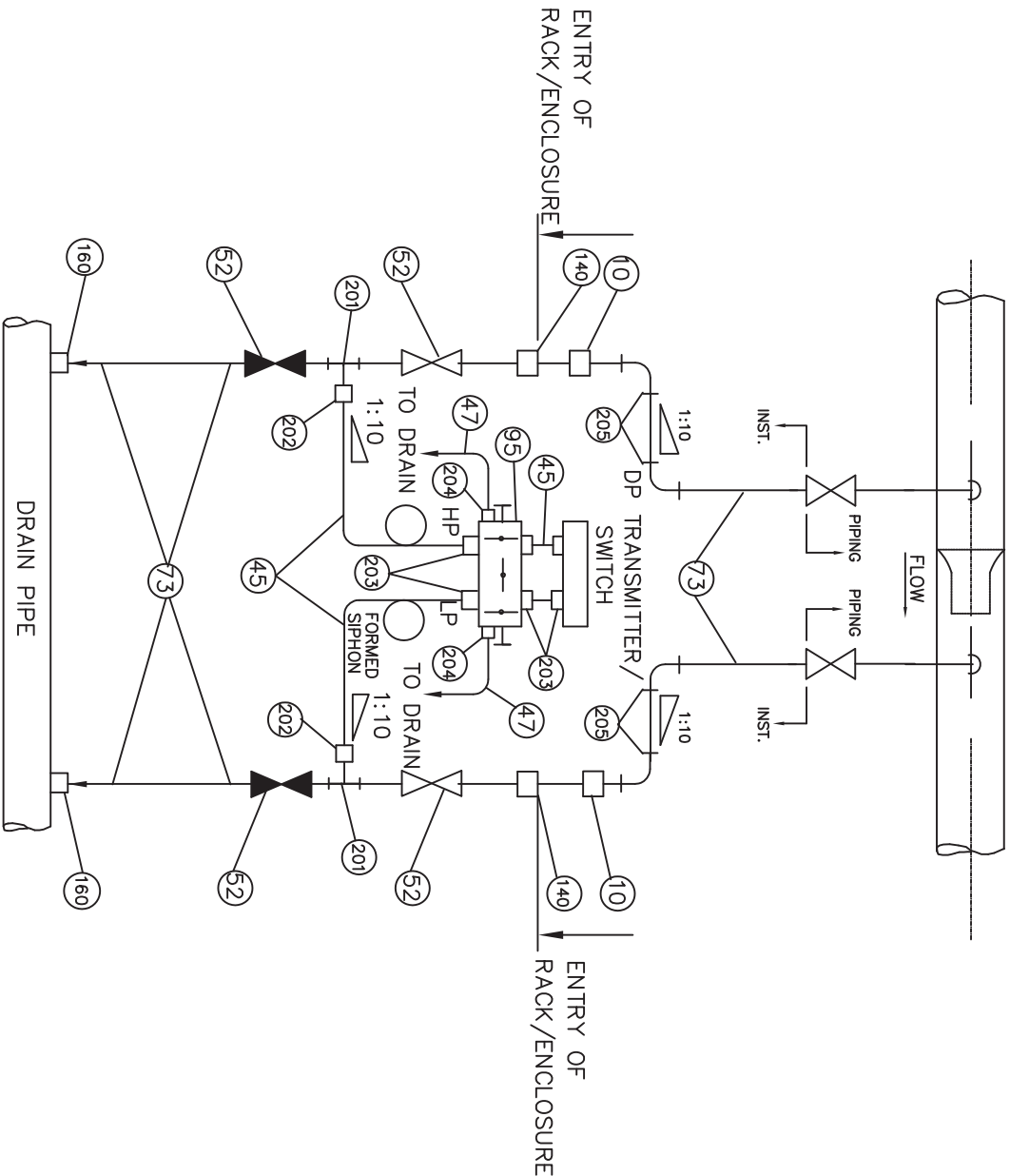
TYPICAL INSTRUMENT INSTALLATION DIAGRAM			
GP	AT	SD	0
APPROVED	CHECKED	DRAWN	DATE
1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WAMABORI THERMAL POWER STATION, GUJARAT)			
GUJARAT STATE ELECTRICITY CORPORATION LIMITED			
VADODARA, GUJARAT			
JOB NO. DCPL-K9213R		SCALE	NIL
DWG. NO. K9213R-DWG-I-0060		SHT.	6 OF 20
		REV.	0



DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

PRELIMINARY
TENDER PURPOSE ONLY

DIFF. PRESS. TRANSMITTER/DIFF. PRESS. SWITCH
MOUNTED BELOW SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
201	2	EQUAL TEE (FEMALE)1/2" SW 6000lbs
202	2	MALE CONNECTOR 1/2" PE X 1/2" OD 6000 lbs
52	4	GLOBE VALVES 1/2" SW 600lbs
45	6 Mtrs	TUBE 1/2" OD 2.1 MM THICK
203	6	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 6000 lbs
73	30mtrs	IMPULSE PIPE 15 NB GR.B SCH 80
95	1	5 VALVE MANIFOLD 1/2" NPT(F)
10	2	FULL COUPLING 1/2" SW 6000lbs
47	0.3Mtrs	TUBE 8 MM OD 1.0 MM THICK
204	2	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 6000 lbs
205	4	90° ELBOW 1/2" SW 6000lbs
140	2	BULK HEAD UNION/COUPLING CL:6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11
160	2	HALF COUPLING CL:6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11

SERVICE : CONDENSATE,FEED WATER ETC.

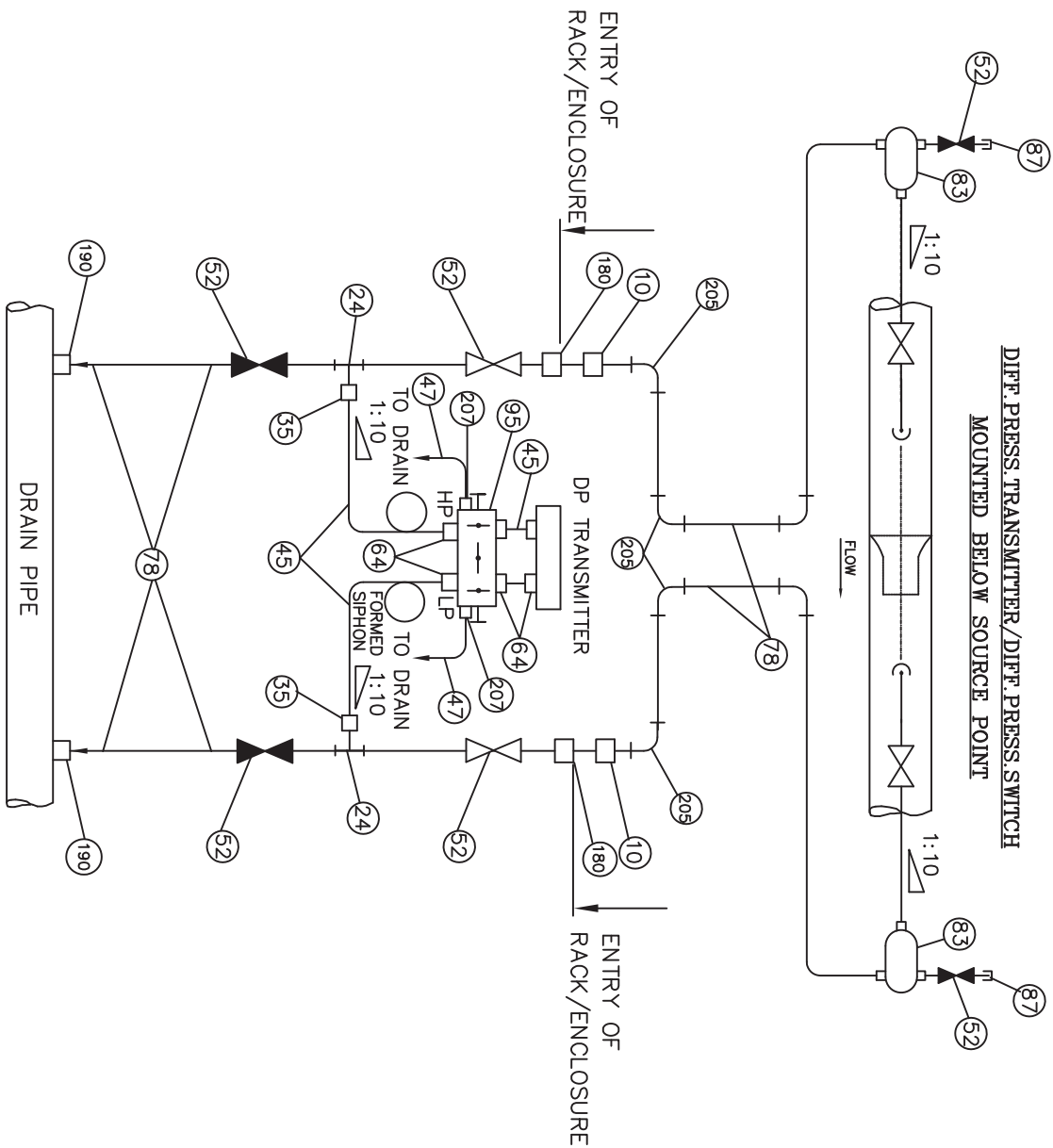
PRIMARY ELEMENT : FLOW NOZZLE/ORIFICE

PRELIMINARY
TENDER PURPOSE ONLY

TYPICAL INSTRUMENT INSTALLATION DIAGRAM		1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)		GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT	
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE
GP	AT	SD	0	21.04.10	

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCP-L-K9213R SCALE NIL SHT. 7 OF 20
DWG. NO. K9213R-DWG-1-0060 REV. 0

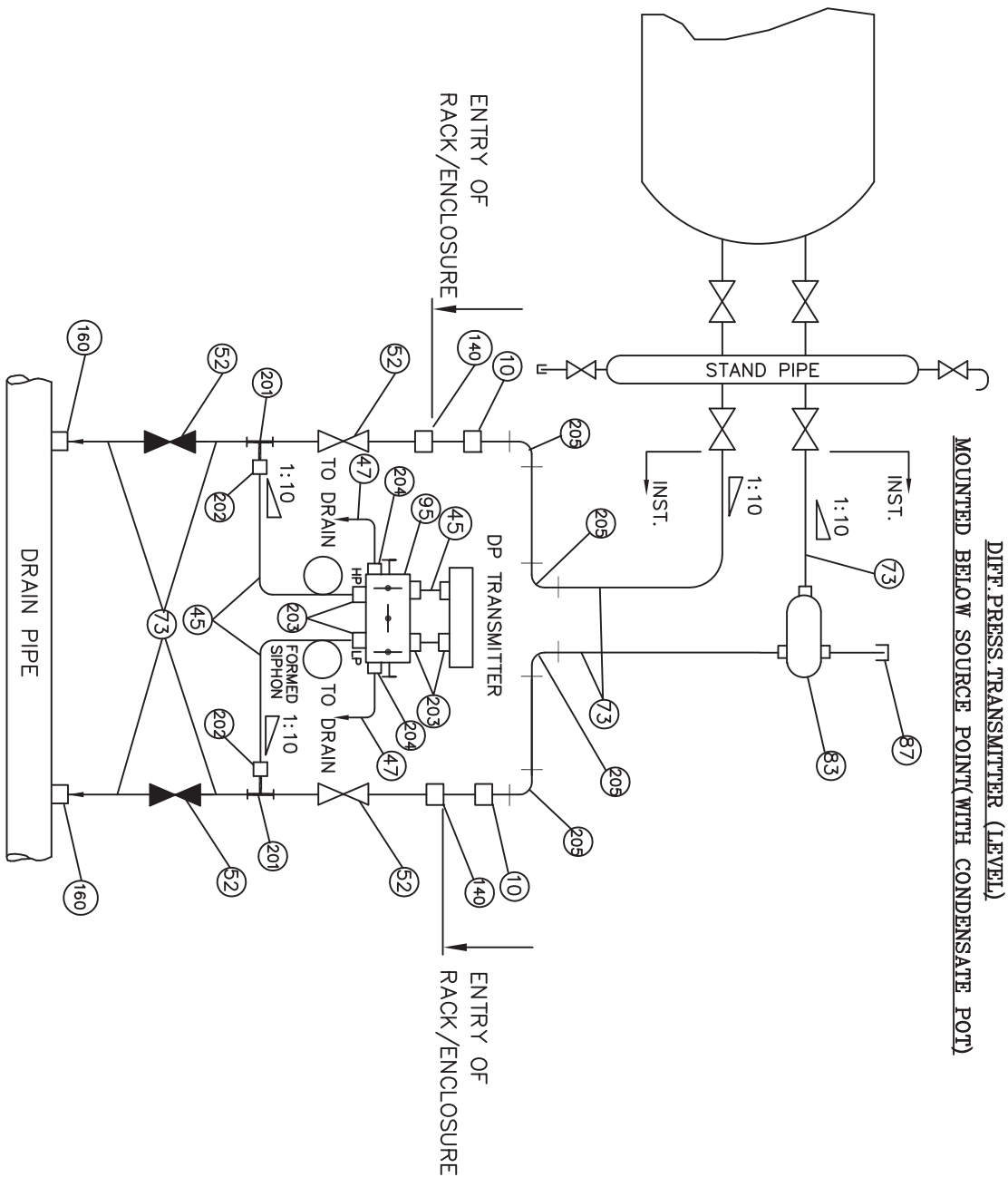


BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
24	2	EQUAL TEE (FEMALE) 1/2" SW 9000lbs
35	2	MALE CONNECTOR 1/2" PE X 1/2" OD 9000 lbs
52	6	GLOBE VALVES 1/2" SW 600lbs
45	6Mtrs.	TUBE 1/2" OD 2.1 MM THICK
64	6	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 9000 lbs
78	30Mtrs	IMPULSE PIPE 15 NB SCH 80
95	1	5 VALVES MANIFOLD 1/2" NPT(F)
10	2	FULL COUPLING 1/2" SW 9000lbs
83	2	CONDENSATION POT 1/2" SW NPT(F) 9000 lbs
87	2	PLUG 1/2" NPT(F) 9000lbs
47	0.3Mtrs	TUBE 8 MM OD 1.0 MM THICK
207	2	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 9000 lbs
205	6	90° ELBOW 1/2" SW 9000lbs
180	2	BULK HEAD UNION/COUPLING CL: 9000 LBS-AS PER ANSI B16.11/2" NB-SW
190	2	HALF COUPLING CL: 9000 LBS/ 1/2" NB-SW AS PER ANSI B16.11

SERVICE : STEAM

PRIMARY ELEMENT : FLOW NOZZLE/ORIFICE

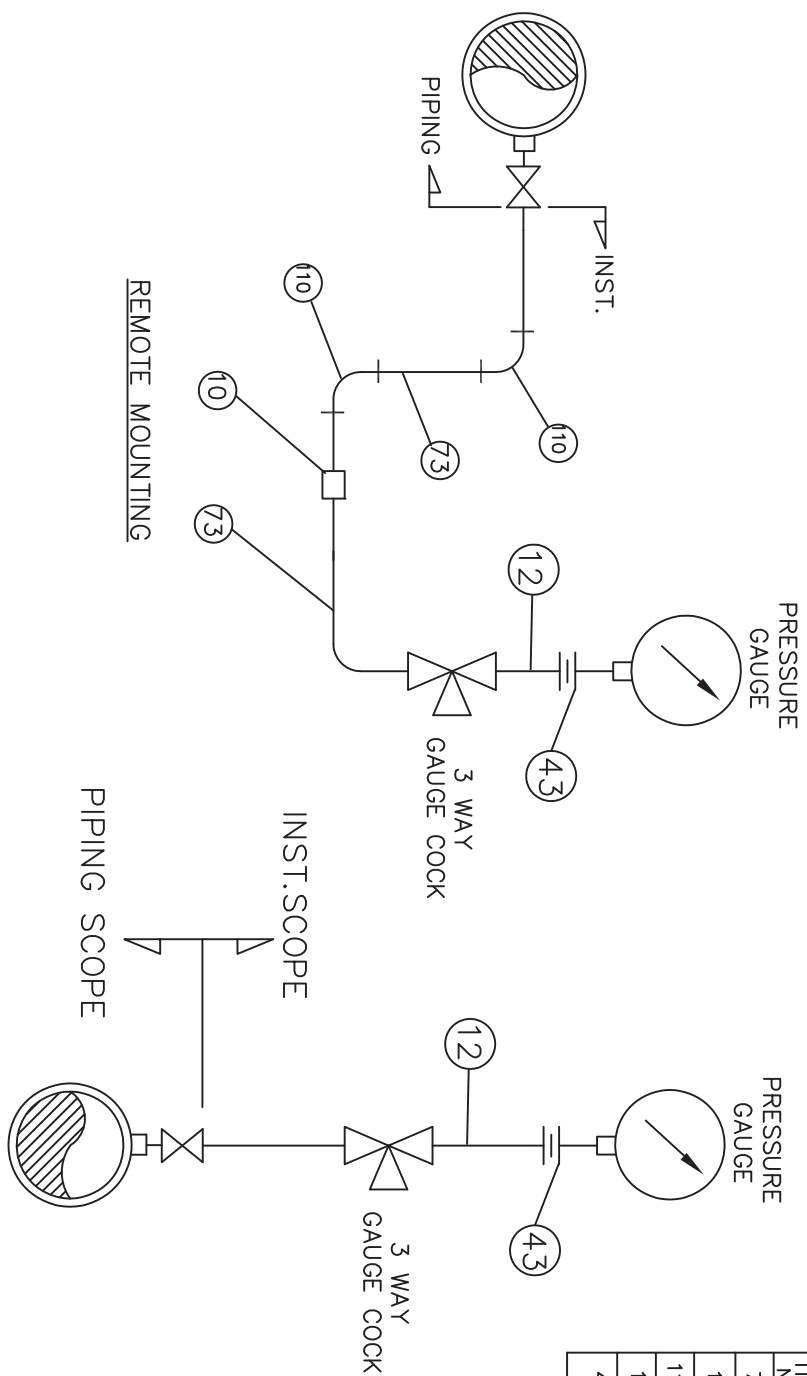
				TYPICAL INSTRUMENT INSTALLATION DIAGRAM	 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI
				1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WAMANGORI THERMAL POWER STATION, GUJARAT)	
				GUJARAT STATE ELECTRICITY CORPORATION LIMITED	
				VADODARA, GUJARAT	
GP	AT	SD	0	JOB NO. DGPL-K9213R	
APPROVED	CHECKED	DRAWN	REV.	DWG. NO. K9213R-DWG-I-0060	
			DATE	SCALE NIL	SHT. 8 OF 20
					REV. 0



BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
201	2	EQUAL TEE (FEMALE) 1/2" SW 6000lbs
202	2	MALE CONNECTOR 1/2" PE X 1/2" OD 6000 lbs
52	4	GLOBE VALVES 1/2" SW 6000lbs
45	6Mtrs.	TUBE 1/2" OD 2.1 MM THICK
203	6	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 6000 lbs
73	30Mtrs	IMPULSE PIPE 15 NB SCH 80
95	1	5 VALVES MANIFOLD 1/2" NPT(F)
10	2	FULL COUPLING 1/2" SW 6000lbs
83	1	CONDENSATE POT 1/2" SW 6000lbs
87	1	PLUG 1/2" NPT(M) 6000lbs
205	4	90° ELBOW 1/2" SW 6000lbs
47	0.3Mtrs	TUBE 8 MM OD 1.0 MM THICK
204	2	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 6000 lbs
140	2	BULK HEAD UNION/COUPLING CL:6000 LBS-AS PER ANSI B16.11,1/2" NB-SW
160	2	HALF COUPLING CL:6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11

SERVICE : BOILER DRUM, DEAERATOR, HEATERS

						TYPICAL INSTRUMENT INSTALLATION DIAGRAM				 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOKATA · MUMBAI · CHENNAI · NEW DELHI			
						1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WAAKARON THERMAL POWER STATION, GUJARAT)				JOB NO. DCP-L-K9213R SCALE NIL SHT. 9 OF 20			
GP	AT	SD		0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT				DWG. NO. K9213R-DWG-I-0060 REV. 0			
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE								



BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
73	15Mtrs	IMPULSE PIPE 15 NB SCH.80
10	1	FULL COUPLING 1/2" SW 3000lbs
110	2	90° ELBOW 1/2" SW 3000lbs
12	1	1/2" NPT(M) X 1/2" PE 4" LONG NIPPLE
43	1	NUT & TAIL FITTING WITH CU WASHER 1/2" NPT(F) X 1/2" PE

SERVICE : WATER, CONDENSATE ETC.

					TYPICAL INSTRUMENT INSTALLATION DIAGRAM				
					1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)				
					GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT				
					 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI				
JOB NO.		DCPL-K9213R		SCALE	NIL		SHT.	11 OF 20	
DWG. NO.		K9213R-DWG-I-0060				REV.	0		



**PRELIMINARY
TENDER PURPOSE ONLY**



DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
 KOLKATA · MUMBAI · CHENNAI · NEW DELHI

APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE
GP	AT	SD		0	21.04.10

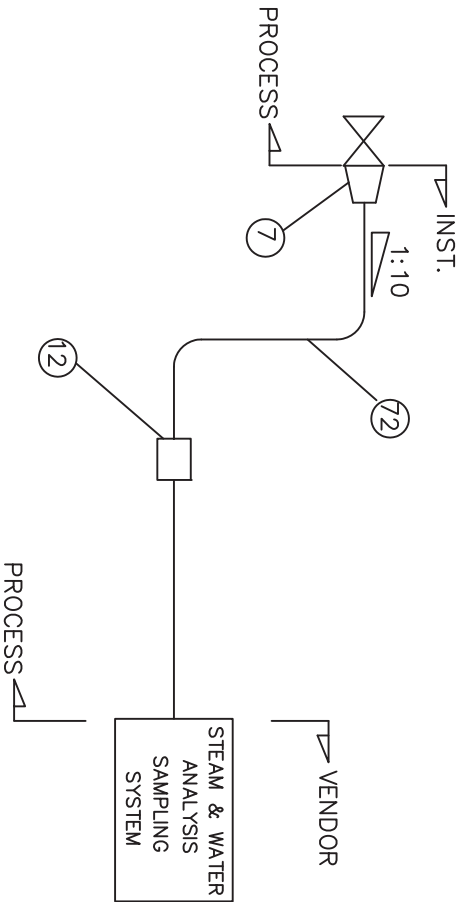
TYPICAL INSTRUMENT INSTALLATION DIAGRAM
1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WAMAGORI THERMAL POWER STATION, GUJARAT)
GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT



DEVELOPMENT CONSULTANTS PVT. LTD.
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

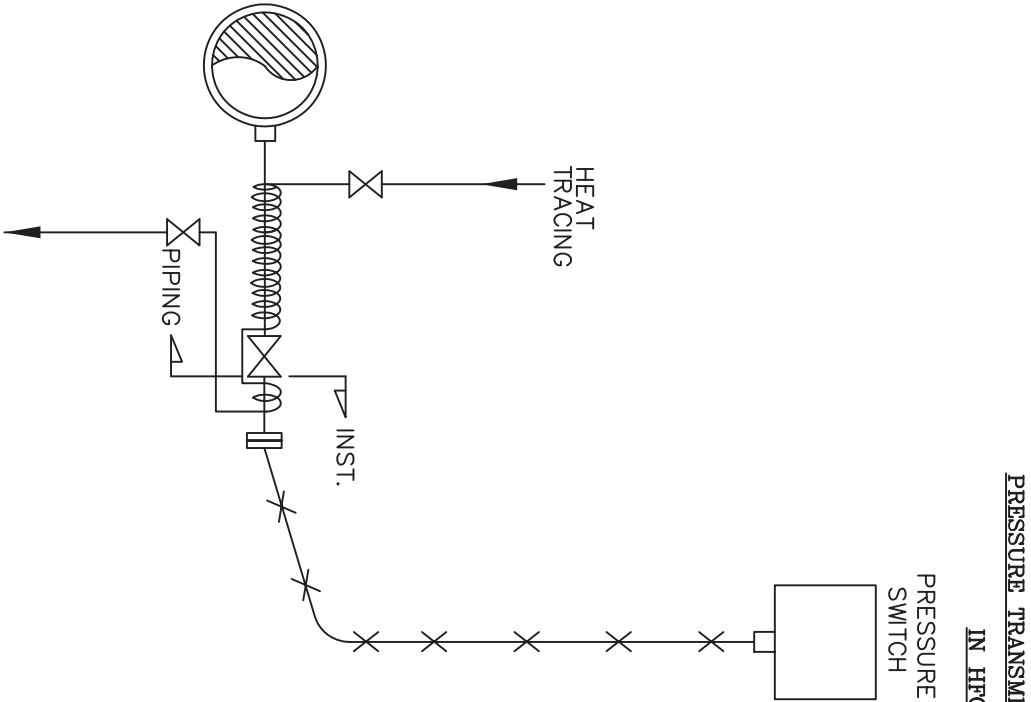
JOB NO. DCP-L-K9213R SCALE NIL SHT. 13 OF 20
DWG. NO. K9213R-DWG-I-0060

PRELIMINARY
TENDER PURPOSE ONLY



BILL OF MATERIAL	
ITEM NO.	QTY / INST
12	1
7	1
72	A/R

						TYPICAL INSTRUMENT INSTALLATION DIAGRAM		
						1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)		
GP	AT	SD		0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT		
APPROVED	CHECKED	DRAWN		REV.	DATE			

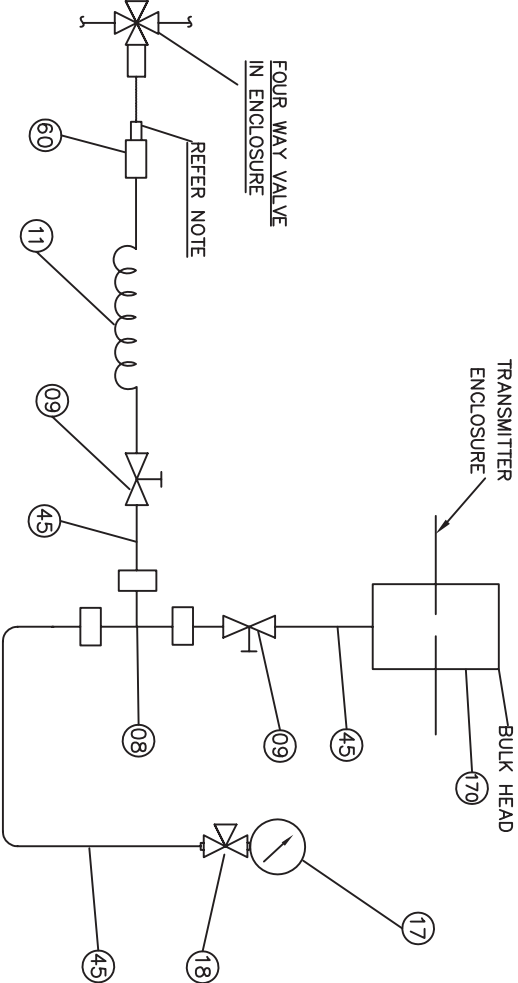
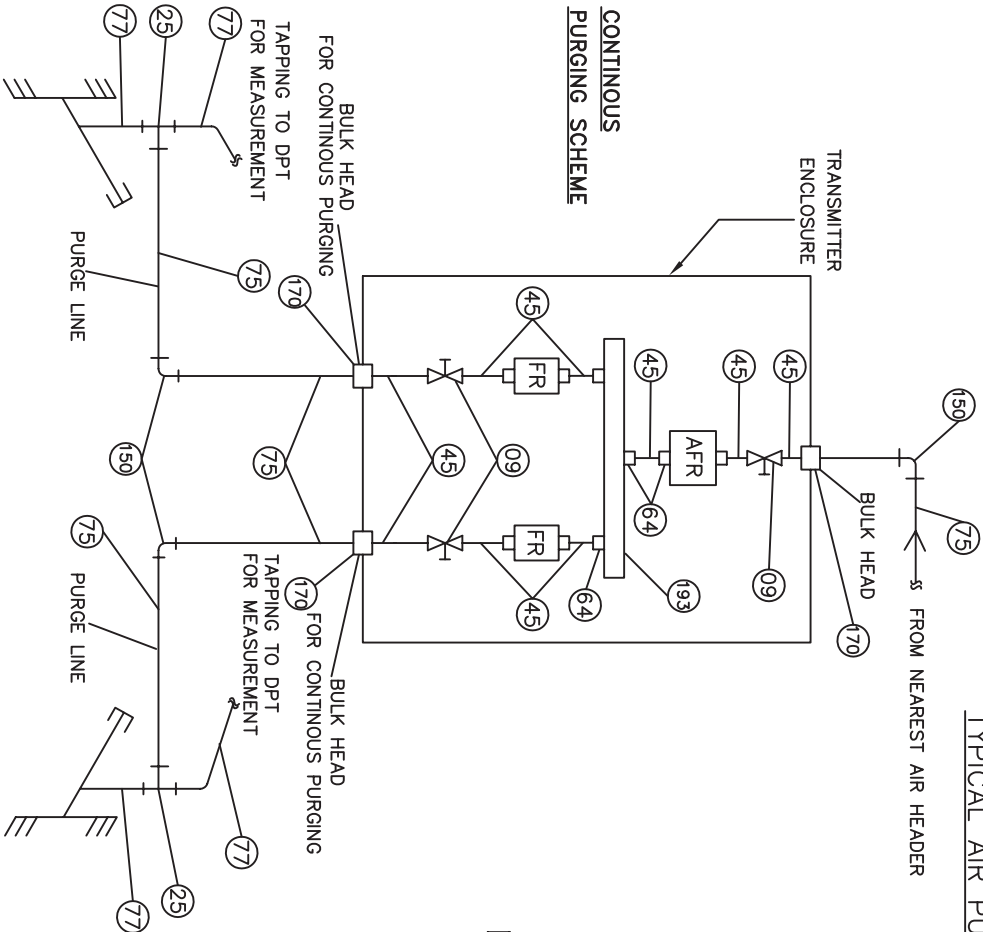


PRELIMINARY
TENDER PURPOSE ONLY

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCP L-K9213R SCALE NIL SH. 14 OF 20
DWG. NO. K9213R-DWG-I-0060 REV. 0

TYPICAL AIR PURGING SCHEMES



NOTE:

QUICK DISCONNECTING FITTING IS CONNECTED TO FOUR WAY VALVE WHERE INTERMITTENT PURGING IS CALLED IN SCHEME.
FR-FLOW REGULATOR

CONTINUE TO SHT. NO. 16/20

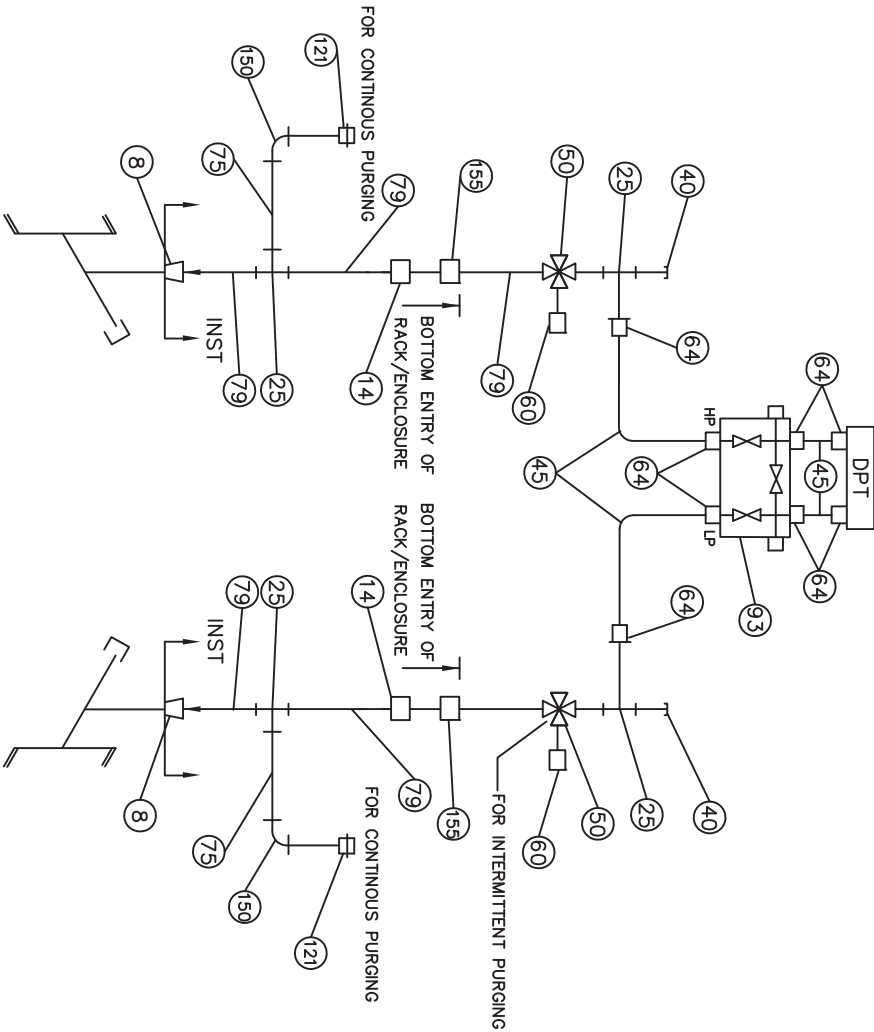
PRELIMINARY
TENDER PURPOSE ONLY

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					TYPICAL INSTRUMENT INSTALLATION DIAGRAM				DEVELOPMENT CONSULTANTS PVT. LTD.	
					1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #9 AT WANKABORI THERMAL POWER STATION, GUJARAT)		KOLKATA · MUMBAI · CHENNAI · NEW DELHI		CONSULTING ENGINEERS	
GP	AT	SD		0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT	JOB NO. DCP-1-K9213R		SCALE	NIL
APPROVED	CHECKED	DRAWN		DESCRIPTION	REV.	DATE	DWG. NO. K9213R-DWG-I-0060		SHT.	16 OF 20
									REV.	0

BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
77	15Mtrs	IMPULSE PIPE 3/4" NB
75	A/R	GI PIPE/1/2" NB
25	2	FORGED UNEQUAL TEE/AS PER ANSI B16.11 SIZE: 2 X 3/4" NB SW X 1/2"NPTF/CL 3000
150	3	GALVANISED ELBOW CL 3000 SIZE: 1/2" NPTF
60	1	QUICK DISCONNECTING FITTING MALE/END CONN. TO SUIT 1/2" OD CONN.
11	A/R	NYLON NOSE TO SUIT 1/2" END CONN./Pr. TESTING 10 Kg/cm ²
45	A/R	SEAMLESS TUBE 1/2" OD TUBE X 2.1 MM THK.
170	3	BULK HEAD COUPLING TO SUIT 1/2" OD TUBE & 1/2" NB PIPE
09	5	BALL VALVETO SUIT 1/2" OD TUBE
64	9	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 3000lbs
193	1	INSTRUMENT AIR HEADER 1" NB PIPE
08	1	EQUAL TEE/SS 316/TO SUIT 1/2" OD TUBE.
17	1	Pr. GAUGE/4" DIAL SIZE/RANGE 0-10 Kg/cm ² CONNECTION 1/2" NPTM
18	1	3 WAY GAUGE 1/2"NPTF X TO SUIT 1/2" TUBE.

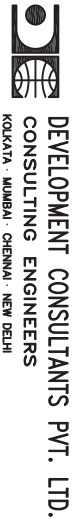
PRELIMINARY
TENDER PURPOSE ONLY



BILL OF MATERIAL	
ITEM NO.	QTY./ INST
DESCRIPTION	
8	2
REDUCER 1" BSPF X 3/4" NB-SW CL 3000	
14	2
FORGED COUPLING 3/4" SW CL 3000/AS PER ANSI B16.11	
25	4
FORGED UNEQUAL TEE AS PER ANSI B16.11 SIZE : 2 X 3/4" NB-SW X 1/2" NPTF/CL3000	
40	2
NIPPLE & CAP 3/4" NB-SCH 80/CAP-3/4" NPTF	
45	6 Mtrs.
SEAMLESS TUBE 1/2" OD X 2.1 MM THK.	
50	2
FOUR WAY VALVE SIZE : (2 X 3/4" NB-SW)X(2 X 1/2"NPTF) CL: 800	
60	2
QUICK DISCONNECTING FITTING SIZE:1/2"NPTM	
64	8
MALE CONNECTOR 1/2" NPT(M) X TO SUIT 1/2" OD TUBE	
79	30Mtrs
SEAMLESS PIPE/3/4" NB SCH 80	
75	A/R
PIPE AS PER IS-1239 SIZE : 1/2" NB-HEAVY GRADE	
93	1
3 VALVE MANIFOLD 1/2" NPT(F)	
150	2
GALVANISED ELBOW CL 3000 SIZE : 1/2" NPTF	
155	2
BULK HEAD COUPLING CL 3000 SIZE : 3/4" NB SW /CL 3000/AS PER ANSI B16.11	
121	2
BULK HEAD COUPLING CL 3000 SIZE : 1/2" NPTF /AS PER ANSI B16.11	

SERVICE : FLUE GAS, FURNACE ETC.

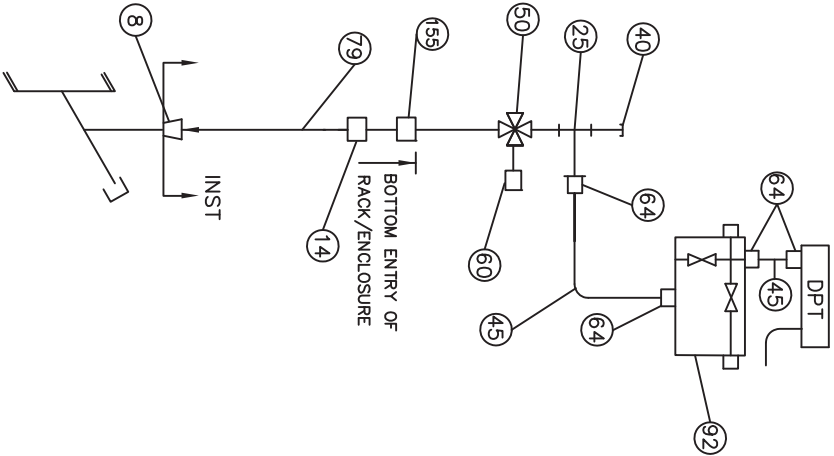
TYPICAL INSTRUMENT INSTALLATION DIAGRAM			
GP	AT	SD	0
21.04.10			
REV.			
DATE			
1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WAMAKBORI THERMAL POWER STATION, GUJARAT)			
GUJARAT STATE ELECTRICITY CORPORATION LIMITED			
VADODARA, GUJARAT			
JOB NO. DGPL-K9213R SCALE NIL SHT. 17 OF 20			
DWG. NO. K9213R-DWG-I-0060			
REV. 0			



DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

PRELIMINARY
TENDER PURPOSE ONLY

DIFF. PRESSURE TRANSMITTER
MOUNTED ABOVE SOURCE POINT



BILL OF MATERIAL	
ITEM NO.	QTY./ INST DESCRIPTION
8	1 REDUCER 1" BSPF X 3/4" NB-SW CL 3000
14	1 FORGED COUPLING 3/4" SW CL 3000/AS PER ANSI B16.11
25	1 FORGED UNEQUAL TEE AS PER ANSI B16.11 SIZE : 2 X 3/4" NB-SW X 1/2" NPTF/CL3000
40	1 NIPPLE & CAP 3/4" NB-SCH 80/CAP-3/4" NPTF
45	6 Mtrs. SEAMLESS TUBE 1/2" OD X 2.1 MM THK.
50	1 FOUR WAY VALVE SIZE : (2 X 3/4" NB-SW)X(2 X 1/2"NPTF) CL: 800
60	1 QUICK DISCONNECTING FITTING SIZE:1/2"NPTM
64	3 MALE CONNECTOR /SS 316 1/2" NPT(M) X TO SUIT 1/2" OD TUBE
79	30Mtrs SEAMLESS PIPE/3/4" NB SCH 80
92	1 2 VALVE MANIFOLD 1/2" NPT(F)
155	1 BULK HEAD COUPLING CL 3000 SIZE : 3/4" SW /CL 3000/AS PER ANSI B16.11

SERVICE : FLUE GAS, PRIMARY AIR, SECONDARY AIR ETC.
NOTE : AIR PURGING ARRANGEMENT SHALL BE INCLUDED.

APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE
GP	AT	SD		0	21.04.10

TYPICAL INSTRUMENT INSTALLATION DIAGRAM		1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WAMABORI THERMAL POWER STATION, GUJARAT)	
GUJARAT STATE ELECTRICITY CORPORATION LIMITED		VADODARA, GUJARAT	
DWG. NO. K9213R-DWG-I-0060		JOB NO. DCPL-K9213R SCALE NIL SHT. 18 OF 20	



DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

PRELIMINARY
TENDER PURPOSE ONLY

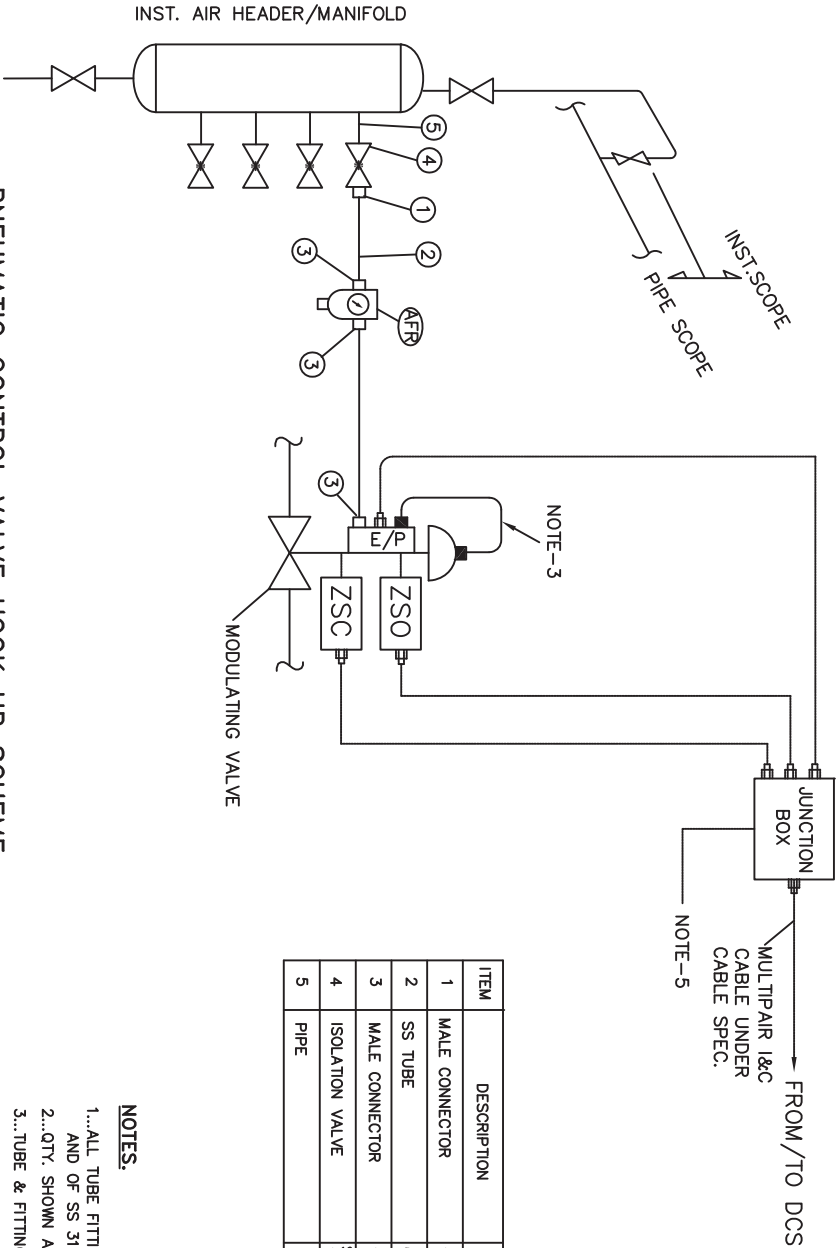
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE
GP	AT	SD		0	21.04.10

TYPICAL INSTRUMENT INSTALLATION DIAGRAM	
1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WAMABORI THERMAL POWER STATION, GUJARAT)	
GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT	

	
DEVELOPMENT CONSULTANTS PVT. LTD. KOLKATA · MUMBAI · CHENNAI · NEW DELHI	
JOB NO. DCPL-K9213R	SCALE NIL
DWG. NO. K9213R-DWG-I-0060	SHT. 19 OF 20
REV. 0	

PRELIMINARY
TENDER PURPOSE ONLY

PNEUMATIC CONTROL VALVE HOOK UP SCHEME



ITEM	DESCRIPTION	SPECIFICATION	QTY.	REMARKS
1	MALE CONNECTOR	1/2"NPT(M) X 6 mm OD COMPRN.	1	
2	SS TUBE	6 mm OD X 1 mm THK.	10 MTRS.	
3	MALE CONNECTOR	1/4"NPT(M) X 6 mm OD COMPRN.	3	
4	ISOLATION VALVE	SS BALL TYPE 600LBS 1/2" SW X 1/2" NPT(F)		
5	PIPE	1/2" NB SCH 40S	A/R	

NOTES.

- 1...ALL TUBE FITTINGS ARE OF DOUBLE COMPRESSION TYPE AND OF SS 316 MATERIAL.
- 2...QTY. SHOWN ARE TYPICAL FOR ONE INSTALLATION ONLY.
- 3...TUBE & FITTINGS MARKED ■ ARE INTEGRAL TO THE VALVE.
- 4...LIMIT SWITCHES WILL BE CONNECTED WHEREVER APPLICABLE.
- 5...JUNCTION BOX WILL BE INTEGRAL TO ACTUATOR.
- 6...ISOLATION VALVE SHALL BE INSTALLED CLOSE TO THE VALVE ASSEMBLY.

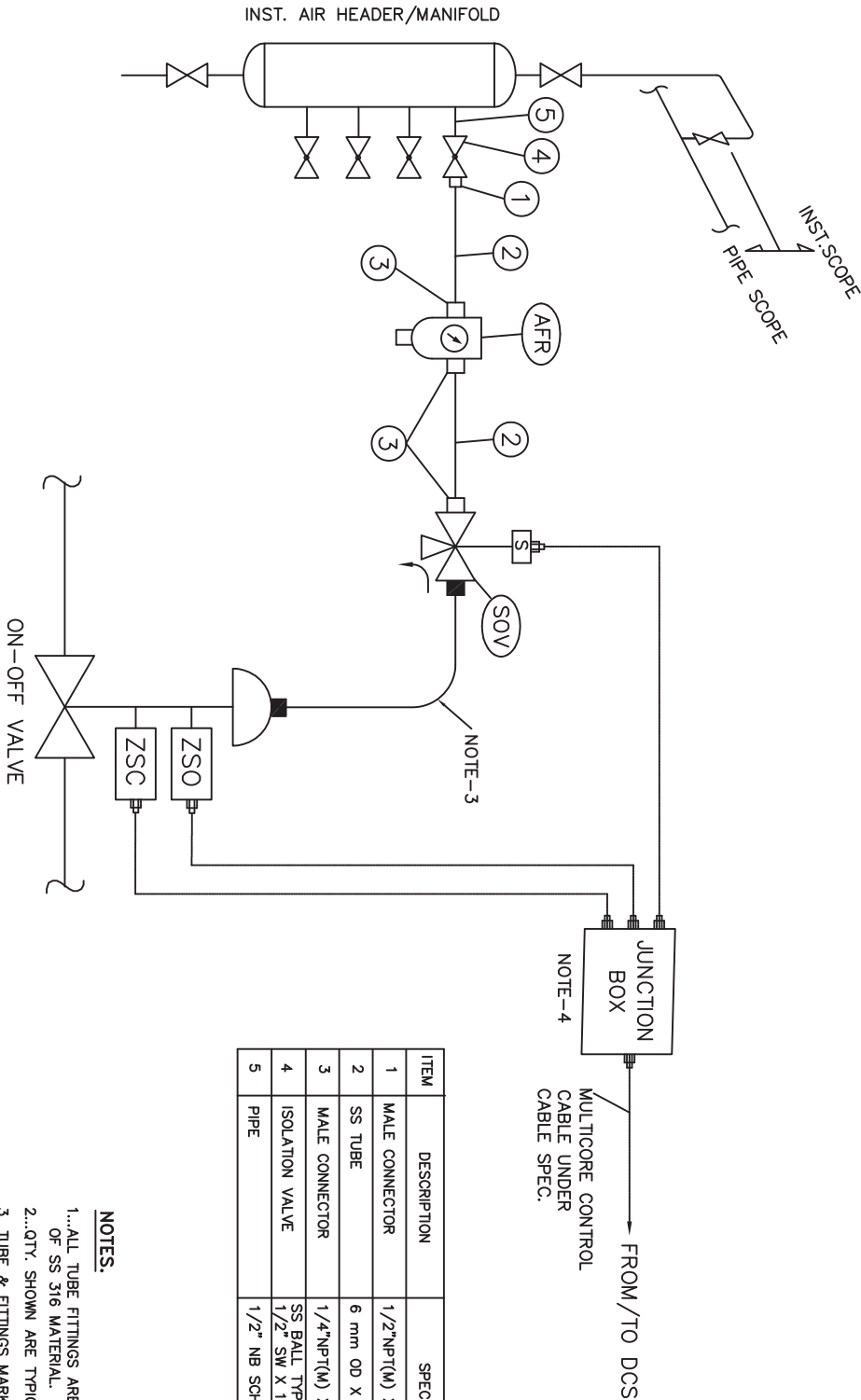
				TYPICAL INSTRUMENT INSTALLATION DIAGRAM			
				1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WAMKABORI THERMAL POWER STATION, GUJARAT)			
				GUJARAT STATE ELECTRICITY CORPORATION LIMITED			
				VADODARA, GUJARAT			
GP	AT	SD		0	21.04.10		
APPROVED	CHECKED	DRAWN	DESCRIPTION		REV.	DATE	

				PRELIMINARY TENDER PURPOSE ONLY			
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DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCP-L-K9213R SCALE NIL SHT. 20 OF 20
DWG. NO. K9213R-DWG-I-0060 REV. 0

PNEUMATIC SOV HOOK UP SCHEME



ITEM	DESCRIPTION	SPECIFICATION	QTY.	REMARKS
1	MALE CONNECTOR	1/2"NPT(M) X 6 mm OD COMPRN.	1	
2	SS TUBE	6 mm OD X 1.0 mm THK.	10 MTRS.	
3	MALE CONNECTOR	1/4"NPT(M) X 6 mm OD COMPRN.	3	
4	ISOLATION VALVE	SS BALL TYPE 600LBS 1/2" SW X 1/2" NPT(F)		
5	PIPE	1/2" NB SCH 40S	A/R	

NOTES.

- 1...ALL TUBE FITTINGS ARE OF DOUBLE COMPRESSION TYPE AND OF SS 316 MATERIAL.
- 2...QTY. SHOWN ARE TYPICAL FOR ONE INSTALLATION ONLY.
- 3...TUBE & FITTINGS MARKED ■ ARE INTEGRAL TO THE VALVE.
- 4...JUNCTION BOX WILL BE INTEGRAL TO ACTUATOR.
- 5...ISOLATION VALVE SHALL BE INSTALLED CLOSE TO THE VALVE ASSEMBLY.



**1x800 MW WANAKBORI STPP
TECHNICAL SPECIFICATION FOR
PRE TREATMENT PLANT**

SPECIFICATION NO. PE-TS-408-158-A001

VOLUME : II B

SECTION : E

REV 00

DATE:

SHEET

ANNEXURE-I

LIST OF MAKES OF SUB-VENDOR ITEMS

	TITLE: 1x800 MW WANAKBORI STPP TECHNICAL SPECIFICATION FOR PRE TREATMENT PLANT	SPEC NO: PE-TS-408-158-A001	
		VOLUME: II-B	
		SECTION: E	
		REV NO: 00	DATE:

LIST OF SUB VENDORS (ANNEXURE-I)

S NO.	ITEM	APPROVED SUPPLIERS	PLACE
1	ATMOSPHERIC TANK (CS/SS)		
		FABTECH	PUNE
		TECHNOFAB	NEW DELHI
		JASMINOT POLYMERTECH	PUNE
		PRESSURE VESSELS INDUSTRY	PUNE
		SPARKON ENGINEERING	
		BELCO POLLUTION CONTROL PVT LTD	GREATER NOIDA
2	PRSSURE VESSEL		
		FABTECH	PUNE
		TECHNOFAB	NEW DELHI
		R&C	MUMBAI
		ISGEC	YAMUNANAGAR
		ANUP ENGG.	AHMEDABAD
3	TANK /PIPING FABRICATION		
		FABTECH	PUNE
		TECHNOFAB	NEW DELHI
		BELCO POLLUTION CONTROL PVT LTD	GREATER NOIDA
		AQUATHERM	KOLKATA
4	TANK (FRP)		
		INDUSTRIAL SERVICE	KOLKATA
		SUNRISE	BARODA
		GANDHI & ASSOCIATES	AHMEDABAD
		MODERN EQUIPMENTS	CHENNAI
		EAGLE PLAST	PUNE
		OMEGA PLAST	MUMBAI
5	METERING PUMPA/PRV		
		MILTON ROY INDIA	CHENNAI
		VK PUMP	NASIK
		METACHEM	MUMBAI
		SWELORE	AHMEDABAD
6	STROKE CONTROLLER		
		V K PUMPS	NASIK
		METACHEM	MUMBAI
		SWELORE	AHMEDABAD
		MILTON ROY INDIA	CHENNAI
7	SAFETY VALVES/RELIEF VALVES	METACHEM	MUMBAI
		KEYSTONE	BARODA
		V K PUMPS	NASIK
		MILTON ROY	CHENNAI
8	AGITATOR/STIRRER	REMI	MUMBAI
		FIBRE & FIBRE PRODUTS	
		STANDARD ENGINEERS	MUMBAI
		CROMPTON GREAVES	AHAMADNAGAR
9	STRAINER	OTOKLIN	MUMBAI
		GRAND PRIX	NEW DELHI
		AYPEE	NEW DELHI
		GREAVES COTTON	MUMBAI
		MULTITEX	NEW DELHI
		FILTRATION ENGINEERING	MUMBAI
		BHATIA ENGINEERING	DELHI
		FLUIDLINE VALVES	MUMBAI
10	EJECTOR		
11	HORIZONTAL	ESSEMM TECHNOLOGIES	MUMBAI
		KIRLOSKAR BROS. LTD	PUNE

	TITLE: 1x800 MW WANAKBORI STPP TECHNICAL SPECIFICATION FOR PRE TREATMENT PLANT	SPEC NO: PE-TS-408-158-A001	
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	CENRIFUGAL PUMP		
		M&P	PUNE
		KSB PUMPS LTD	PUNE
		SAM PUMPS	COINBATORE
		BEACON WEAR	CHENNAI
		MATHER & PLATT	PUNE
		SULZER PUMPS LTD	MUMBAI
12	ORIFICE PLATE	MICRO PRECISION	FARIDABAD
		INSTRUMENTAION LTD	PALGHAT
		CARLO DYNAMICS	HYDRABAD
13	GAT E VALVES		
		BDK	HUBLI
		LEADER	JALANDHAR
		BANKIM	KOLKATA
		H SARKAR	KOLKATA
		AV VALVES	AGRA
		HAWA VALVES	MUMBAI
		STEEL STRON VALVES	MUMBAI
		AKSONS MECH. ENTERPRISES	MUMBAI
		BABCOCK BORSIG ESPANA, S.A.	SPAIN
		CRESCENT VALVES MFG.CO.PVT.LTD.	MUMBAI
		KIRLOSKAR BROTHERS LTD.	PUNE
		KSB PUMPS LTD.	MUMBAI
		MICON VALVES (INDIA) PVT.LTD	MUMBAI
		NITON INDUSTRIES	MUMBAI
		NECO SCHUBERT & SALZER LTD.	NAGPUR
		OSWAL INDUSTRIES LTD.	AHMEDABAD
		Surya Valves and Instruments Manufacturing Company	Chennai
		VENUS PUMP & ENGG. WORKS	KOLKATA
		VALTECH INDUSTRIES ,MUMBAI	MUMBAI
14	GLOBE VALVE		
		BDK	HUBLI
		LEADER	JALANDHAR
		BANKIM	KOLKATA
		H SARKAR	KOLKATA
		AV VALVES	AGRA
		HAWA VALVES	MUMBAI
		STEEL STRON VALVES	MUMBAI
		AKSONS MECH. ENTERPRISES	MUMBAI
		BABCOCK BORSIG ESPANA, S.A.	SPAIN
		CRESCENT VALVES MFG.CO.PVT.LTD.	MUMBAI
		KIRLOSKAR BROTHERS LTD.	PUNE
		KSB PUMPS LTD.	MUMBAI
		MICON VALVES (INDIA) PVT.LTD	MUMBAI
		NITON INDUSTRIES	MUMBAI
		NECO SCHUBERT & SALZER LTD.	NAGPUR
		OSWAL INDUSTRIES LTD.	AHMEDABAD
		Surya Valves and Instruments Manufacturing Company	Chennai
		VENUS PUMP & ENGG. WORKS	KOLKATA
		VALTECH INDUSTRIES ,MUMBAI	MUMBAI
15	BALL VALVE		
		BDK	HUBLI
		LEADER	JALANDHAR
		BANKIM	KOLKATA
		H SARKAR	KOLKATA
		AV VALVES	AGRA
		HAWA VALVES	MUMBAI
		FLOW CHEM	AHMEDABAD
		STEEL STRON VALVES	MUMBAI
		AKAY VALVES LTD.	MUMBAI
		AQUA VALVES PVT.LTD.	KARNATAKA
		CRESCENT VALVES	MUMBAI

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		FISHER SANMAR LIMITED	CHENNAI
		HABONIM VAAS AUTOMATION PVT LTD.,CHENNAI	CHENNAI
		KIRLOSKAR BROTHERS LTD.	PUNE
		KSB PUMPS LTD.	MUMBAI
		MICROFINISH VALVES PVT LTD.	HUBLI
		MICON VALVES (INDIA) PVT.LTD	MUMBAI
		PEC VALVES	MUMBAI
16	NRV CHECK VALVE		
		BDK	HUBLI
		LEADER	JALANDHAR
		BANKIM	KOLKATA
		H SARKAR	KOLKATA
		AV VALVES	AGRA
		HAWA VALVES	MUMBAI
		STEEL STRON VALVES	MUMBAI
		AKSONS MECH. ENTERPRISES	MUMBAI
		BABCOCK BORSIG ESPANA, S.A.	SPAIN
		CRESCENT VALVES MFG.CO.PVT.LTD.	MUMBAI
		KIRLOSKAR BROTHERS LTD.	PUNE
		KSB PUMPS LTD.	MUMBAI
		MICON VALVES (INDIA) PVT.LTD	MUMBAI
		NITON INDUSTRIES	MUMBAI
		NECO SCHUBERT & SALZER LTD.	NAGPUR
		OSWAL INDUSTRIES LTD.	AHMEDABAD
		Surya Valves and Instruments Manufacturing Company	Chennai
		VENUS PUMP & ENGG. WORKS	KOLKATA
		VALTECH INDUSTRIES ,MUMBAI	MUMBAI
17	SLICE GATE		
		H SARKAR	KOLKATA
		JASH ENGINEERING	INDORE
		YASHWANT	MIRAJ
18	DIAPHRAGM VALVE		
		PROCON ENGINEERES	MUMBAI
		HAWA VALVES	MUMBAI
		BDK VALVES	HUBLI
		FOURESS	BANALORE
		INERVALVE	GUJRAT
19	BUTTER FLY VALVE		
		BDK VALVES	HUBLI
		TYCO VALVES	HALOL
		INTERVALVES	PUNE
		FOURESS	BANGALORE
		LEADER	JALANDHAR
20	3 WAY VALVE		
		HI TECH	AHMEDABAD
		ADVANCE VALVES PVT.LTD	NOIDA
		BDK	HUBLI
		FOURESS ENGG.INDIA LTD.	MUMBAI
		FLUIDLINEVALVES COMPANY PRIVATE LTD.,	MUMBAI
		INSTRUMENTATION LTD.	PALAKAD
		KIRLOSKAR BROTHERS LTD.	PUNE

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		VENUS PUMP & ENGG. WORKS	KOLKATA
		Surya Valves and Instruments Manufacturing Company	Chennai
		STAFFORD CONTROLS LIMITED	PUNE
		MICON VALVES (INDIA) PVT.LTD	MUMBAI
21	PLUG VALVE		
		FISHER SANMAR LIMITED	CHENNAI
		BDK	HUBLI
		LARSEN & TOUBRO LTD.	MUMBAI
		LEADER	JALANDHAR
		MICON VALVES (INDIA) PVT.LTD	MUMBAI
22	PIPING (SS/CS)		
		CHOKSHI TUBES	AHMEDABAD
		REMI	MUMBAI
		RATNAMANI	AHMEDABAD
		CHITRAKOOT TUBES	HYDRABAD.
		REMI	
		JINDAL STAINLESS	BAHADURGARH
		TISCO	JAMSEDPUR
		SAIL	
		MUKUT PIPES	RAJPURA
23	FITTINGS (CS/SS)		
		BHARAT FORGE	PUNE
		RELIANCE FORGE	
		EBY	MUMBAI
		SIDDARTH & GAUTAM	FARIDABAD
		MS FITTINGS	KOLKATA
		PRADEEP METALS LTD	MUMBAI
		TUBE PRODUCT INCOROPORATION	BARODA
24	FLANGES (SS/CS)		
		PRADEEP METALS LTD	MUMBAI
		TUBE PRODUCT INCOROPORATION	BARODA
		MS FITTINGS AND FLANGES	KOLKATA
		HAWA ENGINEERING	
		ALIANCE PIPE & PLANGES	KOLKATA
		JAI AMBE	MUMBAI
25	PIPE (CPVC)		
		GEROGE FISHCHER IPING SYSTEMS PVT LTD	DELHI
		ASTROL PLYTECHINC LTD	AHMEDABAD
26	VALVES (GATE/GLOBE/NRV/BALL) -CPVC		
		GEROGE FISHCHER IPING SYSTEMS PVT LTD	DELHI
		ASTROL PLYTECHINC LTD	AHMEDABAD
27	Rubber Lining for Pipes/Tanks		
		Rishi Indutries	Sonepet
		Industrial Lining Ltd	Baroda
		MIL	CHENNAI
28	FILTER MEDIA		
		GLOBAL ABSORBENT	KOLKATA
		BHARAT MINERALS	
29	FLASH MISER		
		GEO MILLER	
		VOLTAS	
		EIMCO KCP	
		REMI	
30	CLARIFLOCCULATOR		
		TRIVENI	
		GEO MILLER	
		VOLTAS	
		EIMCO KCP	
31	LT MOTORS		
		KEC	BANGALORE

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		SIEMENS	MUMBAI
		ABB	FARIDABAD
		CROMPTON GREAVES LTD	MUMBAI
		BHARAT BIJLEE	MUMBAI
		NGEF	BANGALORE
32	FUSES		
		INDO ASIAN	
33	PUSH BUTTONS		
		BCH	
		CONTROL & SWITCHGEAR.	
		CANDS	
		L&T	
		SIEMENS	
		GEC	
34	MCB		
		MDS SWITCHGEAR LTD.	
		INDO ASIAN	
		S&S	
		POWER SWITCHGEAR LTD	
35	CONTROL SWITCHES		
		ALSTOM LTD	
		KAYCEE	
36	PRESSURE GAUGE/DPG		
		AUXIROL	UK
		SWITZER (FOR DP GAUGES)	CHENNAI
		BUDENBURG	UK
		A N INSTRUMENTS	KOLKATA
		BELLS CONTROL	KOLKATA
		MANOMETER INDIA	MUMBAI
		GENERAL INST	MUMBAI/GOA
		GLUCK INDIA	MUMBAI
37	LEVEL GAUGES		
		SIGMA INSTRUMENTS	MUMBAI
		LEVCON	KOLKATA
		SB ELECTROMECHANICAL	PUNE
		BLISS ANAND PVT.LTD.	GURGAON
		CHEMTROLS SAMIL (INDIA) PVT.LTD.	MUMBAI
		TOSHNIWAL BROTHERS (P) LTD.	DELHI
38	LEVEL SWITCHES		
		LEVCON	KOLKATA
		EIP INSTRUMENTS	NOIDA
		EIP BULK CONTROL	DELHI
		SIGMA INSTRUMENTS	MUMBAI
		EIP ENCIRO LEVEL CONTROL	NOIDA
		NIVO CONTROL	INDORE
		E&H	GERMANY
		DEXEL BROOK	USA
		BLISS ANAND PVT.LTD.	GURGAON
		CHEMTROLS SAMIL (INDIA) PVT.LTD.	MUMBAI
		SOR INC.	USA
		WAAREE INSTRUMENTS LIMITED,	MUMBAI
39	DIFF. PRESURE SWITCH		
		INDFOS IND	GHAZIABAD
		BARTON INST. SYSTEM	USA
		SWITZER	CHENNAI
		VASUTECH (VARMA TRAFAG , EXCEPT FOR DIAPH VACCUM TYPE)	REWARI
		SOR	USA
		DRESSER	USA
		KDG	UK
		DELTA CONTROLS	USA
		HERION	GERMANY
		KAUSTUBA UDYOG	PUNE

	TITLE: 1x800 MW WANAKBORI STPP TECHNICAL SPECIFICATION FOR PRE TREATMENT PLANT	SPEC NO: PE-TS-408-158-A001	
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		SWITZER INSTRUMENT LTD.	CHENNAI
		SOR INC.	USA
		VASU TECH LIMITED	DELHI
40	TEMPERATURE GAUGE		
		A N INSTRUMENTS	KOLKATA
		BUDENBURG	UK
		DRESSER INDUSTRIES INC.	USA
		FORBES MARSHALL (HYD) LTD.	HYDRABAD
		GOA INSTRUMENTS INDUSTRIES PVT.LTD	GOA
		H GURE	BANGALORE
		WAREE	MUMBAI
41	TEMPERATURE SWITCH		
		INDFOSS (INDIA) LTD.	GAZIABAD
		DRESSER INDUSTRIES INC.	USA
		SWITZER INSTRUMENT LTD.	CHENNAI
		SOR INC.	USA
		TOSHNIWAL BROTHERS (P) LTD.	DELHI
		VASU TECH LIMITED	DELHI
42	FLOW ELEMENT		
		BRISTOL BABCOCK LTD.	U.K
		BALIGA LIGHTING EQUIPMENTS PRIVATE LIMITED	CHENNAI
		ENGINEERING SPECIALITIES PRIVATE LTD	KOLKATA
		INSTRUMENTATION LTD.	PALAKAD
		MICRO PRECISION PRODUCTS	FARIDABAD
		STAR-MECH CONTROLS (I) PVT.LTD	PUNE
43	TEMPERATURE ELEMENT		
		GENERAL INSTRUMENT CONSORTIUM	DELHI
		DETRIVE INSTN.& ELECTRONICS LTD.	MUMBAI
		TOSHNIWAL BROTHERS (P)LTD.	DELHI
		WAAREE INSTRUMENTS LIMITED	MUMBAI
44	DENSITY INDICATOR		
		EUREKA	PUNE
		SCIENTIFICE DEVICES	THANE
45	FLOW TRANSMITTER		
		EMERSON	DAMAN
		TOKOGAWA	BANLORE
		HONEY WELL	
		ABB	FARIDABAD
46	LEVEL TRANSMITTER		
		BRISTOL BABCOCK LTD.	U.K
		EMERSON	DAMAN
		TOKOGAWA	BANLORE
		HONEY WELL	
		ABB	FARIDABAD
		BIRLA KENTTAYLOR LTD.	HARYANA
		BLISS ANAND PVT.LTD.	GURGAON
		FISHERROSEMOUNT (INDIA) LTD	MUMBAI
		SIEMENS	MUMBAI
		SMART INSTRUMENTS LTD, BRAZIL	MUMBAI
		V.AUTOMAT & INSTS.(P) LTD.	DELHI
47	SILICA ANALYZER		
		HACH	SWITZERLAND
		POLYMETRON	
48	SODIUM ANALYZER		
		HACH	SWITZERLAND
		POLYMETRON	
49	ROTAMETER		
		CHEMTROLS SAMIL (INDIA) PVT.LTD.	MUMBAI
		EUREKA	PUNE
		INSTRUMENTATION ENGINEERS PRIVATE LIMITED	HYDRABAD
		TRANSDUCERS AND CONTROLS PVT. LTD.	HYDRABAD

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		ABB	
50	TURBIDITY METER		
		HACH	
		ABB	
		TOKOGAWA	
		ROSE MOUNT	
51	PH ANALYZER/ TRANSMITTER		
		EMERSON	DAMAN
		TOKOGAWA	BANLORE
		HONEY WELL	
		ABB	FARIDABAD
		HACH	SWITZERLAND
52	SOLENOID VALVE		
		ROTEX	VITTAL UDYOG NAGAR
53	LIMIT SWITCHES		
		SIEMENS	MUMBAI
		HONEY WELL	
54	LOCAL CONTROL PANEL	INDSUSTRIAL SWITCHGEAR & CONTROL	MUMBAI
		POSITRONICS	BARODA
		ECS	NOIDA
		SWITCHING CIRCUIT	KOLKATA
		CONTROL & SCHEMATICS	HYDRABAD
		GE POWER	BANGLORE
		SIEMENS	KOLKATA
		C&S	NOIDA
		PYROTECH	UDAIPUR
		DELTA CONTROL	MUMBAI
		L&T	MUMBAI
55	INST CABLES (SCREENED CABLES)	RELIANCE	BANGLORE
		DELTON	FARIDABAD/NEW DELHI
		NICCO	KOLKATA
		CCI	MUMBAI
		UNIVERSAL	SATNA
56	CONTORL CABLES	DELTON	FARIDABAD/NEW DELHI
		FINOLEX	PUNE
57	POWER CABLES (LT CABLES)	CCI	MUMBAI
		NICCO	KOLKATA
		UNIVERSAL	SATNA
		IACL (HVPL)	NEW DELHI
		FGI	KOLKATA
		FINOLEX	PUNE
		INDUSTRIAL CABLE	RAJPURA
58	PAINT		
		BERGER	
		ASIAN PAINTS	
		SHALIMAR	
		J&N	

Notes:-

- All the finally selected sub vendors shall be subject to customer approval during detailed engineering without any delivery/ commercial implications to BHEL/ CUSTOMER.
- This vendor list applicable for Mechanical, electrical and C&I items.



**1x800 MW WANAKBORI STPP
TECHNICAL SPECIFICATION FOR
PRE TREATMENT PLANT**

SPECIFICATION NO. PE-TS-408-158-A001

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SHEET

**ANNEXURE-II
MANDATORY SPARE LIST**

	TITLE: 1x800 MW WANAKBORI STPP TECHNICAL SPECIFICATION FOR PRE TREATMENT PLANT	SPEC NO: PE-TS-408-158-A001	
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LIST OF MANDATORY SPARES ANNEXURE-II

SL. No.	Equipment / Package name	Qty.	Remarks (BHEL)
	PRETREATMENT PLANT		
1	SPARES FOR HORIZONTAL CENTRIFUGAL PUMPS	For each service	
1.1	Shaft	1 No.	
1.2	Shaft Sleeve	2 Nos.	
1.3	Impeller	1 No.	
1.4	Impeller locking nut and bolt	4 Nos.	
1.5	Impeller wear ring	4 Nos.	
1.6	Casing wear ring	4 Nos.	
1.7	Oil Seal	4 Nos.	
1.8	Oil Deflector	3 Nos.	
1.9	Oil Ring	3 Nos.	
1.10	Gland Packing	400%	
1.11	Lantern Ring	3 Nos.	
1.12	Mech Seal Assembly	1 No.	
1.13	Stationary/Carbon Packing and "O" Ring for Mechanical Seal	3 Sets	
1.14	Oil Level Gauge	3 Nos.	
1.15	Coupling	2 Nos.	
1.16	Rubber Bush for Coupling	2 Nos.	
1.17	"O" Rings	2 Sets	
1.18	Suction Strainers Element	3 Nos.	
1.19	Bearing for Pump Motor	2 Sets	
2	SPARES FOR VERTICAL TYPE CENTRIFUGAL PUMPS (AT CLARIFIED WATER PUMP HOUSE & AT SLUDGE PIT)	For each service	
2.1	Complete Bowl assembly	1 Set	
2.2	Impeller (s)	1 Set	
2.3	Shafts	1 Set	
2.4	Casing wearing (s)	1 Set	
2.5	Impeller wear ring (s)	1 Set	
2.6	Shaft Sleeves	2 Set.	
2.7	Shaft Couplings	1 Set	
2.8	Shaft nuts & keys	1set.	
2.9	Lantern rings	1 Set	
2.10	Bell mouth liner	1 Set	
2.11	Bearings	1 Set	
2.12	Pump motor coupling	1 Set	
3	SPARES FOR SOLID CONTACT CLARIFIERS	For each service	
3.1	Floculator Assembly	1 Set.	
3.2	Gear box for Floculator Driver	1 Set	

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3.3	Gear box for Flocculator Driven	1 Set	
3.4	Gear box for Rail drum drive	1 Set	
3.5	Oil seals for all type of gear box	5 Sets	
3.6	Worm wheel	1Set for each type	
3.7	Worm wheel worm shaft	1Set for each type	
3.8	Coupling complete set	1Set for each type	
4	SPARES FOR AGITATORS	For each service	
4.1	Gear Box Unit Complete	1 No.	
4.2	Bearing for Gear Box Unit	1 Set	
4.3	Coupling complete (Motor/Gear box and gear box/agitator)	1 Set	
4.4	Coupling Bolts	1 Set	
4.5	Coupling shim pack (if applicable)	4 Sets	
4.6	Oil seals	4 Sets	
5	SPARES FOR VALVES	For each service	
5.1	i) Manual Diaphragm valves	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.	
	ii) Spare Diaphragm for above	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.	
	iii) Diaphragm	10% of total quantity used for each type and size with minimum no. one (1) for each type and size.	
5.2	i) Non return valves (NRV)	2 nos. of each size & type	
	ii) Flaps for above NRV	2 nos. of each size	
5.3	Gate / Globe / Ball / Plug valve/needle valve		
	i) Upto 4"	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.	
	ii) Above 4"	1 no. each type and size.	
5.4	Butter fly valve		
	i) Upto 4"	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.	
	ii) Above 4"	1 no. each type and size	
6.0	UPS (For BOP systems)		
6.1	Fuse	3 (Three) times of total quantity of each type of fuses used in the system (for all BOP systems).	
6.2	SCR	10% of total quantity of each type used in the system or minimum 2(two) nos. whichever is more.	Not applicable.
6.3	Diode	10% of total quantity of each type used in the system or minimum 2(two) nos. whichever is more.	
6.4	IGBT	2 (two) nos.	
6.5	Electronic Module/ PCB		

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6.5.1	Static Switch	1 (one) no. each type of Electronic Card/ PCB/ modules used in the system	
6.5.2	Inverter	1 (one) no. each type of Electronic Card/ PCB/ modules used in the system	
6.5.3	Static voltage Regulator	1 (one) no. each type of Electronic Card/ PCB/ modules used in the system	
6.5.4	Charger	1 (one) no. each type of Electronic Card/ PCB/ modules used in the system	
6.5.5	UPS of 2 KVA rating or below.	One Complete set.	Not applicable.
6.5.6	Selector Switch	1 (one) no. each type	
6.5.7	Digital Voltage/ Current Indicator (LCD type)	1 (one) no. each type	
6.5.8	Indication Lamp- Complete assembly (Red/ Green colour)	1 (one) no. each type	
6.5.9	Cooling Fan - 240 VAC supply	1 (one) no. each type	
6.6	UPS Battery		
6.6.1	Battery Cell (Uncharged, Dry)	10% of total quantity of each BOP UPS.	
6.6.2	Inter connecting cell strips	10 nos.	
6.6.3	Rubber gloves	1 pair	
6.6.4	Voltmeter for measuring cell voltage (Center zero type)	1 no.	
6.6.5	Apron & Goggles	1 set	
6.6.6	Cell lifting puller	1 no.	
6.6.7	Insulated socket spanner with handle	1 no.	
6.6.8	Terminal screw with bellaville washer	10% of total quantity used	
6.6.9	Thermometer	1 no.	
7.0	415 Volt Motor (above 30KW Rating upto 160KW)		
7.1	End Shield Cover Driving & Non-Driving End	1Set for each type and rating of Motor	
7.2	Driving End & Non-Driving End Bearing	1Set for each type and rating of Motor	
7.3	Cooling Fan	1No. for each type and rating of Motor	
7.4	Motor Space Heater	1No. for each type and rating of Motor	
7.5	Motor Terminal Block	1No. for each type and rating of Motor	
7.6	Complete Set of Coupling	1Set for each Application	
8.0	415 Volt Motor (Upto 30KW Rating)		
8.1	Driving End & Non-Driving End Bearing	3Set for each type and rating of Motor	
8.2	Cooling Fan	2No. for each type and rating of Motor	
8.3	Motor Terminal Block	5No. for each type and rating of Motor	
8.4	Complete Set of Coupling	1Set for each Application	
9.0	Field Instruments (Transmitters/temperature elements (TC / RTD) / Gauges / Switches etc. along with relevant accessories)		
9.1	10 (ten) percent of total of each type or at least one (whichever is higher) of each type along with accessories.		

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10.0	Control System (DCS, PLC etc.)		
10.1	2 (two) numbers each of keyboard and cursor control devices.		
10.2	2 (two) numbers of LCD TFT (24") Monitors.		
10.3	10 (ten) sets of spare interface cables with connecting plugs for each type of peripherals & I / O hardware.		
10.4	10 (ten) percent of power supply modules of the total qty. offered for each type or 4 (four) numbers, whichever is higher.		
10.5	10 (ten) percent of the total qty. offered for each type of electronic modules (I / O) or 5 (five) numbers of each electronic type of module, whichever is higher.		
10.6	10 (ten) percent of total bus couplers and communication interface cards of each type or 2 (two) numbers of bus couplers and communication interface cards whichever is higher.		
10.7	Controllers for DCS,Control panel ST,Boiler control system,Balance of plant system,PLC system/Sub-systems 10%of each type(at least 1 no. of each type) whichever is higher.		
11.0	Control Valves		
11.1	2 (two) sets of spare control valve stem packing for each of the control valves, as offered.		
11.2	1 (one) set of spare valve trim (including cage, plug, stem, seat rings, guide bushings etc.) for both the units for each of the control valves, as offered.		
12.0	Actuators		
12.1	1 (one) set of spare actuators with drive of each type and rating.		
12.2	10 (ten) percent of valve positioners of each type.		
12.3	10 (ten) percent of position transmitters of each type.		
12.4	10 (ten) percent of limit switches/torque switches of each type.		

Note: **Only applicable items shall be considered. Applicable items are those which are installed in the system.**



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ANNEXURE-III

**PAINTING & COLOUR SCHEME
(REFER SECTION C2 B)**



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ANNEXURE-IV

LIST OF TOOLS & TACKLES

Bidder to consider necessary tools and tackles for mechanical, electrical and control & instrument as per their system requirement. In addition bidder to adhere relevant clauses of tender specification also. List of tools and tackles to be furnish by bidder during bid submission.



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**ANNEXURE-V
CLARIFIED WATER ANALYSIS
VOID**



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ANNEXURE-VI

DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE



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DRAWING/DOCUMENT SUBMISSION PROCEDURE (ANNEXURE-VI)

SL NO	DESCRIPTION	GSECL BARODA	GSECL WANAKBORI	DCPL KOLKATA	BHEL SITE	BHEL PEM
1	Correspondence- Technical					
	Vendor to BHEL	3+SC	3+SC	3+SC	3+SC	3+SC
2	Correspondence- Commercial					
	Vendor to BHEL	3+SC	3+SC	3+SC	3+SC	3+SC
3	Drawing/Document for approval					
	Vendor to BHEL	3+SC	3+SC	3+SC	--	5+SC
4	Drawing/Document (approved)					
	Vendor to BHEL	3+SC	3+SC	3+SC	3+SC	1+SC
5	Inspection/Test report					
	Vendor to BHEL	1+SC	1+SC	1+SC	1+SC	1+SC
6	O&M Manual					
	Vendor to BHEL	3+SC+CD	2+SC+CD	2+SC+CD	5+SC+CD	1+SC+CD
7	Final approved drawing/document (as built)	3+SC+CD	2+SC+CD	2+SC+CD	5+SC+CD	1+SC+CD

Note-1: SC: Soft copy, CD-Compact Disc.

Note-2: All soft copy (Autocad/EXCEL/Microsoft Word/Stad/etc) document shall be submitted by bidder whenever required by BHEL/Customer/Consultant.



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**ANNEXURE-VII
QUALITY PLAN**



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Tests		Material Test	WPS/PQR/Welder Qualification	DPT/MPI	UT	RT	Hydraulic / Water Fill	Balancing	Type test	Performance Test	All test as per relevant Std/ Appd. Data Sheets	Visual & Dimension	Remarks
Items / Components													
A	Centrifugal pumps												LEGENDS: 1 As per AWWA C 504 2 One per heat/heat treatment batch. 3 On machined surface only. 4 Only DPT on root run after back gauging and finish weld. 5 For shaft ≥ 50 mm 6 For plates ≥ 25mm 7 For pipes weld thickness ≥20mm 8 As per HIS, USA 9 Void 10 On welds for dished ends manufactured with plates having weld joint. On vessel/tank as per design code. 11 Seat leakage test for actuator-operated valves shall be checked for seat leakage by closing the valve with actuator. 12 Pipes and fittings for rubber lining shall be free from internal weld bead.
I	Casing	Y2	-	Y ³	-	-	Y	-	-	-	-	Y	
II	Impeller	Y2	-	Y ³	-	-	-	Y	-	-	-	Y	
III	Shaft	Y2	-	Y ³	Y ⁵	-	-	-	-	-	-	Y	
IV	Fabricated components	Y	Y	Y ³	-	-	Y	-	-	-	-	Y	
V	Assembled Pumps	-	-	-	-	-	-	-	-	Y8	-	-	
B	Tanks & vessels	Y	Y	Y ⁴	Y ⁶	Y ¹⁰	Y	-	-	-	Y	Y	
C	R&W pipes	Y	Y	Y ⁴	-	Y ⁷	Y	-	-	-	Y	Y	
D	RE joint	Y	-	-	-	-	Y	-	-	Y	-	Y	
E	Rubber lining	Y	-	-	-	-	-	-	-	-	Y	Y	
F	Pipes & Fittings	Y ²	Y	-	-	-	Y	-	-	-	-	Y ¹ ₂	
G	Gear box	Y	-	Y	Y	-	-	-	-	Y	Y	Y	
H	Gate/Globe/ Check valve	Y	-	Y	-	-	Y ₁ 1	-	-	-	Y	Y	
NOTE-1: - The above are minimum quality checks to be carried out at manufacturers works. The detailed quality plan based on above is to be developed by the main vendor incorporating witness stage for approval by BHEL/Customer. NOTE-2: Butt welds, if any on-dished ends, shall be radio graphed after dishing. All dished ends for pressure vessels shall be stress relieved after dishing. NOTE-3: Also refer data sheet-A for inspection for testing.													



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ANNEXURE-VIII

**MASTER DRAWING LIST WITH SCHEDULE OF
SUBMISSION**



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SL NO.	DOCUMENT / DRAWING NO.	DRAWING / DOCUMENT TITLE	SCHEDULE OF SUBMISSION IN WEEKS
1.	PE-V0-408-158-A001	P&I DIAGRAM FOR PT PLANT	4
2.	PE-V0-408-158-A002	LAYOUT FOR PT LANT	4
3.	PE-V0-408-158-A003	HYDRAULIC FLOW DIAGRAM & HYDRAULIC LEVEL CALCULATIONS	4
4.	PE-V0-408-158-A004	PROCESS SIZING CALCULATION	4
5.	PE-V0-408-158-A005	PRESSURE DROP CALCULATIONS	6
6.	PE-V0-408-158-A006	SUB VENDOR LIST AND INSPECTION CATEGORY	4
7.	PE-V0-408-158-A007	CONTROL PHILOSOPHY	4
8.	PE-V0-408-158-A008	TECHNICAL DATA SHEET FOR HORIZONTAL / VERTICAL CENTRIFUGAL PUMPS	6
9.	PE-V0-408-158-A009	QAP FOR HORIZONTAL / VERTICAL CENTRIFUGALPUMPS WITH MOTOR	6
10	PE-V0-408-158-A010	TECHNICAL DATA SHEET FOR METERING PUMPS	6
11	PE-V0-408-158-A011	QAP FOR METERING PUMPS WITH MOTOR	6
12	PE-V0-408-158-A012	TECHNICAL DATA SHEET FOR BLOWERS	6
13	PE-V0-408-158-A013	QAP FOR BLOWERS WITH MOTOR	8
14	PE-V0-408-158-A014	TECHNICAL DATASHEET FOR BALL VALVES	8
15	PE-V0-408-158-A015	TECHNICAL DATASHEET FOR BUTTERFLY VALVES	8
16	PE-V0-408-158-A016	TECHNICAL DATASHEET FOR DIAPHRAGM VALVES	8
17	PE-V0-408-158-A017	TECHNICAL DATASHEET FOR GATE VALVES	8
18	PE-V0-408-158-A018	TECHNICAL DATASHEET FOR NON RETURN VALVES	8
19	PE-V0-408-158-A019	TECHNICAL DATASHEET FOR SOLENOID VALVES	8
20	PE-V0-408-158-A020	QAP FOR VALVES	10
21	PE-V0-408-158-A021	VALVE SCHEDULE	6
22	PE-V0-408-158-A022	PIPING LAYOUT FOR PT PLANT	10
23	PE-V0-408-158-A023	PIPING SUPPORT DRAWING FOR PT PLANT	12
24	PE-V0-408-158-A024	PIPING SPECIFICATION	12
25	PE-V0-408-158-A026	TECHNICAL DATA SHEET FOR AGITATOR	12
26	PE-V0-408-158-A027	TECHNICAL DATA SHEET HOIST, WEIGHING SCALE , CHAIN PULLEY BLOCK	12
27	PE-V0-408-158-A028	MECH. GA FOR CASCADE AERATOR, STILLING CHAMBER, FLASH MIXER AND PARSHALL FLUME FOR CLARIFIER	12
28	PE-V0-408-158-A029	MECH. GA FOR STILLING CHAMBER, FLASH MIXER AND PARSHALL FLUME FOR DM CLARIFIER	12



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29	PE-V0-408-158-A030	MECH. GA FOR CLARIFIER	12
30	PE-V0-408-158-A033	MECH. GA AND DATA SHEET FOR CLARIFIER BRIDGE MECHANISM	12
31	PE-V0-408-158-A035	MECH. GA FOR CHEMICAL HOUSE INCLUDING ALL DOSING TANKS	12
32	PE-V0-408-158-A036	MECH. GA FOR SLUDGE SUMP	12
33	PE-V0-408-158-A039	MECHANICAL GA FOR TRENCHES, PIPE SUPPORTS PEDESTALS AND FOR ANCHOR PLATES	12
34	PE-V0-408-158-A041	QAP for PT PLANT (BALANCE ITEMS)	10
35	PE-V0-408-158-A042	TECHNICAL DATASHEET FOR MOTORS (HORIZONTAL CENTRIFUGAL PUMPS , METERING PUMPS, BLOWERS, AGITATORS)	8
36	PE-V0-408-158-A043	ELECTRICAL LOAD LIST	12
37	PE-V0-408-158-A044	CABLE SCHEDULE & INTERCONNECTION DRG.	12
38	PE-V0-408-158-A045	CABLE TRAY/TRENCH & CONDUIT ROUTING DIAGRAM FOR PTP	14
39	PE-V0-408-158-A046	TECHNICAL DATSHEET AND HOOK UP DRAWING FOR LOCAL INSTRUMENTS	15
40	PE-V0-408-158-A047	TECHNICAL DATSHEET AND HOOK UP DRAWING FOR TRANSMITTERS	15
41	PE-V0-408-158-A048	TECHNICAL DATSHEET AND HOOK UP DRAWING FOR ANALYSERS	15
42	PE-V0-408-158-A049	INSTRUMENT SCHEDULE	10
43	PE-V0-408-158-A050	TECHNICAL DATA SHEET AND GA FOR JUNCTION BOX	15
44	PE-V0-408-158-A051	PLC DOCUMENTS FOR PT PLANT--PLC CONFIGURATION DIAGRAM, DATA SHEET FOR PLC, GA & WIRING DETAILS FOR PLC PANEL, I/O LIST, BOM, MIMIC DIAGRAM, SCADA SCREEN , LIST FOR SIGNALS EXCHANGE WITH DDCMIS (BOTH HARDWIRED & SERIAL INTERFACE IN BHE	16
45	PE-V0-408-158-A052	UPS AND BATTERY SIZING CALCULATION, DATA SHEET AND GA FOR UPS	16
46	PE-V0-408-158-A053	QAP FOR UPS	16
47	PE-V0-408-158-A054	QAP / CHECK LIST FOR ALL INSTRUMENTS	16
48	PE-V0-408-158-A055	QAP AND FAT FOR PLC	16
49	PE-V0-408-158-A056	CIVIL DESIGN BASIS REPORT	18
50	PE-V0-408-158-A057	CIVIL DESIGN CALCULATION FOR STILLING CHAMBER, FLASH MIXER AND PARSHALL FLUME FOR CLARIFIER	18
51	PE-V0-408-158-A058	CIVIL GA FOR STILLING CHAMBER, FLASH MIXER AND PARSHALL FLUME FOR CLARIFIER	18
52	PE-V0-408-158-A059	REINFORCEMENT DRAWING FOR STILLING CHAMBER, FLASH MIXER AND	18



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		PARSHALL FLUME FOR CLARIFIER	
53	PE-V0-408-158-A060	CIVIL DESIGN CALCULATION FOR STILLING CHAMBER, FLASH MIXER AND PARSHALL FLUME FOR DM CLARIFIER	18
54	PE-V0-408-158-A061	CIVIL GA FOR STILLING CHAMBER, FLASH MIXER AND PARSHALL FLUME FOR DM CLARIFIER	18
55	PE-V0-408-158-A062	REINFORCEMENT DRAWING FOR STILLING CHAMBER, FLASH MIXER AND PARSHALL FLUME FOR DM CLARIFIER	20
56	PE-V0-408-158-A063	CIVIL DESIGN CALCULATION FOR CLARIFIER	18
57	PE-V0-408-158-A064	CIVIL GA FOR CLARIFIER	18
58	PE-V0-408-158-A065	REINFORCEMENT DRAWING FOR CLARIFIER	20
59	PE-V0-408-158-A069	CIVIL DESIGN CALCULATION FOR CLARIFIED WATER CHANNEL TO CLARIFIED WATER TANK	18
60	PE-V0-408-158-A070	CIVIL GA FOR CLARIFIED WATER CHANNEL TO CLARIFIED WATER TANK	18
61	PE-V0-408-158-A071	REINFORCEMENT DRAWING FOR CLARIFIED WATER CHANNEL TO CLARIFIED WATER TANK	20
62	PE-V0-408-158-A075	CIVIL DESIGN CALCULATION FOR SLUDGE SUMP	18
63	PE-V0-408-158-A076	CIVIL GA FOR SLUDGE SUMP	18
64	PE-V0-408-158-A077	REINFORCEMENT DRAWING DARWING FOR SLUDGE SUMP	20
65	PE-V0-408-158-A078	ARCHITECTURAL DRAWING FOR CHEMICAL HOUSE (INCLUDING RAW WATER CHLORINATION ROOM).	20
66	PE-V0-408-158-A079	CIVIL DESIGN CALCULATION FOR CHEMICAL HOUSE (INCLUDING RAW WATER CHLORINATION ROOM).	20
67	PE-V0-408-158-A080	CIVIL GA AND REINFORCEMENT DETAILS DARWING FOR CHEMICAL HOUSE (FOOTING, COLUMNS AND PLINTH BEAMS), GROUND FLOOR, FIRST FLOOR BEAM AND SLABS, ROFOR BEAM AND SLABS, STAIRCASE, TOILETS, DOSING TANKS AND OVERHEAD POTABLE WATER RANK (INCLUDING RAW WATER CHLORINATION ROOM).	20
68	PE-V0-408-158-A080	CIVIL GA FOR FOUNDATION FOR RAW WATER CHLORINATION PLANT EQUIPMENT.	20
69	PE-V0-408-158-A081	RCC DETAILS FOR FOUNDATION FOR RAW WATER CHLORINATION PLANT EQUIPMENT.	20
70	PE-V0-408-158-A090	FABRICATION DETAIL DRAWING FOR PUDDLE PIPES	20



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71	PE-V0-408-158-A091	CIVIL GA DRAWING FOR TRENCHES, PIPE SUPPORT PEDESTAL AND FOR ANCHOR PLATES.	18
72	PE-V0-408-158-A092	PAINTING SCHEDULE	8
73	PE-V0-408-158-A094	PG TEST	14
74	PE-V0-408-158-A095	O&M MANUAL COVERING CATALOGUE FOR ALL ITEMS.	24
75	PE-V0-408-158-A096	ENGINEERING BOQ	16

1. A= APPROVAL. I = INFORMATION.

2. Any additional drawings-documents required during detailed engineering stage shall be provided by bidder without any commercial, technical and delivery implication to BHEL and customer.

3. Bidder to note that the successful bidder, during detail engineering, will submit the drg/doc through web based Document Management System in addition to hard copies to be submitted as per the Annexure IV of this specification. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.

- Internet explorer version – Minimum Internet Explorer 7
- Internet speed – 2 mbps (Minimum preferred)
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked
- Vendor's internal proxy setting should not block DMS application's link (<http://124.124.36.198/wrenchwebaccess/login.aspx>)
- DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, commenting and tracking documents on PEM's DMS have been uploaded on PEM internet website (www.bhelpem.com) under the Vendor session.
- For quick access bidder may refer the link <http://bhelpem.com/DMSManuals/DMSManuals.html>



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ANNEXURE-IX

**FORMAT FOR OPERATION AND MAINTENANCE
MANUAL**



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Project name :
Project number :
Package Name :
PO reference :
Document number :
Revision number :

Sl.no. & Sections	Description	Tick (V)if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	COVER PAGE				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	INDEX				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	DESCRIPTION OF PLANT/SYSTEM				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				



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Sl.no. & Sections	Description	Tick (V)if included in Manual			Remarks
		Yes	No	Not Applicable	
3.8	Control philosophy /control write-ups				
4.0	COMMISSIONING ACTIVITIES (IF NOT COVERED IN SEPARATE DOCUMENT I.E. ERECTION MANUAL, COMMISSIONING MANUAL)				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	OPERATION GUIDELINES FOR PLANT PERSONAL/USER/OPERATOR				
5.1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5.2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5.3	Do's & Don't of the equipments.				
5.4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5.5	Parameters to be monitored with normal values and limiting values				
5.6	Trouble shooting with causes and remedial measures				
5.7	Routine operational checks, recommended logs & records				
5.8	Changeover schedule if more than one auxiliary for the same purpose is given				
5.9	Painting requirement and schedule				
5.10	Inspection, repair , Testing and calibration procedures				
6.0	MAINTENANCE GUIDELINES FOR PLANT				



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Sl.no. & Sections	Description	Tick (V)if included in Manual			Remarks
		Yes	No	Not Applicable	
	PERSONAL				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	Statutory and other specific requirements considerations.				
8.0	List of reference documents				
9.0	Binding as per requirement				



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ANNEXURE-X

SITE STORAGE AND PRESERVATION

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHANICAL BOPs

(Doc No: PE-DC-SSG-A001 REV.00)



PROJECT ENGINEERING MANAGEMENT, POWER SECTOR
BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

CONTENT

- 1 SCOPE OF THE DOCUMENT
- 2 PURPOSE OF STORAGE & PRESERVATION
- 3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION
 - a) GENERAL STORAGE REQUIREMENTS
 - b) GENERAL PRESERVATION REQUIREMENTS
 - c) GENERAL INSPECTION REQUIREMENTS
- 4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT
5. CONCLUSION
6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.
11. Following preservatives/preservation methods can be used depending upon type of equipment
 - a. Rust preventive fluid (RPF)
 - b. Rust protective paints
 - c. Tarpaulin covers, in case of outdoor storage
 - d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –
 - Ingress of moisture and corrosion damages.
 - Damage to protective coating.
 - Open ends in pipes, vessels and equipment -
 - In case any open ends are noticed, same shall be capped.
2. Any damages to equipment / materials.
 - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
 - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere. (C)**

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.



ii **Semi-closed storage. (S)**

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.





iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as “scrap yard” slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.



The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H ₂ SO ₄)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self-life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self-life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

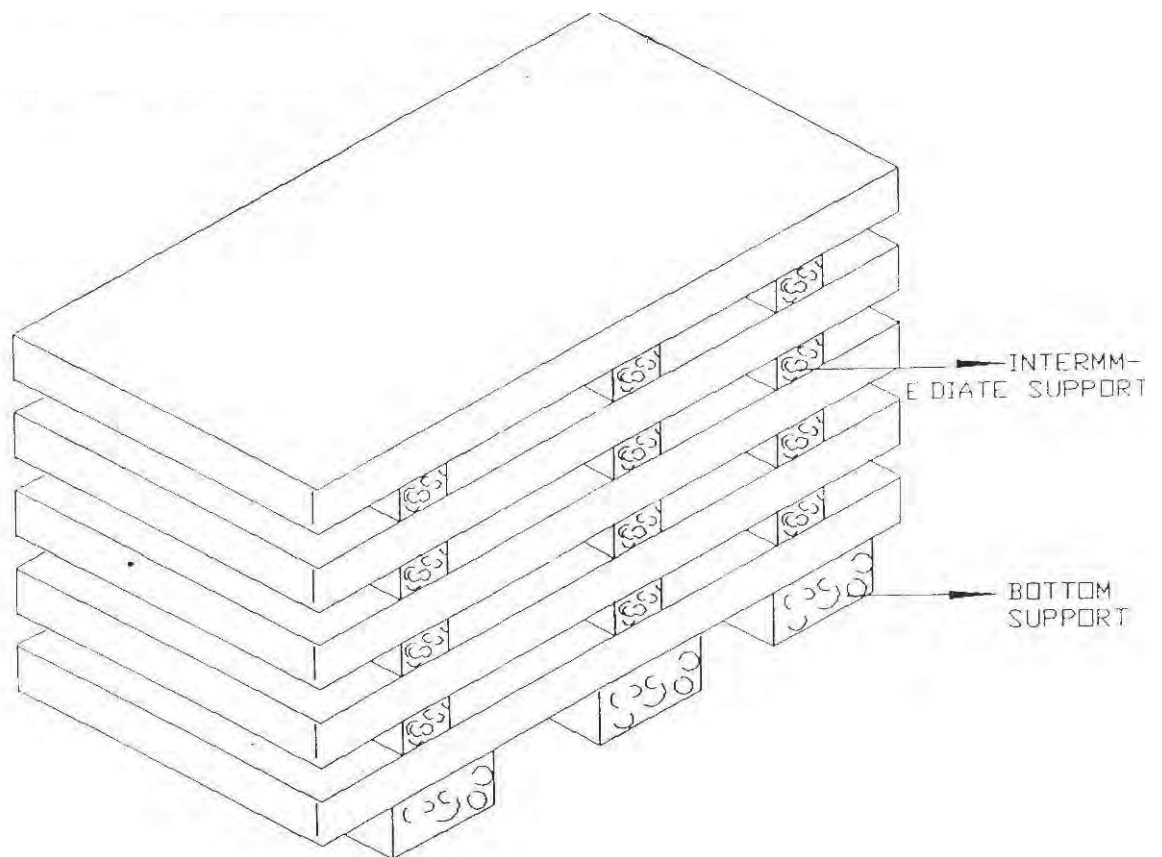


Figure – 1 – PLATE STACKING ARRANGEMENT

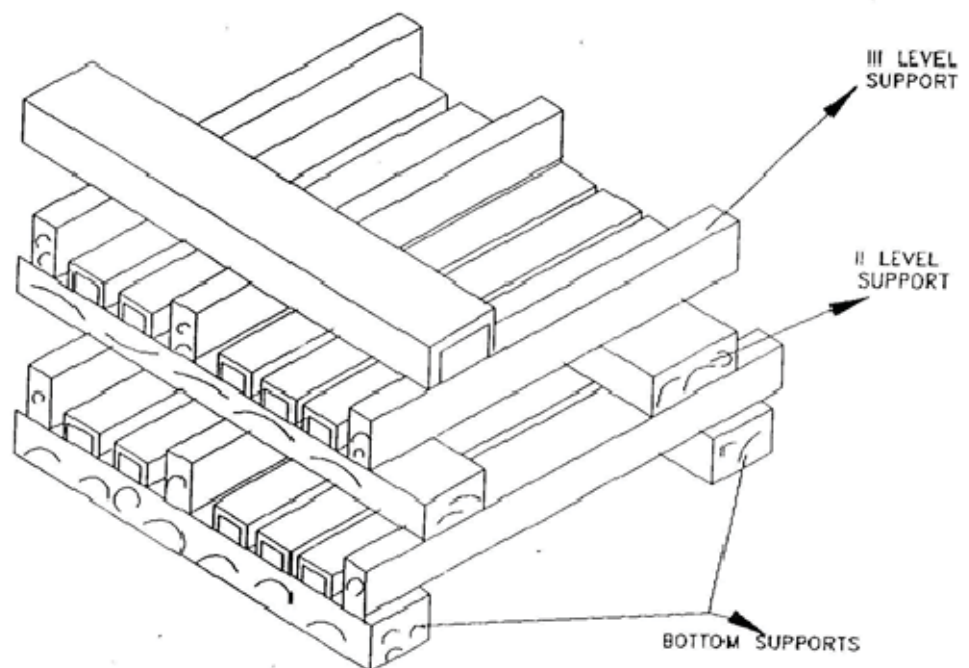


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT



**1x800 MW WANAKBORI STPP
TECHNICAL SPECIFICATION FOR
PRE TREATMENT PLANT**

SPECIFICATION No: PE-TS-408-158-A001

VOLUME : II B

SECTION : E

REV 00

DATE:

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ANNEXURE-XI

PACKING PROCEDURE
(COVERED UNDER SECTION C 2B)

	1x800 MW WANAKBORI STPP		
		VOLUME	
		SECTION	
		REV. NO. 00	DATE : 10.03.2015
		SHEET	OF

KKS PHILOSOPHY



DOCUMENT TITLE

KKS NUMBERING PHILOSOPHY

KKS NUMBERING PHILOSOPHY

For identifying (tagging) an instrument / equipment in Power plant KKS numbering scheme is used. The purpose is to assign a unique number to every equipment in the power plant. For C&I equipment unique number are to be provided up to the signal level so that a unique number Input / Output exist in DCS for every signal.

Normally KKS number is a 10 digit alpha-numeric code and is typically split into the following:

X	X	X	A A Y			Y B B B		
---	---	---	-------	--	--	---------	--	--

First three digits indicate the Sub-System. The Code for the major system are given as per **Annexure-1**.

Fourth and Fifth digits are the **Numerical Keys at System Code Level** and used to distinguish between main systems having same Alpha Codes.

Sixth and Seventh digits are the **Equipment / Apparatus / Measuring Circuit Code**. The code of various Equipment / Apparatus / Measuring Circuit is shown in **Annexure-2**

Eight, Nine and tenth digits are the **Numerical Keys at Equipment / Apparatus / Measuring Circuit Code** and used to distinguish between various instruments in the same sub-group. Numerical keys at System / Equipment / Apparatus / Measuring Circuit is shown in **Annexure-3**.

	DOCUMENT TITLE
	KKS NUMBERING PHILOSOPHY

ANNEXURE-1

List of System / Sub-System Codes used in Power Plant:

- 1) Compressed air system : QEA, QEC
- 2) Ventilation System : SAA TO SAZ
- 3) Fire Detection & Protection System + Fire Water pumps : SGM, SGN, SGO, SGP
- 4) Sewage Treatment : SJA TO SJZ
- 5) Pre-treatment Plant : GBI, GBM, GBV
- 6) RO DM Plant : GCI, GCM, GBV

ANNEXURE-2

Standard Equipment Codes:

AA	Valves including drives, also hand operated
AB	Seclusions, Lock, Gates, Doors
AC	Heat Exchanger
AE	Turning, Driving, Lifting equipment
AF	Continuous conveyors, Feeders
AG	Generator Units
AH	Heating and Cooling Units
AK	Pressing and Packaging equipment
AM	Mixer, Stirrer
AN	Blower, Air Pumps / Fans, Compressor Units
AP	Pump Units
AT	Purification, Drying, Filter
AV	Combustion Equipment e.g. grates

Standard Apparatus Codes:

BB	Vessels and Tank
BF	Foundation
BG	Boiler Heating Surfaces
BN	Injector, Ejector
BP	Flow and throughput limitation equipment (Orifice)
BQ	Holders, Carrying Equipment, Support
BR	Piping, Ducts, Chutes, Compensator
BS	Sound Absorber
BU	Insulations, Sheatings



DOCUMENT TITLE

KKS NUMBERING PHILOSOPHY

Standard Measuring Circuits Codes:

CD	Density
CE	Electrical Quantities
CF	Flow, throughput
CG	Distance, Length, Position
CK	Time
CL	Level
CM	Humidity
CQ	Analysis (SWAS)
CS	Speed, Velocity, Frequency
CT	Temperature
CY	Vibration, Expansion

ANNEXURE-3**Numerical Keys****A) Numerical Keys at System Code Level**

- i) Use 10, 20, 30, ... To distinguish between main systems having same Alpha Codes. Examples:
 - a) Main Steam (Left) and Main Steam (Right)
 - b) BFP – A/B/C
 - c) ID Fan – A/B, FD Fan A/B, AH – A/B
- ii) For branch off from main system path having code say 10, keep the same alpha code and use 11, 12, 13 etc. Similarly for other branch off from main system path having code say 20, keep the same alpha code and use 21, 22, 23 etc and shall carry on further in the same way.
- iii) If the branch off from main system / sub system path is used for some other system, where different alpha codes can be applied, then in that case the said branch line will be designated by the alpha codes of the system to which it is providing the input.

B) Numerical keys at Equipment Code level:

There are three numerical keys available for each type of equipment code. Following has been agreed upon considering present practice, better flexibility and ease in sorting.

- i) Valves and Dampers --- *Equipment Code – AA*

N1N2 N3

DOCUMENT TITLE			
KKS NUMBERING PHILOSOPHY			
			
Motorised (<i>on/off duty</i>)	-	0	01 to 50
Motorised (<i>inching duty</i>)	-	0	51 to 99
Pneumatic (Control)	-	1	01 to 50
Motorised (<i>thyrestor Control</i>)	-	1	51 to 99
Sol. Operated	-	2	01 to 99
(Open / Close duty (Valves, NRVs, Gate)			
Hydraulic	-	3	01 to 99
NRV (Without actuation)	-	4	01 to 99
Manual	-	5	01 to 99
Manual	-	6	01 to 99
Relief & Safety Valves	-	7	01 to 99
Reserve	-	8	01 to 99
Reserve	-	9	01 to 99
ii) Field Instruments			
Field Transmitters & Analog Signals	-	0	01 to 99
Field Switches & Binary Signals	-	1	00 to 99
PG Test Point	-	4	00 to 99
Gauges	-	5	00 to 99
Automatic Turbine Tester (ATT)-HWR	-	2	00 to 99
(Reserved for protection Signals used by Hardwar)			
Example of Numerical Key Usage:			
In line with the philosophy adopted for Valves / Dampers /instruments etc. pumps and fans in the main systems (having different system code) can be numbered as AP/N100 and as AP/N101, 102, ... Where system code is same.			



**1x800 MW WANAKBORI STPP
TECHNICAL SPECIFICATION FOR
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SPECIFICATION No: PE-TS-408-158-A001

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VOLUME III



**1x800 MW WANAKBORI STPP
TECHNICAL SPECIFICATION FOR
PRE TREATMENT PLANT**

SPECIFICATION No: PE-TS-408-158-A001

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**BIDDER SHOULD SUBMIT THE SIGNED AND STAMPED COPY OF THE
FOLLOWING DOCUMENTS:**

1. Compliance cum confirmation certificate
2. Un priced format for main package
3. No deviation certificate
4. Pre bid clarification schedule



**1x800 MW WANAKBORI STPP
TECHNICAL SPECIFICATION FOR
PRE TREATMENT PLANT**

SPECIFICATION No: PE-TS-408-158-A001

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COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing / stamping this compliance certificate (every sheet) and furnish same with the offer.

- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under “exclusion and those resolved as per ‘Schedule of Deviations’, with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the ‘Schedule of Deviations’. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the ‘Schedule of Deviations’
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.
- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer’s decision shall be binding on the bidder whenever the deficiency is pointed out.

For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

- f) The commissioning spares shall be supplied on ‘As Required Basis’ & prices for same included in the base price itself.
- g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.
- h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site



**1x800 MW WANAKBORI STPP
TECHNICAL SPECIFICATION FOR
PRE TREATMENT PLANT**

SPECIFICATION No: PE-TS-408-158-A001

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commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account

- j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's / Customer's / Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.
- k) As built drawings shall be submitted as and when required during the project execution.
- l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.
- m) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.
- n) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.
- o) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.



TITLE:

1x800 MW WANAKBORI STPP
TECHNICAL SPECIFICATION FOR PRE TREATMENT PLANT

SPEC NO: PE-TS-408-158-A001

VOLUME: III

SECTION:3

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DATE:

SCHEDULE OF PRE-BID CLARIFICATION

All clarification from the Technical Specification shall be filled in by the BIDDER clause by clause in this format only.

VOLUME	SECTION	CLAUSE NO.	PAGE NO.	SPECIFICATION REQUIREMENT	CLARIFICATION	REASONS FOR CLARIFICATION

PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE

NAME

TECH SPEC NO.

DESIGNATION

SIGNATURE

DATE

COMPANY SEAL

PE-TS-408-158-A001

BHEL – PS- PEM-PPEI: NOIDA, SECTOR 16A, UP-201301

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DEVIATION SHEET (COST OF WITHDRAWAL)

PROJECT:-1x800 MW WANAKBORI STPP
TECHNICAL SPECIFICATION FOR PRE TREATMENT PLANT
PACKAGE:- PRE TREATMENT PLANT [SECTION-4, VOLUME-III]

TENDER ENQUIRY REFERENCE:-**NAME OF BIDDER:-**

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
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TECHNICAL DEVIATIONS

COMMERCIAL DEVIATIONS

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	DESIGNATIONS	SIGN & DATE	
------	--------------	-------------	--

NOTES:

- For self manufactured items of bidder, cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
- For directly dispatchable items, cost of withdrawal of deviation will be applicable on the basic price including taxes, duties & freight.
- All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
- Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
- Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.
- Bidder shall furnish price copy of above format along with price bid.
- The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
- Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
- For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.
- Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
- All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
- Cost of withdrawal is to be given separately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.
- In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
- In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.



TITLE:

**1x800 MW WANAKBORI STPP
TECHNICAL SPECIFICATION FOR
PRE TREATMENT PLANT**

BHEL DOCUMENTS NO.: PE-TS-408-158-A001

VOLUME **III**

SECTION-5

REV. NO. 00

SUGGESTIVE PRICE FORMAT FOR PRE TREATMENT PLANT FOR 1X800 MW WANAKBORI STPP.

Sl. No.	DESCRIPTION OF EQUIPMENT / ITEM	TOTAL PRICE FOR "FOR" SITE
(1)	(2)	(3)
1.0	Total lump sum firm price on FOR site basis for design, engineering, manufacture, fabrication, assembly, Civil Design, structural and construction works at site for all equipment including road and pathway/walkway, inspection and testing at vendor's & sub-vendor's works, painting, mandatory spares along with spares for erection and commissioning, startup and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling & transportation at site, Erection & Commissioning, trial run, on FOR site basis, preparation & submission of "As Built" drawings, PG test at site and handing over of Pre Treatment Plant as per the details in different sections / volumes of this specification- PE-TS-408-158-A001 as required for safe and trouble free smooth operation for 1X800 MW WANAKBORI STP at Wanakbori, Gujarat.	
	NOTES:	
a	Bidder to note that total price indicated above at 1.0 shall be considered for evaluation and hence should be complete in all respect for the full scope defined and considering all terms and conditions agreed.	
b	In case, price indicated above does not match with item wise break-up given at 2.0, the highest price so calculated shall be considered for evaluation but in case of order, the same shall be placed at the lowest price.	
2.0	BREAK-UP OF PRICES GIVEN IN 1.0 ABOVE	
2.1	Total lump sum price on Design, engineering, manufacture, assembly, tests at manufacturer's works, forwarding, transportation, delivery of entire Pre Treatment Plant to the site including Start up and commissioning spares as required, as defined subsequently complete with all accessories, auxiliaries as specified in Technical specification No. PE-TS-408-158-A001 as required for safe and trouble free smooth operation.	
2.2	Total lump sum price for supply/delivery of mandatory spares as specified in Technical specification No. PE-TS-410-158-A001.	
2.3	Total lump sum price on unloading, handling, storage, and in plant transportation at site, erection, commissioning trial run the entire Pre Treatment Plant, as defined subsequently complete with all accessories, auxiliaries as specified in Technical specification No. PE-TS-408-158-A001 as required for safe and trouble free smooth operation.	
2.4	Total lump sum price on performance guarantee test, and handing over to Purchaser the entire Pre Treatment Plant, as defined subsequently the Pre Treatment Plant and ancillaries as specified in Technical specification No. PE-TS-408-158-A001 as required for safe and trouble free smooth operation.	
2.5	Total lump sum price on Civil Design, structural and construction works at site for all equipment including road and pathway/walkway for the entire Pre Treatment Plant, as defined subsequently the Pre Treatment Plant and ancillaries as specified in Technical specification No. PE-TS-408-158-A001 as required for safe and trouble free smooth operation.	



1x800 MW WANAKBORI STPP
TECHNICAL SPECIFICATION FOR
PRE TREATMENT PLANT

SPECIFICATION No: PE-TS-408-158-A001

VOLUME : III

SECTION : 6

REV 00

DATE:

SHEET

ELECTRICAL LOAD DATA
(REFER SCETION C3)

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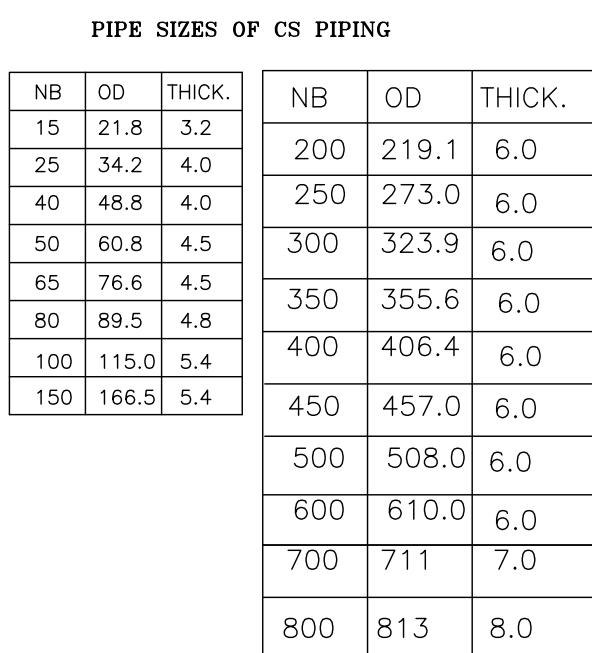
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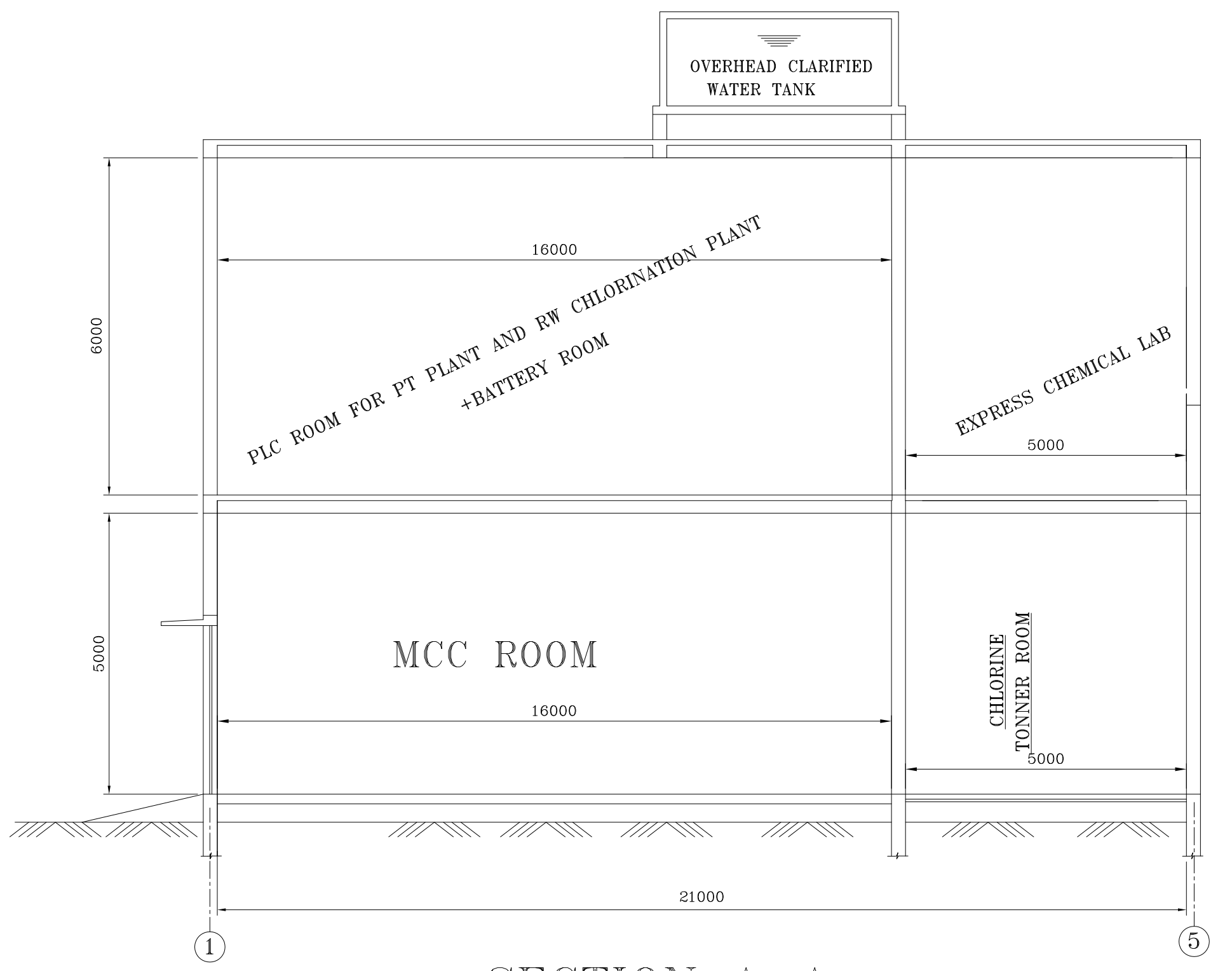
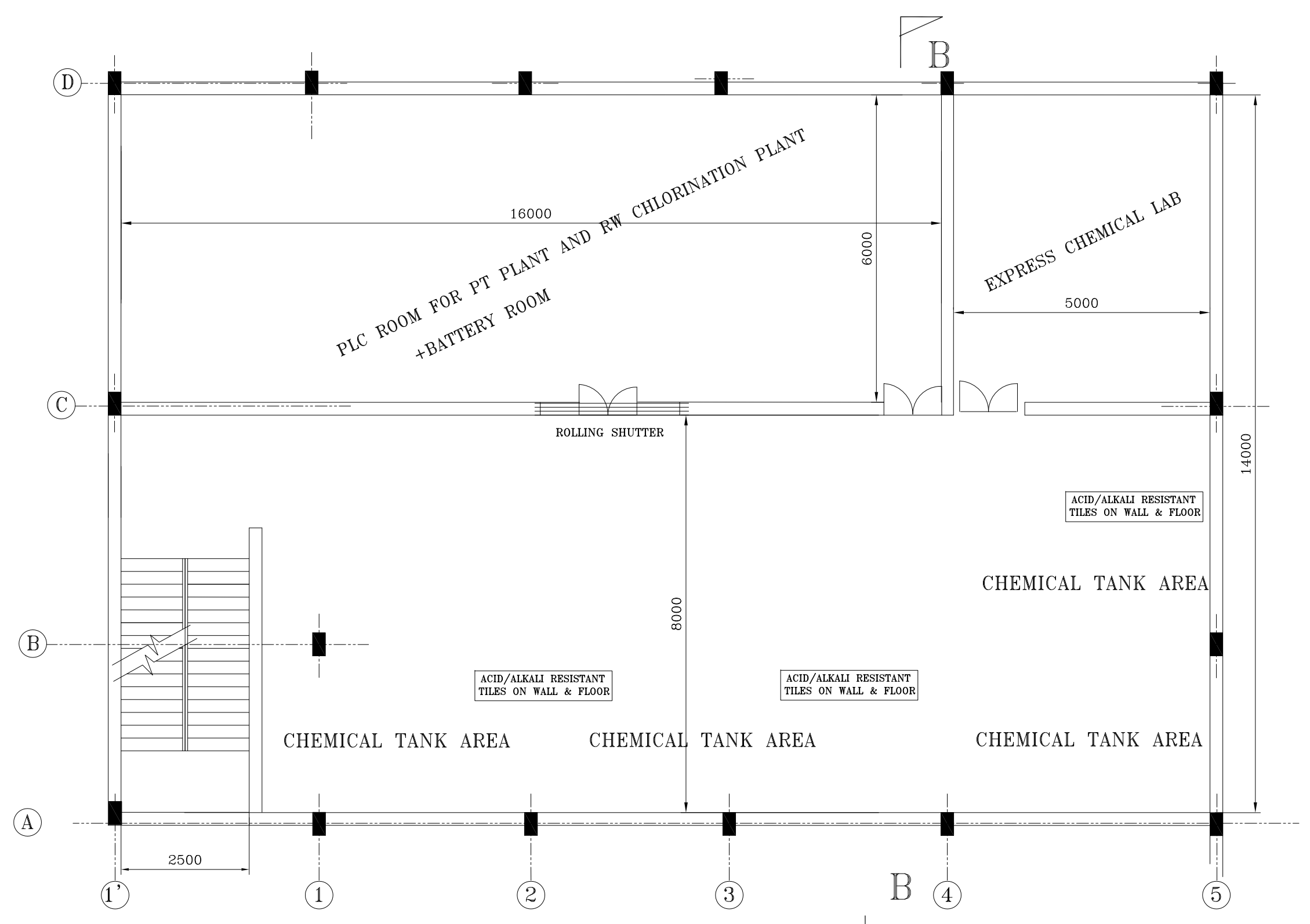
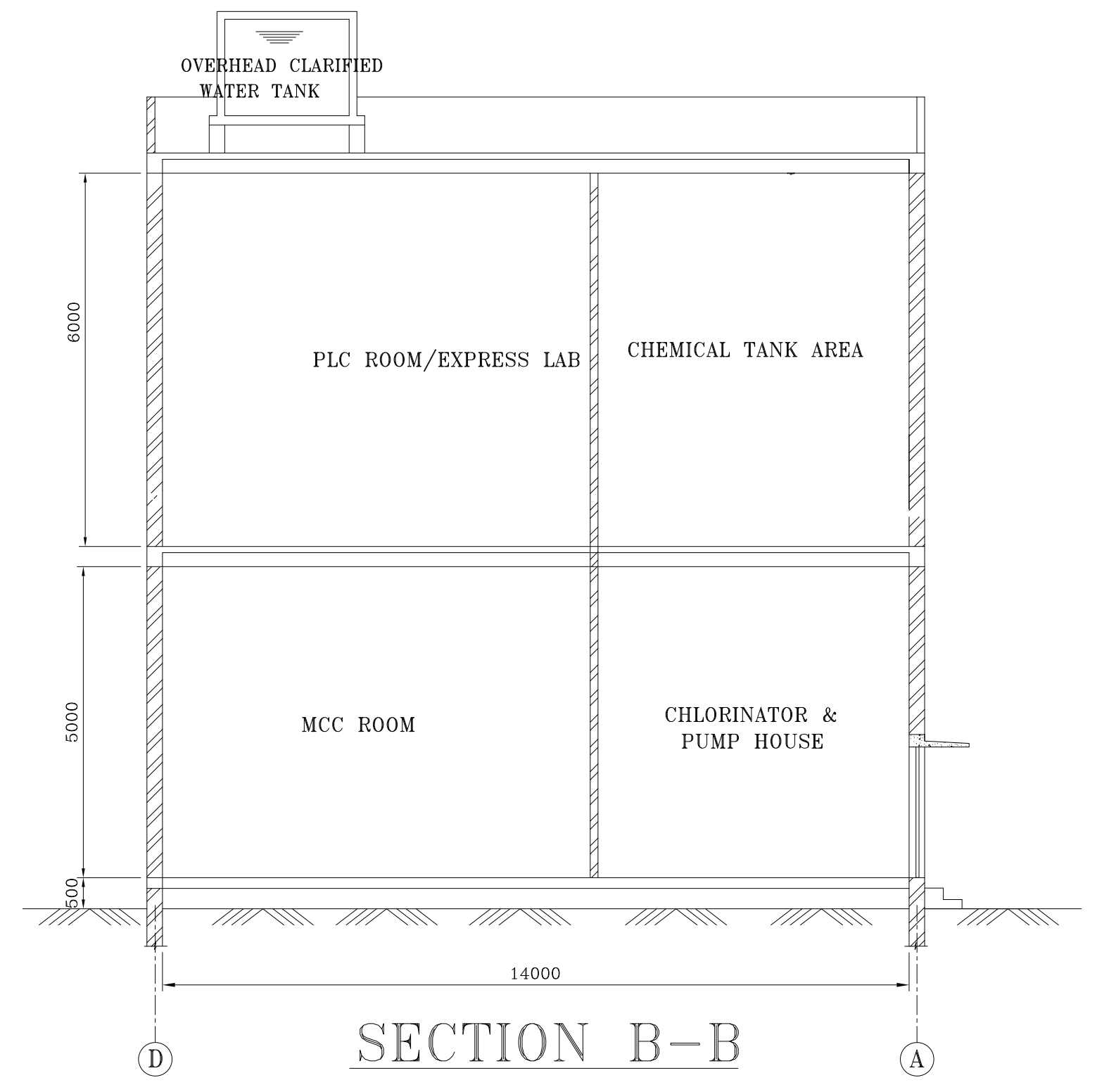
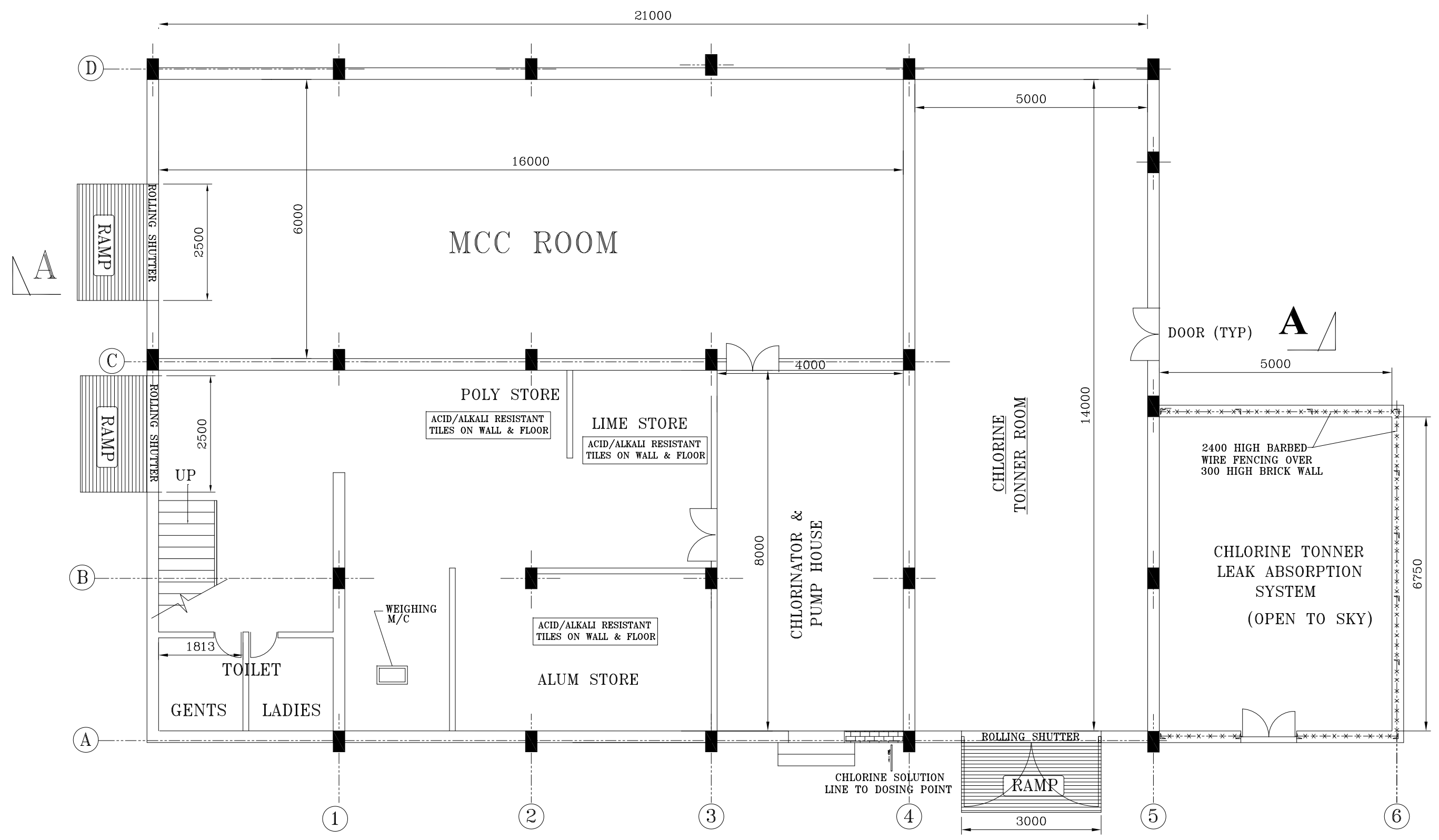
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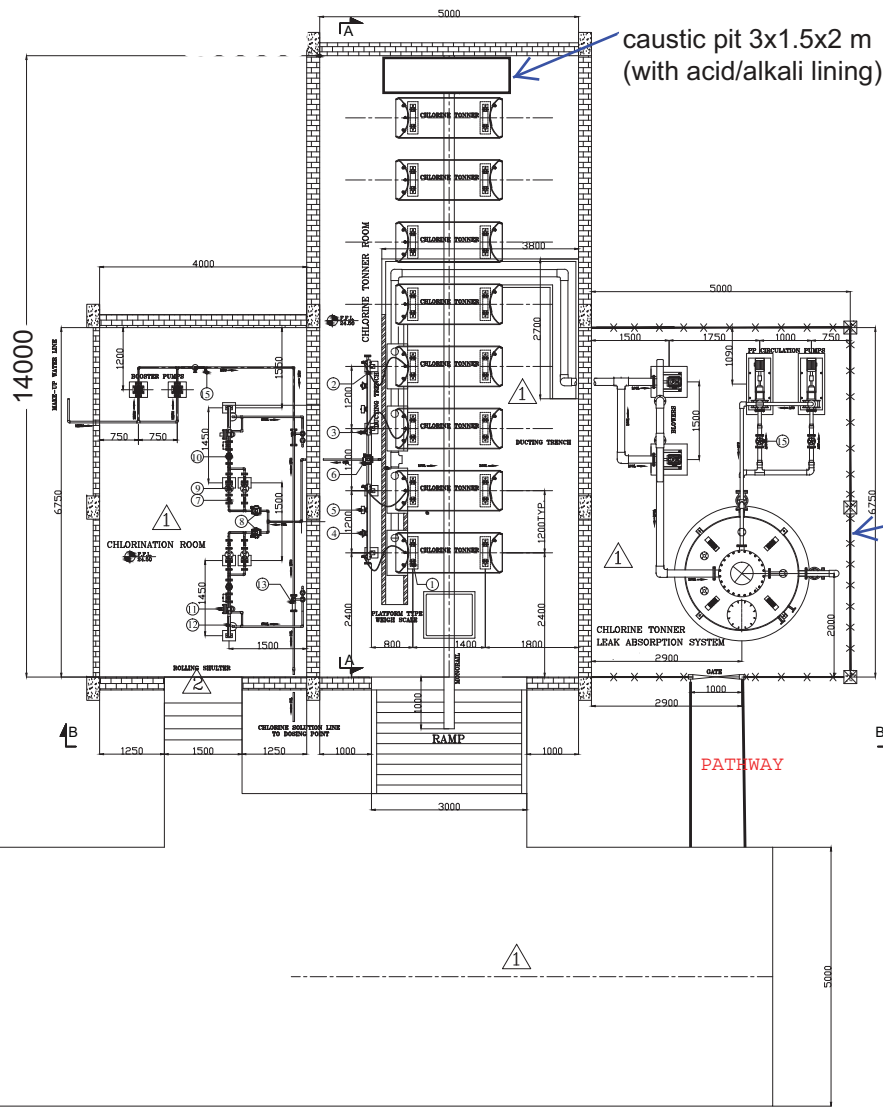


	GUJARAT STATE ELECTRICITY CORPORATION LIMITED									
	VADODARA, GUJARAT									
1x800 MW Wanakbori Thermal Power Station Extn. Unit-8										
	DEVELOPMENT CONSULTANTS PVT. LTD.									
	CONSULTING ENGINEERS									
KOLKATA - MUMBAI - CHENNAI - NEW DELHI										
	BHARAT HEAVY ELECTRICALS LTD.									
	PROJECT ENGINEERING MANAGEMENT									
BHEL SUB VENDORS										
PLANT WATER SYSTEM P&ID										
UNIT :	SCALE :								BHEL DWG. NO. : PE-DG-408-172-17001	REV :
										05

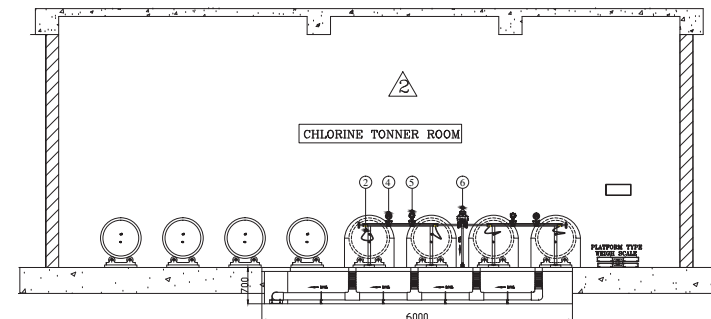


- NOTES:
1. ALL DIMENSIONS ARE IN m.m UNLESS OTHERWISE STATED.
 2. THE SIZE AND DIMENSION SHOWING ARE MINIMUM AND TENTATIVE IN NATURE.

GENERAL ARRANGEMENT OF PT PLANT CHEMICAL HOUSE (INCLUDING RAW WATER CHLORINATION PLANT)
(BHEL DOC NO. PE-DG-408-158-A005)

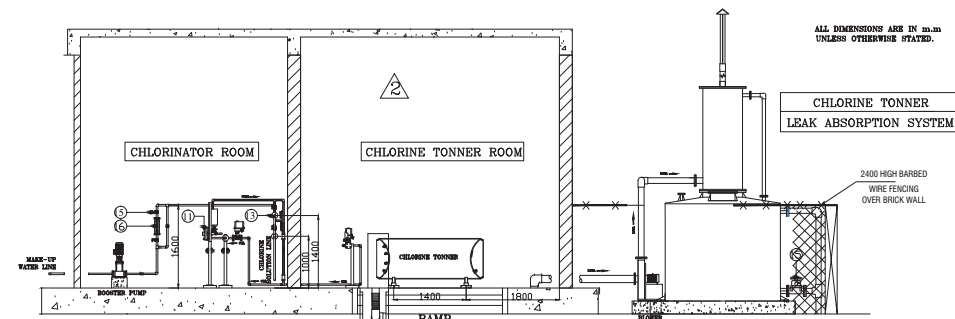


R.W CHLORINATION PLAN



SECTION A-A

2400 MM HEIGHT WIRE
FENCING OVER BRICK WALL



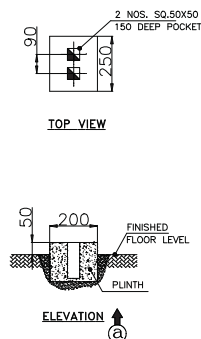
SECTION B-B

LAYOUT AND TENTATIVE CIVIL INPUT FOR RAW
WATER CHLORINATION PLANT

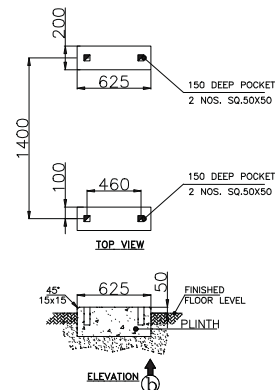
BHEL DOC NO. PE-DG-408-158-A006

LIST OF ITEMS	
S.No.	DESCRIPTION OF ITEMS
1	TONNER ROLLER SUPPORT
2	COILED COPPER TUBE
3	CHLORINE VALVE
4	PRESSURE GAUGE WITH ISOLATION VALVE
5	PRESSURE SWITCH WITH ISOLATION VALVE
6	AUTO CHANGE OVER VALVE
7	BALL VALVE
8	AUTO SHUT OFF VALVE
9	GAS FILTER
10	PRESSURE REDUCING VALVE
11	AUTOMATIC VACUUM REGULATOR
12	CHLORINATOR CABINET
13	INJECTOR
14	GATE VALVE
15	DIAPHRAGM VALVE
16	FLOW INDICATOR

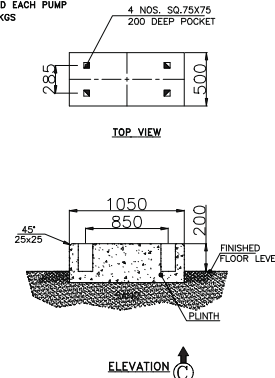
FOUNDATION DETAILS FOR -(P1)
TONNER MANI FOLD FRAME SUPPORT (EACH)
APPROX-LOAD WEIGHT 50Kgs



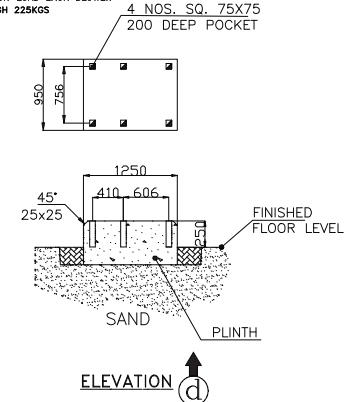
FOUNDATION DETAILS FOR -(P2)
TONNER ROLLER SUPPORT (EACH)
APPROX-LOAD WEIGHT 1.8TONS



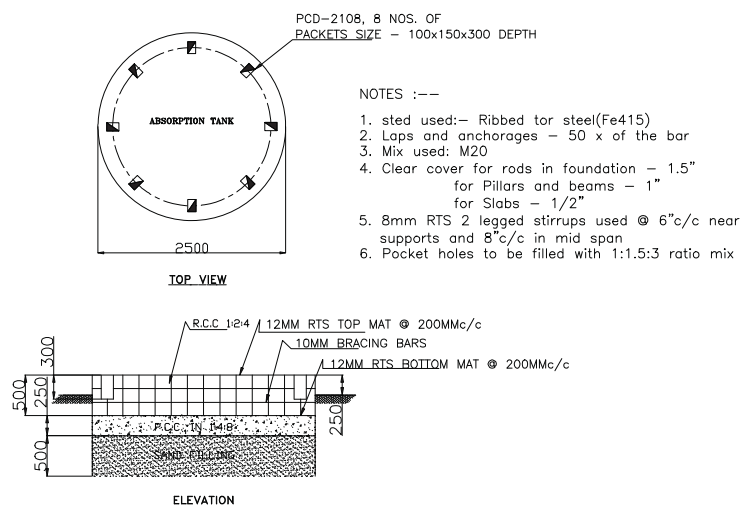
FOUNDATION DETAILS FOR -(P3)
PP CIRCULATION PUMP (EACH)
APPROX-LOAD EACH PUMP
WEIGH 175KGS



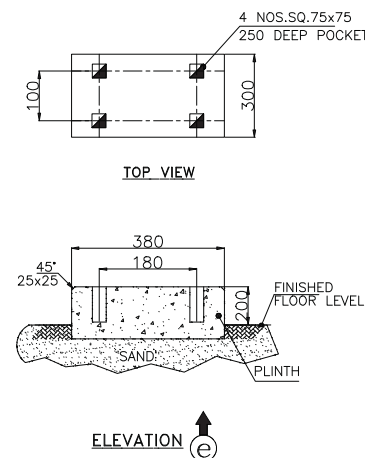
FOUNDATION DETAILS FOR -(P4)
BLOWER (EACH)
APPROX-LOAD EACH BLOWER
WEIGH 225KGS



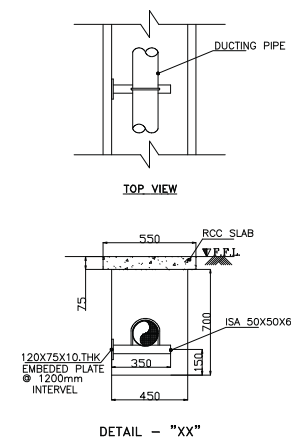
FOUNDATION DETAILS FOR
ABSORPTION TANK 7KL
APPROX-LOAD WEIGHT (TOWER & INCLUDING CHEMICAL) - 14TONS.



FOUNDATION DETAILS FOR - (P5)
BOOSTER PUMP (EACH)
APPROX-LOAD WEIGHT 35Kgs.



DUCTING TRENCH DETAIL

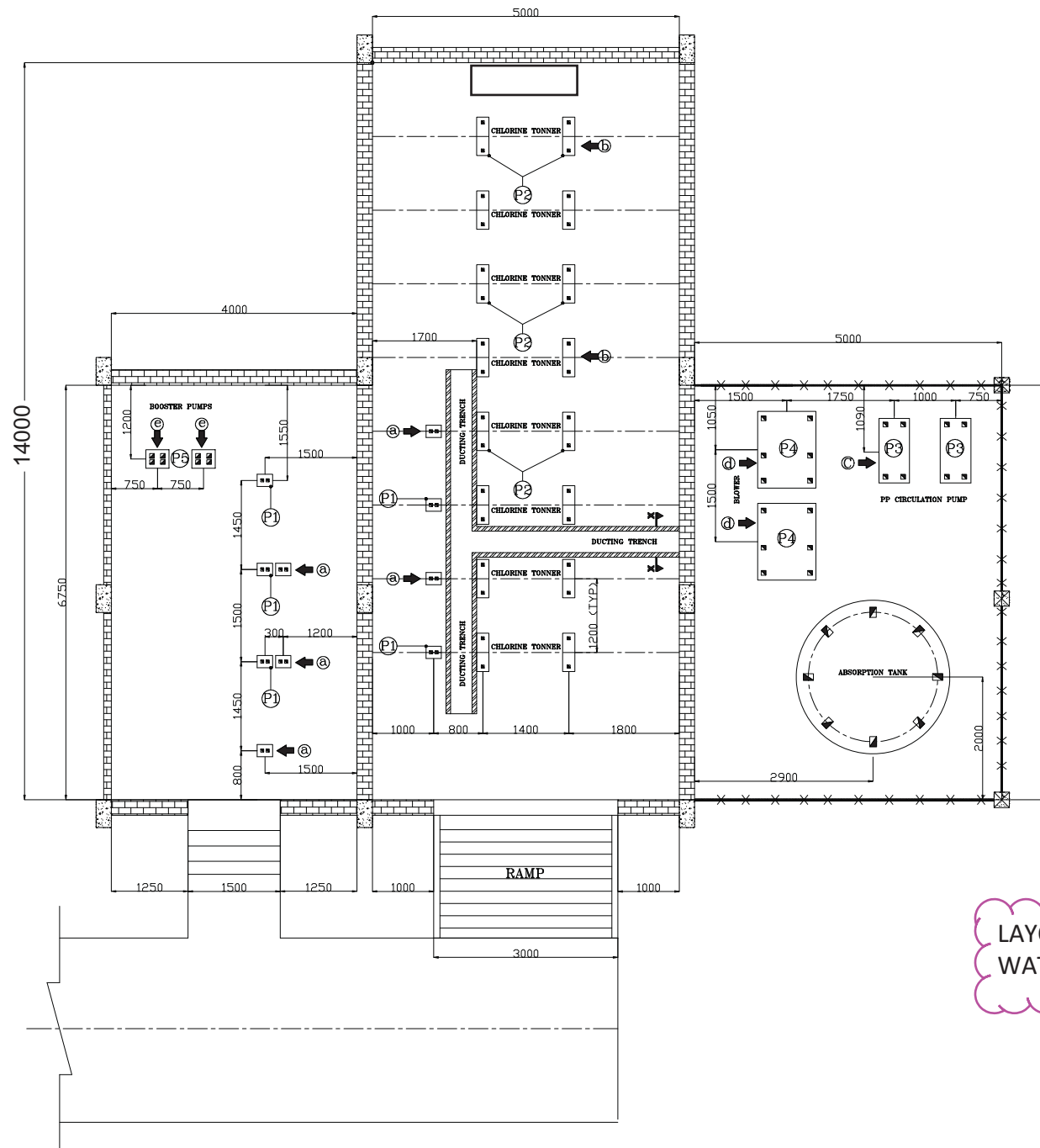


SCHEDULE OF PEDESTAL(P)

TYPE	LENGTH	WIDTH	HEIGHT	QTY.
P1	250	200	50	10
P2	625	200	50	16
P3	1050	500	200	2
P4	1250	950	250	2
P5	380	300	200	2

LAYOUT AND TENTATIVE CIVIL INPUT FOR RAW
WATER CHLORINATION PLANT

BHEL DOC NO. PE-DG-408-158-A006



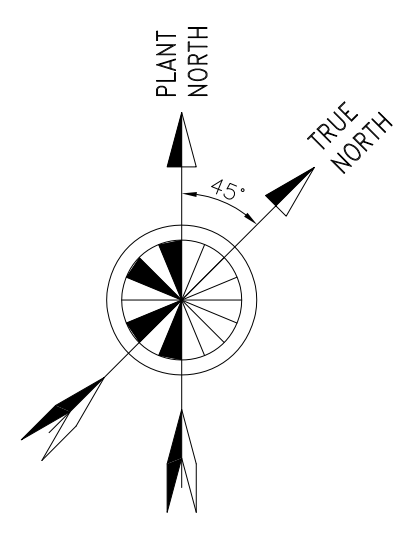
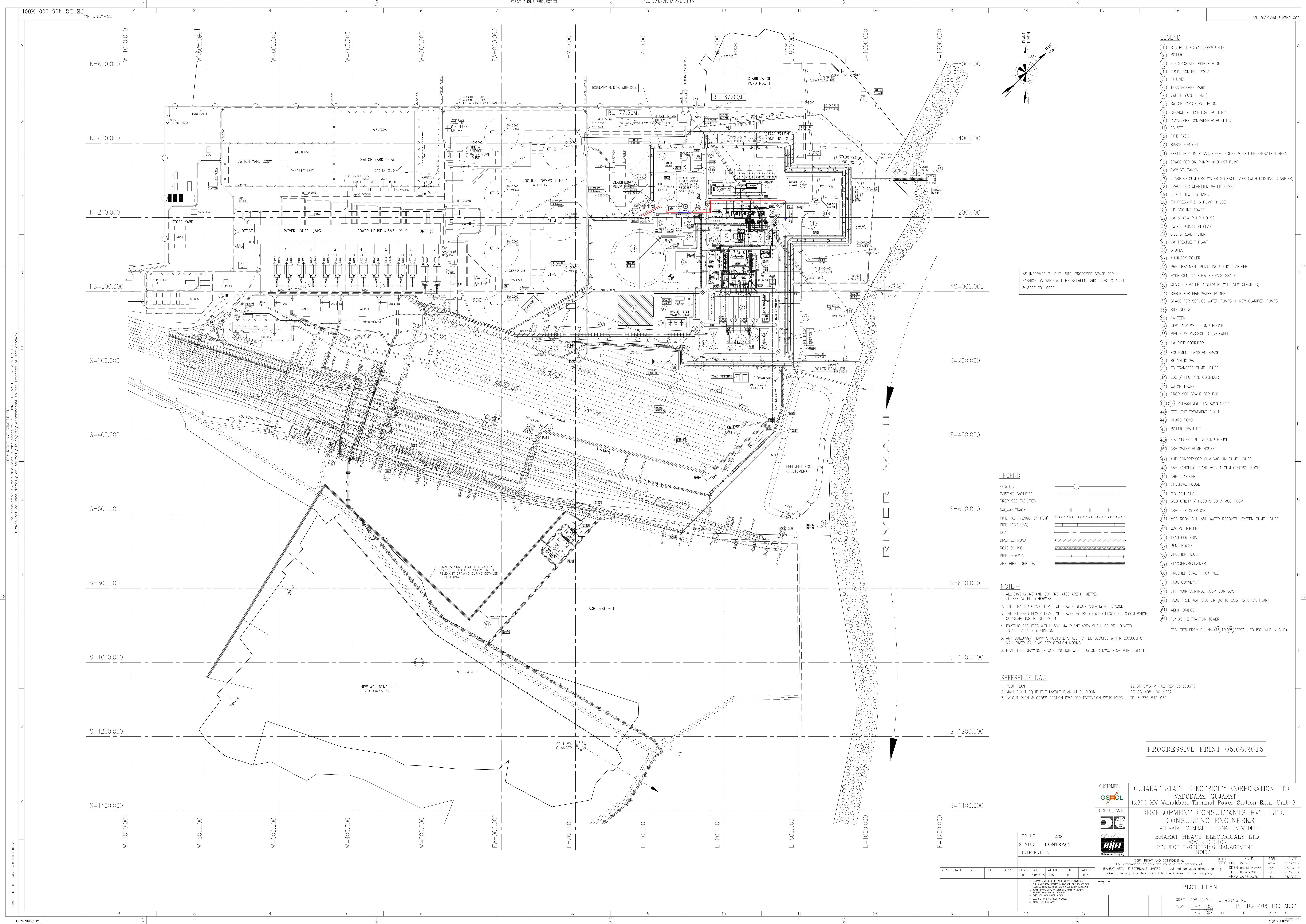
LAYOUT AND TENTATIVE CIVIL INPUT FOR RAW
WATER CHLORINATION PLANT

BHEL DOC NO. PE-DG-408-158-A006

Sheet - 3 of 3

TECH SPEC NO.
PE-TS-408-158-A001

R.W CHLORINATION PLAN



AS INFORMED BY BHEL SITE, PROPOSED SPACE FOR FABRICATION YARD WILL BE BETWEEN GRID 200S TO 400S & 800E TO 1000E.

LEGEND

- FENCING
- EXISTING FACILITIES
- PROPOSED FACILITIES
- RAILWAY TRACK
- PIPE RACK (ENGG. BY PEM)
- PIPE RACK (ISG)
- ROAD
- DIVERTED ROAD
- ROAD BY ISG
- PIPE PEDESTAL
- AHP PIPE CORRIDOR

NOTE:-

1. ALL DIMENSIONS AND CO-ORDINATES ARE IN METRES UNLESS NOTED OTHERWISE.
2. THE FINISHED GRADE LEVEL OF POWER BLOCK AREA IS RL. 72.00M.
3. THE FINISHED FLOOR LEVEL OF POWER HOUSE GROUND FLOOR EL. 0.00M WHICH CORRESPONDS TO RL. 72.3M
4. EXISTING FACILITIES WITHIN 800 MM PLANT AREA SHALL BE RE-LOCATED TO SUIT AT SITE CONDITION.
5. ANY BUILDING/ HEAVY STRUCTURE SHALL NOT BE LOCATED WITHIN 200.00M OF MAH RIVER BANK AS PER CITATION NORMS.
6. READ THIS DRAWING IN CONJUNCTION WITH CUSTOMER DWG. NO.- WTPS: SEC.19.

REFERENCE DWG.

1. PLOT PLAN
2. MAIN PLANT EQUIPMENT LAYOUT PLAN AT EL. 0.00M
3. LAYOUT PLAN & CROSS SECTION DWG FOR EXTENSION SWITCHYARD

9213R-DWG-M-002 REV-05 (CUST.)
PE-DG-408-100-M002
TB-3-375-510-060

PROGRESSIVE PRINT 05.06.2015

CUSTOMER:		GUJARAT STATE ELECTRICITY CORPORATION LTD VADODARA, GUJARAT			
CONSULTANT:		DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA MUMBAI CHENNAI NEW DELHI			
JOB NO.		408			
STATUS		CONTRACT			
DISTRIBUTION		BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA			

REV.	DATE	ALTD	CHD	APPD	REV	DATE	ALTD	CHD	APPD	REV	DATE	ALTD	CHD	APPD
1	12.03.2015				1	12.03.2015				1	12.03.2015			
TITLE										PLOT PLAN				
DEPT.										SCALE 1:3000				
SIGN										DRAWING NO.				
										PG-DG-408-100-M001				
										SHEET 1 OF 1				
										REV. 01				

TECH SPEC NO. PE-TS-408-100-M001