NTPC LIMITED

(A Govt. of India Enterprises)

2 X 500 MW NTPC SIPAT TPS, STAGE-II - FGD

TECHNICAL SPECIFICATION

FOR

GYPSUM DEWATERING EQUIPMENT (VACUUM BELT FILTER TYPE)

SPECIFICATION NO.: PE-TS-491-571-A101

BHARAT HEAVY ELECTRICALS LIMITED
(A Govt. of India Undertaking)

POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
PROJECT ENGIEERING INSTITUTE BUILDING
SECTOR-16A, PLOT NO. 25, NOIDA, INDIA

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SECTION - I

SECTION-I

SUB-SECTION-A

INTENT OF SPECIFICATION

1.0 INTENT OF SPECIFICATION

1.1 The specification covers Supply part, Services part and Mandatory Spares comprising of design (i.e. Preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles, , first fill and top-up of lubricants & consumables, mandatory spares along with spares for erection, start-up and commissioning, forwarding, proper packing, shipment and delivery at site, assembly AND Services part covers **supervision services for** erection & commissioning, trial run at site and carrying out Performance guarantee tests at site, training of customer/ client O&M staff covering all aspects of the GDS-Operation & Maintenance (6 days) at Site, training of customer's personnel at manufacturer's works (6 mandays including lodging and boarding) & handover in flawless condition of the package to the customer complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order of **Gypsum Dewatering Equipment, sub-assembly of Flue Gas Desulphurization (FGD) plant of 2 X 500 MW NTPC SIPAT TPS, STAGE-II - FGD, Bilaspur District of Chhattisgarh State, INDIA.**

1.2 The capacity of the plant is 1000 MW which has been implemented in 2 units for stage-II. Two (02) Sets of Gypsum Dewatering Equipment (1 working + 1 standby) common for all units shall be provided.

1.3 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply, erection and commissioning, performance and guarantee/demonstration testing of GYPSUM DEWATERING EQUIPMENT

1.4 The Bidder shall offer only proven design, which meets the Provenness criteria indicated in the NIT. Necessary documentary evidences shall be submitted along with the bid. If bidder doesn't meet the specified provenness criteria, their bid may not be considered for further evaluation.

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

1.6 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing. Similarly, the extent of supply also includes all items required for completion of the system for its safe, efficient, reliable and trouble-free operation and maintenance shall also be in supplier's scope unless specifically excluded and notwithstanding that they may have been omitted in drawings / specifications or schedules.

1.7 The general term and conditions, instructions to tenderers and other attachment(s) referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to the compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.

1.8 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Section-III of the specification **within 10 days of receipt of tender documents.** In absence of any such clarification(s), in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser / Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further, in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

1.9 The bidder's offer shall not carry any section like clarification, interpretations and /or assumptions.

1.10 Deviations, if any, should be very clearly brought out clause by clause along with cost of withdrawal in the enclosed schedule (in Section -III); otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/it's customer.

1.11 In the event of any conflict between the requirements of two clauses of this specification & requirements of different codes/standards and between respective clauses of sub-section C & sub-section D, more stringent clause as per the interpretation of the owner shall apply.

1.12 In case, all the above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.

1.13 For definition of words like Contractor, bidder, supplier, vendor, Customer/ Purchaser / Employer, consultant, please refer relevant clause of General Conditions of Contract (GCC).

SECTION: I

SUB-SECTION: B

PROJECT INFORMATION

1.00.00 **BACKGROUND**

Sipat Super Thermal Power Project (Coal Based) stage-II (2X500MW) is set up in the state of Chhattisgarh, located near Sipat in Bilaspur district.The capacity of the project in Stage-II is 1000 MW comprising of 2 x 500 MW units and the ultimate capacity of the project is 2980 MW (3X660 + 2X500 MW).

1.01.00 **LOCATION AND APPROACH**

The site is located east of the Kurung left bank canal and is bounded by villages Rank, Kaudia and Janji in the Bilaspur district of Chhattisgarh. It is in between latitudes $22^{o}05'$ & $22^{o}09'$ North and longitudes 82^{o} 16' & 82^{o} 18' East. The site is approx. 20 kms. from Bilaspur city and is approachable via the Bilaspur - Sipat state highway which takes off to the North-East from Bilaspur City. The nearest railway station is Jairamnagar on the Nagpur-Raipur-Calcutta mainline. Raipur, which is approximately 140 kms. from the site is the nearest commercial airport.

1.02.00 **LAND REQUIREMENT**

Land required for the ultimate stage of project i.e. 2980 MW is acquired.

1.03.00 **WATER**

The water requirement for the ultimate stage of the project is 120 million cubic meter/ annum. Source/ arrangement to meet water requirement is from Hasdeo Barrage Right Bank Canal (RBC) has been accorded by MP Water Resource Deptt. CWC has also concurred for 120 MCM drawal, sufficient for Stage-I & Stage-II of the project.

Water is drawn from the RBC, originated from Hasdeo Barrage pond, at chainage 37.95 km. nearest to Sipat STPP. One month's in-plant storage reservoir is provided for meeting the water requirement during the canal closure period.

1.04.00 **COAL AVAILABILITY AND TRANSPORTATION**

Coal Availability

SLC (LT) had accorded long term linkage of 10 million tonne / year.

Coal Transportation

Coal is being transported through merry-go-round system.

Coal Quality Parameters / Fuel Oil Characteristics

The coal quality parameters and ash characteristics/parameters (Table-1, Annexure-BI) and Fuel oil Characteristics (Table-2A & 2B, AnnexureBI) is attached under this sub-section.

1.05.00 **Steam Generator and ESP data:** refer Table-3

1.06.00 **Plant Water details:**
(i) FGD Process water/CW blow down water quality is indicated in Table-4.

(ii) Clarified water quality is indicated in Table-5.

(iii) DM water quality is indicated in Table-5A

2.00.00 **NOT USED**

3.00.00 **NOT USED**

4.00.00 **METEOROLOGICAL DATA**

Important meteorological data from nearest observatory at Champa is placed at **ANNEXURE- AI.**

5.00.00 **CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT**

All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1 to Part 4). Pending finalization of Part 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for embankments.

A site specific seismic study has been conducted for the project site. The peak ground horizontal acceleration for the project site, the site specific acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Appendix-I.

Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values.

The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in Appendix-I includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 to Part 4).

Damping in Structures

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

Steel structures	2%
Reinforced Concrete structures	5%
Reinforced Concrete Stacks	3%
Steel stacks	2%

Method of Analysis

Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1).

In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS:1893 (Part 1).

The spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the structure falls to the left of the peak in the spectral acceleration curve.

For buildings, if the design base shear (V_B) obtained from modal combination is less than the base shear ($\bar{V}_B$) computed using the approximate fundamental period (T_a) given in IS:1893:Part 1 and using site specific acceleration spectra with appropriate multiplying factor, the response quantities (e.g. member forces, displacements, storey forces, storey shears and base reactions) shall be enhanced in the ratio of $\bar{V}_B / V_B$. However, no reduction is permitted if $\bar{V}_B$ is less than V_B.

Design/Detailing for Ductility for Structures

The site specific design acceleration spectra is a reduced spectra and has an in-built allowance for ductility. Structures shall be engineered and detailed in accordance with relevant Indian/International standards to achieve ductility.

ANNEXURE-C1

SITE SPECIFIC DESIGN PARAMETERS

The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows:

a) The basic wind speed "V_b" at ten metres above the mean ground level : 45 metres/second

b) The risk coefficient "K_1" : 1.07

c) Category of terrain : Category-2

7.00.0 FOUNDATION SYSTEM AND GEOTECHNICAL DATA

7.01.0 Soil Data

Owner has carried out geotechnical investigation in the proposed area of Sipat STPP. Bearing capacity for design of foundations and Bore logs data are given at **Annexure – C2** of this specification. The geotechnical investigation report comprising of Boreholes, Laboratory tests, Chemical analysis, etc. in respect of the sub-strata prevailing at site will be made available for the Bidder's study at the Employer's office, if required. The onus of correct assessment / interpretation and understanding of the existing subsoil condition / data is on the Bidder. In case, bidder feels that the available data is inadequate, he may carry out his own geotechnical investigation. Geotechnical Investigation layout/location of borehole/field test where investigation has been carried out and is enclosed as **Annexure-C3**. Further, if any change in layout or area not covered as per enclosed Geotechnical Investigation layout, Contractor shall carry out geotechnical investigation in the area at no cost to owner. The scheme for geotechnical investigation shall be approved by owner before execution. Geotechnical investigation work shall got executed by the Contractor through the agencies as mentioned in Clause No. 7.07.00. However, no time extension shall be given on account of soil investigation carried out by the Bidder. The geotechnical investigation report shall be prepared with detailed recommendations regarding type of foundation and allowable bearing pressure for various structures/ facilities and other soil parameters. The report shall be submitted for Owner's approval prior to commencement of design of foundation.

Site levelling & grading had been carried out and achieved finished ground level (FGL). Bidder may refer topographical survey drawing for variation in existing/ natural ground level (NGL) and FGL.

Ground water table is varying from 2.0m to 5.0m at the time of geotechnical investigation and may fluctuate with seasonal variation

7.01.01 The furnished borelog details are specific to the co-ordinates where the boreholes have been carried out and are provided for bidder's information only. Soil profile in the proposed area may vary with respect to the borelogs enclosed for bidder's information. Bidder has to consider all such variations in his estimation, over the extent of the work to be carried out. The Bidder should note that nothing extra whatsoever on account of variation between soil data collected by Owner and that

found by the Bidder during geotechnical investigation by him or during execution of works, shall be Payable.

7.01.02 Tank Foundations

a) The tanks shall rest on flexible tank pad foundation, resting on sand with concrete ring wall to retain sand. Base of the concrete ring wall shall not rest on the expansive soil, if any.

b) Entire loose/ soft soil inside the concrete ring wall shall be removed and shall be filled with sand. Sand for filling shall be clean and well graded conforming to IS 383 with grading Zone I to III.

c) Sand shall be spread in layers not exceeding 30cm compacted thickness over the area. Each layer shall be uniformly compacted by mechanical means like plate vibrators, small vibratory rollers, etc to achieve a relative density of not less than 80%.

d) Other requirements of tank foundations shall be as per IS 803 and as specified elsewhere in the specifications.

7.02.00 **Foundation System**

The requirements for the foundation system to be adopted are as given in subsequent clauses.

7.02.01 General Requirements

a) All structures/equipment shall be supported on suitable open foundations (isolated, combined, raft) depending on type of structures/facilities, sub-strata, topography etc.

b) The roads, ground floor slabs, trenches, pipe pedestals, channels/drains and staircase foundation with foundation loading intensity less than 4 T / M2 may be supported on open / shallow foundations resting on virgin / controlled compacted filled up soil. If the encountered sub-strata is black cotton soil, the same shall be either replaced upto the full depth or black cotton soil shall be stabilized by suitable treatment.

c) No other foundation (other than as mentioned in (b) above and (i) below) shall rest on the filled up ground / soil.

d) Before execution of work, the bidder shall ensure that there is no obstruction to underground/overground facilities like sewer lines, pipe lines etc. Any such damage and remedial/ rectification measures shall be at the contractors cost.

e) Bidder shall also ensure that there is no damage to existing nearby foundations and the foundations pertaining to this package are not placed at shallower depth than the nearby foundations. If required depth of foundation is deeper than the existing foundations, proper protection shall be provided to existing foundations. If required bidder may carry out GPR survey to locate existing underground facilities at no extra cost to owner.

f) All foundations shall be designed in accordance with relevant parts of the latest revisions of Indian Standards.

g) The water table for design purpose shall be considered at Finished Ground Level.

h) A combination of open and pile foundations shall not be permitted under the same equipment / structure / building.

i) Foundation for equipment on ground floor

For equipment of static weight upto 1.5 T, the equipment may be supported on the ground floor slab by locally thickening the slab. Thickening of the ground floor slab shall be done upto an extent of about 0.6 m beyond the plan area of the equipment on all the sides. Further, the load intensity below the equipment shall be limited to 4T/m2. Other requirements of floor slab and compaction below the floor slab shall be adhered, as specified elsewhere in the specifications.

For equipment's of static weight between 1.5 T and 20 T, the equipment may be supported on compacted sand filling with the load intensity below the equipment limited to 4T/m2. The minimum depth of foundation is 1.0m below FFL. Other requirements of sand compaction below the foundation shall be adhered, as specified elsewhere in the specifications.

For equipment of static weight more than 20 T, the equipment foundation shall be taken to the founding level or shall be built up with PCC from the level as mentioned in the Annexure C2 -Table 2. The pedestal of equipment foundation or the foundation Block shall be isolated from the adjoining floor slab by providing bitumen impregnated fiber board of minimum 50 mm thick, conforming to IS: 1838 all around the equipment pedestal for the full depth of the floor slab.

7.02.02 **Open Foundations**

In case open foundations are adopted, following shall be adhered to.

a) The minimum width of foundation shall be 1.0 m.

b) Minimum depth of foundation shall be 1.0m below Ground Level.

c) It shall be ensured that all foundations of a particular structure/ buildings/ facility shall rest on one bearing stratum.

d) Wherever the intended bearing sub-strata is virgin soil stratum but the actual stratum encountered during foundation excavation consists of filled up soil at founding level, under such cases either the foundation shall be lowered completely into the virgin stratum or the filled up soil upto the virgin layers shall be removed and built up through PCC (1:4:8) up to designed foundation level.

e) Wherever the intended bearing stratum is weathered rock, but the actual strata encountered during excavation consists of both overburden soil and weathered rock at founding level, under such cases, the overburden upto the weathered rock level including 0.5 m into the weathered rock shall be removed and built up through PCC (1:3:6) upto the designed founding level. Thus, maintaining the same founding level for all the footings of a structure. The treatment at the base of foundation before laying the PCC shall be carried out as per IS: 12070.

f) The last layer of about 300 mm before reaching the founding level shall be excavated carefully by such equipment so that soil / rock at the required level will be left in its natural condition.

g) If joints, fissures or other discontinuities in rock are encountered at founding level, then treatment of such rock defects shall be carried out as per IS: 13063-1991 in consultation with the Engineer.

7.03.00 Special Requirements

Details of treatment for foundations / underground structures required to counteract soil / water chemical environment, cement type, grade of concrete, type of reinforcement, cover to reinforcement and protective coating to foundations, etc. shall be as mentioned in Annexure-C2 of this specification.

7.04.00 Excavation, Filling and Dewatering

7.04.01 For excavation works, comprehensive dewatering with well point or deep wells arrangement, if required, shall be adopted. Scheme for dewatering and design with all computations and back up data for dewatering shall be submitted for the owner's information. The water table shall be maintained at 0.5m below the founding depth.

7.04.02 Excavation for shallow foundations shall be covered with PCC immediately after reaching the founding level. In case of any local loosening of soil or any loose pockets are encountered at founding level during excavation the same shall be removed and compensated by PCC M7.5. The final layer of about 300 mm thickness above the founding level shall be excavated by suitable means, so as to avoid disturbance to founding stratum.

7.04.03 Backfilling around foundations, pipes, trenches, sumps, pits, plinths, etc. shall be carried out with approved material in layers not exceeding 300 mm compacted thickness (higher thickness of layers upto 500mm with heavy mechanical compacting equipment) and each layer shall be compacted to 90% of standard proctor density for cohesive soils and to 80% of relative density for non cohesive soils. In any case, black cotton soil shall not be used in back filling without providing cusion of 1m of non expansive cohesive soil/moorum around the footings. In case of roads in the area of black cotton soil, minimum 0.4m moorum shall be provided.

Rock pieces having size less than 150 mm and interstices filled with soil may be used for backfilling around foundation, plinths etc. and shall be compacted to minimum of 85% of original stack of material after filling the interstices.

7.04.04 Founding level for trenches/channels shall be decided as per functional requirement. The bottom of excavation shall be properly compacted prior to casting of bottom slab of trenches / channels.

7.04.05 CBR tests for pavement/road design shall be carried out by the Contractor after earth filling (if applicable) has been completed up to the formation level.

7.04.06 The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding of material or article from any bank or side of such excavation which is more than one and a half meter above the footing by providing adequate piling, shoring, bracing etc. Against such bank or sides.

Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench.

Table-4

WATER ANALYSIS

COOLING WATER ANALYSIS /CW BLOW DOWN WATER ANALYSIS

Sl. No.	Constituent	as	mg per litre
1.	Calcium	$CaCO_3$	256
2.	Magnesium	$CaCO_3$	70
3.	Sodium	$CaCO_3$	125
4.	Potassium	$CaCO_3$	0
5.	Total Cations	$CaCO_3$	451
6.	Bicarbonates	$CaCO_3$	178.5
7.	Carbonates	$CaCO_3$	0
8.	Nitrate	$CaCO_3$	0
9.	Chloride	$CaCO_3$	75
10.	Sulphate	$CaCO_3$	197.5
11.	Total Anions	$CaCO_3$	451
12.	Silica	SiO_2	55
13.	Iron	Fe	1.5
14.	pH Value	-	7.8-8.2
15.	Turbidity	NTU	100
16.	Total Dissolved solids	$CaCO_3$	528.05
17.	Organic matter (Oxygen absorbed from Acid Permanganate In 4 Hrs.)	mg/l	0.25

Note : The C.W system is expected to operate at about 5 Cycles of Concentration.

Table-5

CLARIFIED WATER ANALYSIS

Sl. No.	Constituent	as	mg per litre
1.	Calcium	$CaCO_3$	51.2
2.	Magnesium	$CaCO_3$	14
3.	Sodium	$CaCO_3$	25
4.	Potassium	$CaCO_3$	0
5.	Total Cations	$CaCO_3$	90.2
6.	Bicarbonates	$CaCO_3$	35.7
7.	Carbonates	$CaCO_3$	0
8.	Nitrate	$CaCO_3$	0
9.	Chloride	$CaCO_3$	15
10.	Sulphate	$CaCO_3$	39.5
11.	Total Anions	$CaCO_3$	90.2
12.	Silica	SiO_2	11
13.	Iron	Fe	0.3
14.	pH Value	-	6.8-8
15.	Turbidity	NTU	20
16.	Total Dissolved solids	$CaCO_3$	105.61
17.	Organic matter (Oxygen absorbed from Acid Permanganate In 4 Hrs.)	mg/l	0.05

Table-5A

ANALYSIS OF DM WATER

Sl. No.	Constituent	as	mg per litre
1.	Silica	SiO2	.02 ppm
2.	Iron	Fe	Nil
3.	Total Hardness		Nil
4.	PH Value		6.8 to 7.2
5.	Conductivity		Not more than 0.1 excluding
6.	Bicarbonates		the effects of free CO2

Drawings are enclosed as per Table-6 for initial overview to the Bidder.

SECTION: I

SUB SECTION: C

TECHNICAL SPECIFICATION

SECTION: I

SUB-SECTION: C 1

SPECIFIC TECHNICAL REQUIREMENT

1.1	FUNCTION

The purpose of the specification is to provide complete Gypsum Dewatering Equipment (GDWE) for (2x500 MW) Stage-II – NTPC SIPAT TPS, under the scope of this tender.

1.2	TECHNICAL INFORMATION	
1.2.1	Quantity of Gypsum De-Watering Equipment	Two (2) Set (one working + one standby)
1.2.2	Capacity of the Gypsum De-Watering Equipment	36.33 Tones per hour (wet cake) minimum at outlet of Vacuum Belt Filter for each Belt Filter
1.2.3	Moisture content	10% (Max)
1.2.4	Gypsum purity by BHEL	≥ 90%
1.2.5	Chloride content	< 100 ppm

2.1	SCOPE OF SUPPLY & SERVICES

The specification covers Supply part, Services part and Mandatory spares comprising of design (i.e. Preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles, first fill and top-up of lubricants & consumables, mandatory spares along with spares for erection, start-up and commissioning, forwarding, proper packing, shipment and delivery at site, assembly AND services part covers **supervision services for** erection & commissioning, trial run at site and carrying out Performance guarantee tests at site, training of customer/ client O&M staff covering all aspects of the GDWE- Operation & Maintenance, Troubleshooting etc., training of customer/ client O&M staff covering all aspects of the GDWE- Operation & Maintenance (6 days) at Site, training of customer at manufacturer's works (6 mandays including lodging and boarding) & handover in flawless condition of the package to the customer complete with all accessories

Design: Broadly includes basic engineering, detail engineering, preparation and submission of engineering drawings/calculations/datasheets/quality assurance documents/field quality plans, storage instructions, commissioning procedures, Erection & assembly Drawings, operation & maintenance manuals, performance guarantee test procedures and assisting BHEL in obtaining time bound approval from customer.

Supply: Broadly includes manufacturing/fabrication, shop floor testing, stage inspections, final inspections, painting, packing & forwarding.

Services: Broadly includes supervision services for erection & commissioning, trial run at site and carrying out Performance guarantee tests at site, training of customer/ client O&M staff covering all aspects of the GDWE- Operation & Maintenance (6 days) at Site, training of customer at manufacturer's works (6 mandays including lodging and boarding) & handover in flawless condition of the package to the customer.

2.1.1 The scope of supply for Gypsum Dewatering Equipment shall include but not limited to the following:

(*Wherever (*) is marked, one (1) set means complete requirement for both the Gypsum Dewatering Equipment*)

2.1.1.1 Primary hydro cyclone: Two (2) sets

i. Hydrocyclone clusters
ii. Anchor bolts, nuts and washers
iii. Flanges for inlet and overflow
iv. A variety size of vortex finders for the entire hydro cyclone
v. Accessory piping within the skid
vi. Piping, valves, instruments as per the terminal points defined elsewhere in the specification

2.1.1.2 Secondary hydro cyclone: Two (2) sets

i. Hydrocyclone clusters
ii. Anchor bolts, nuts and washers
iii. Flanges for inlet and overflow
iv. A variety size of vortex finders for the entire hydro cyclone
v. Accessory piping within the skid
vi. Piping, valves, instruments as per the terminal points defined elsewhere in the specification

2.1.1.3 Vacuum belt filters complete with Accessories driving motors (IE3) inverter duty with VFD and inverter panel: Two (2) numbers

2.1.1.4 Vacuum receivers with Anchor bolts, nuts and washers: Two (2) numbers.

2.1.1.5 Vacuum pumps with drive (IE3 motor) including water & airline, all connection bolts/nuts/washers for installation, required instruments and any safety device: Two (2) numbers including water & airline, as required.

2.1.1.6 Vent fan including enclosure and its arrangement: Two (2) numbers.

2.1.1.7 Complete arrangement for cloth and cake washing (excluding tanks & their Instruments), pumps with motors (IE3), associated piping, valves, spray nozzles & accessories: One (1) set*

Two (2) nos. of belt filter wash tanks and Two (2) nos. cake washing tanks are envisaged for both the belt filters as per drawing no. 9545-109-109-001-RPT-PVM-F-020_0 (Page no. 8 -11 of 11). Each tank shall be provided with 2 nos. (1 working + 1 standby) of wash pumps. Suitable arrangement for the washing of belt filter cloth and gypsum cake including piping/ valves/ instruments etc. shall be provided by the bidder.

The Scope of supply of Wash tank(s) with inlet/outlet nozzle is in BHEL scope. Instrumentation on tank(s) is excluded from the bidder scope. Inlet piping along with associated instruments/ valves from process water Terminal point (TP) to the tanks inlet nozzles, Process water Outlet piping from the tanks outlet nozzles for cake wash and belt wash comprising of the wash pumps, their motors (IE3) along with associated instruments/ valves etc. shall be in the bidder scope.

However, bidder scope shall be limited to the Engineering as per clause 2.1.1.9 (ii) (g) of this sub-section for the overflow and drain of the tanks.

2.1.1.8 Coupling with guards, wherever applicable: One (1) set*

2.1.1.9 Piping, Valves and accessories

(i) Complete engineering and supply of interconnected piping (slurry, air and water pipes) along with valves, rubber lining (wherever applicable, shall be supplied in erectable condition i.e., no rubber lining to be done at Site), instruments, valves, supports, gaskets, fasteners and accessories which is integral to Gypsum Dewatering Equipment – One (1) set* which is broadly defined below:

a. Slurry piping from Primary hydro cyclones underflow to Vacuum Belt Filters

b. Filtrate piping from Vacuum belt filters to Vacuum receiver's outlet flange.

c. Air piping from vacuum receivers to vacuum pumps to atmosphere

d. Vacuum pumps seal water / drain water pipes to/ from wash tanks. Supply of seal water to vacuum pump shall be provided through clarified water pump as specified in P & ID.

e. Process / clarified water piping from TP outside building to wash tanks.

f. Instrument air piping from TP outside building up to equipment related to the system

(ii) Scope of below-mentioned interconnected piping (slurry, air and water pipes) along with valves, rubber lining (wherever applicable), instruments, valves, supports, gaskets, fasteners and accessories which is non-integral to Gypsum Dewatering Equipment is **limited to engineering only** and supply shall be made by BHEL. Engineering in bidder's scope includes layout & routing of pipes, preparation of isometric drawing and BOQ:

a. Primary hydro cyclone feed tank outlet to the inlet flange of Primary hydro cyclones along with recirculation piping to feed tank

b. Primary hydro cyclones over flow to Inlet of secondary hydro cyclone feed tank

c. Secondary hydro cyclone feed tank outlet to inlet flange of secondary hydro cyclones along with recirculation piping to feed tank.

d. Secondary hydro cyclones underflow to filtrate water tank.

e. Secondary hydro cyclones overflow to inlet flange of wastewater tank.

f. Receiver drain to Filtrate tank and other associated drain of vacuum belt filters to filtrate tank.

g. Overflow and drain piping of cake wash tanks and cloth wash tanks.

2.1.1.10 Instruments/Valves for the entire gypsum dewatering Equipment including integral piping as defined at 2.1.1.9 above (minimum requirement for each gypsum dewatering Equipment is given in the P&ID): One (1) set*.

2.1.1.11 Electric common including but not limited to.

i. Local control panel, if required
ii. LV, HT Motors (as applicable)
iii. Junction Box
iv. Instruments
v. Push buttons

2.1.1.12 Expansion Joints at suction and discharge of each pump/other equipment, as applicable: One (1) Set*.

2.1.1.13 All motors shall be provided with suitable double compression cable gland.

Sizes of cables shall be informed by BHEL during detail engineering. Bidder to provide suitable gland with respect to sizes of cables.

Bidder shall provide cable glands and lugs for all equipment in his scope. Cables shall be terminated using double compression type cable glands and solder less crimping type tinned copper cable lugs.

Bidder shall provide junction box. The Junction box shall have provision for installing glands of suitable size on the bottom of the box.

2.1.1.14 Control System: Control system shall be DDCMIS/ DCS, which shall be BHEL scope. Each equipment shall be furnished with required instrumentation and electrical accessory devices mounted and connected to a junction box.

2.1.1.15 **SIGNALS [Refer Electrical/C&I portion/ P&IDs of this specification, as well]**

2.1.1.15.1 Alarm Signal:

a) Bearing Temperature Transmitter for initiating alarm during when "Bearing temperature high" shall be supplied by Bidder. Bearing temperature transmitter shall be provided with local display also. Bearing temperature transmitter (with 2V3 logic) shall be provided for HT motors (> 200 KW) at both the driving and non-Driving ends.

b) Vibration Monitoring System, which is in BHEL scope, is envisaged for HT Motor. However, for mounting of vibration sensors/probe on DE&NDE Bearing, vendor to provide vibration pad (of dimension of 80mm x 80mm x 10mm each) for mounting of sensors with a provision i.e. M6x1 threaded hole, 13mm deep, predrilled in each pads. Vendor to provide Single notch/slot (of dimension 30mm x 15mm x 3mm) on the circumference of the coupling of Motor for mounting of key phasor, there shall be space and provision in the assembled machine train for mounting the phase marker bracket supplied by BHEL. *(These details shall be confirmed with BHEL during detail engineering).*

2.1.1.15.2 Interlock signal:

a) Belt filter wash tank level low
b) Cake wash tank level low

2.1.1.16 Lubricants & Consumables: All the first fill and one year's toppings requirements of consumables such as grease, oil, lubricants, servo fluids etc. which will be required to put the equipment covered under the scope of specifications into successful commissioning/initial operation and to establish completion to facilities should be provided by contractor/supplier. Refer Clause 7.0 of this sub-section for details.

2.1.1.17 Suitable Painting and rust prevention during shipment and construction.

2.1.1.18 Seaworthy packing & forwarding to project site. Refer project information specified elsewhere in the specification. This is applicable where the equipment is coming through sea route. Otherwise, packing specification of equipment of Indian origin will be followed.

2.1.2 Services to be provided by the bidder:

(i) Detailed Erection and commissioning procedure shall be submitted by successful bidder for carrying out the erection and commissioning at site by BHEL.

(ii) Supervision for Erection & Commissioning, trial run at site.

(iii) Performance guarantee tests at site & handover in flawless condition of the package to the customer.

(iv) Training of customer/ client O&M staff covering all aspects of the GDWE- Operation & Maintenance (6 days) at Site.

(v) Training of customer at manufacturer's works (6 man-days) including lodging and boarding.

(vi) Visits shall be planned by BHEL site team and prior intimation shall be sent to supplier for visit to site for supervision services. Bidder shall be informed at least 10 days in advance for the requirement of visit at site. Visiting team shall consist of one or two experts of bidder as deemed necessary by them.

2.1.3 Mandatory spares as defined as Annexure-II, Sub Section-D of Section I.

2.1.4 Recommended spare parts list to be furnished (is not part of scope of supply)

2.1.5 Any other items required not covered above but required for the completeness of the system; it shall be included in the offer and shall be supplied by the Bidder/supplier. Bidder shall refer to the P&ID enclosed in Annexure-IV, Sub-Section-D of Section-I for the items under the bidder's scope. All the items indicated in the P&ID are minimal requirements.

2.2	PROCESS DESCRIPTION
1.	Common gypsum dewatering Equipment is envisaged for both units. The dewatering Equipment shall receive the gypsum slurry from Primary Hydro cyclone feed pumps (BHEL Scope). Gypsum dewatering Equipment shall be suitable for handling slurry from all four FGD units. Two sets of primary hydrocyclone (1W+1S) with accessories shall be in vendor scope. Primary hydrocyclone underflow shall be taken to Vacuum Belt Filter (VBF) inlet.
2.	The overflow from the primary sets of hydro-cyclone shall be taken to a secondary hydro-cyclone feed tank (BHEL Scope). Secondary Hydro cyclone feed pumps (BHEL Scope) shall

	transfer the slurry from tanks to secondary hydro cyclone. Two sets of Secondary hydro cyclones (1 working+1 stand by) and its accessories shall be in vendor scope.
3.	The underflow from the secondary hydro-cyclone shall be taken to the filtrate water tank. The over flow from the secondary hydro-cyclone shall be taken to a waste water storage tank.
4.	Two nos. of belt filter wash tanks & Two nos. of cake wash tanks along with rubber lining (BHEL Scope) are envisaged for both the belt filters. Each tank shall be provided with 2 nos. of pumps of suitable requirement.

2.3	**TERMINAL POINTS**
1.	Primary hydro cyclone feed slurry will be provided by BHEL at the inlet flange of the primary hydro cyclone.
2.	Primary hydro cyclone overflow launder outlet flange. Further piping by BHEL to secondary hydrocyclone feed tank.
3.	Secondary hydro cyclone feed slurry will be provided by BHEL at the inlet flange of secondary hydro cyclone.
4.	Secondary hydro cyclone underflow launder outlet flange and overflow launder outlet flange. Further piping by BHEL to waste water and filtrate tank.
5.	Outlet at vacuum receiver and TP near VBF for other drain of such as cloth wash, dyke drain etc.
6.	Process water & instrument air will be provided at one location, located at 5 m from building boundary. Further piping from terminal point to GDW Equipment utilities are in bidder's scope.
7.	VBF Discharge outlet flange for Gypsum discharge is in bidder's scope. Please refer enclosed P&IDs, typical layout & preliminary elevation drawing of GDWE building for the details in the scope.

2.4 For Electrical scope, refer Electrical specification (Sub-section- C3 of Section-I).

2.5 For Control & Instrumentation (C&I) scope, refer C&I specification (Sub-section- C4 of Section-I).

3.0 CODES & STANDARDS AND OTHER REQUIREMENTS

3.1 The design and manufacturing of vacuum belt filter shall follow the latest applicable Indian / International (ASME / EN /Japanese) Standards.

3.2 The performance tests shall be carried out in accordance with ASME PTC 40 (2017) code.

3.3 In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed, including the following:

a) Indian Electricity Act
b) Indian Electricity Rules
c) Indian Explosives Act
d) Indian Factories Act and State Factories Act
e) Indian Boiler Regulations (IBR)
f) Regulations of the Central Pollution Control Board, India

g) Regulations of the Ministry of Environment & Forest (MoEF), Government of India
h) Pollution Control Regulations of Department of Environment, Government of India
i) State Pollution Control Board.
(j.) Rules for Electrical installation by Tariff Advisory Committee (TAC).
(k.) Building and other construction workers (Regulation of Employment and Conditions of services) Act, 1996
(l.) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998
(m.) Explosive Rules, 1983
(n.) Petroleum Act, 1984
(o.) Petroleum Rules, 1976,
(p.) Gas Cylinder Rules, 1981
(q.) Static and Mobile Pressure Vessels (Unified) Rules, 1981
(r.) Workmen's Compensation Act, 1923
(s.) Workmen's Compensation Rules, 1924
(t.) Safety Rules for Construction and Erection
(u.) Safety Policy
(v.) Any other statutory codes / standards / regulations, as may be applicable.

3.4 Unless covered otherwise in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply:

a) Bureau of Indian standards (BIS).
b) Japanese Industrial Standards (JIS).
c) American National Standards Institute (ANSI).
d) American Society of Testing and Materials (ASTM).
e) American Society of Mechanical Engineers (ASME).
f) American Petroleum Institute (API).
g) Standards of the Hydraulic Institute, U.S.A.
h) International Organization for Standardization (ISO).
i) Tubular Exchanger Manufacturer's Association (TEMA).
j) American Welding Society (AWS).
k) National Electrical Manufacturers Association (NEMA).
l) National Fire Protection Association (NFPA).
m) International Electro-Technical Commission (IEC).
n) Expansion Joint Manufacturers Association (EJMA).
o) Heat Exchange Institute (HEI).
p) IEEE standard.
q) JEC standard.

3.5 Other International/ National standards such as DIN, VDI, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the BHEL Customer's approval, for which the bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases, the bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word-to-word translation of the standard that is normally not published in English.

3.6 Two (2) English language copies of all national and international codes and/or standards used in the design of the plant and equipment shall be provided by the Contractor to the Employer within two calendar months from the date of the Notification of Award.

3.7 In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the BHEL shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of BHEL such changes and advise BHEL of the resulting effect.

4.0	DETAILED TECHNICAL SPECIFICATION

4.1	DETAILED SPECIFICATION
4.1.1	Bidder shall supply two stage gypsum dewatering Equipment consisting of primary hydro cyclones, vacuum belt filters (VBF) and secondary hydro cyclones for dewatering of gypsum from absorber to less than 10% moisture at the design capacity specified elsewhere in the specification.
4.1.2	Bidder shall supply 2x100% gypsum dewatering Equipment with each stream sized to dewater **36.33 TPH (Wet cake)** at outlet of VBF produced by the all units operating at design point. All other stipulations with respect to sizing and design of the dewatering Equipment, auxiliaries and other systems shall be in line with this specification.
4.2	**Hydro-cyclones**
4.2.1	Two (2) sets of primary hydro cyclones are envisaged, each set shall be sized to dewater the gypsum slurry produced by the unit operating at design point.
4.2.2	Each set of primary hydro-cyclone shall be provided with 10% spare hydro-cyclones. The capacity defined in the previous clause shall be met with spare hydro-cyclones out of service.
4.2.3	The primary hydro-cyclone shall be installed directly above the belt filters. The overflow of the hydro-cyclones shall be taken to Hydro-cyclone Waste Water tank via secondary hydro-cyclone feed tank and secondary waste water hydro cyclone as shown in the relevant P&IDs.
4.2.4	Both primary and secondary hydro-cyclones shall be of modular construction. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose.
4.2.5	The hydro-cyclone shall be of proven design and shall be provided with replaceable rubber lining. The feed chamber, overflow and underflow chamber shall be made of carbon steel of adequate thickness with a rubber lining of **minimum 12 mm** thickness. Liners shall have a **minimum wear life of not less than 7000 hours**.
4.2.6	Two (2) sets of secondary hydro cyclones are to be installed. Each set of secondary hydro-cyclone shall be sized to process the maximum discharge from the secondary hydro-cyclone feed pumps. A minimum 10% spare hydro-cyclones shall be provided in each set. Secondary Hydro-cyclones shall be of modular construction and of proven design. The secondary hydro-cyclone shall be made up of polyurethane or urethane materials. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose.
4.2.7	All Hydro Cyclones clusters shall be made of polyurethane or urethane material only.
4.3	**Vacuum Belt Filters**
4.3.1	Two (2) numbers of vacuum belt filters each of capacity **36.33 TPH (Wet cake)** at the outlet of each VBF are envisaged. Each vacuum belt filter shall be sized to meet the following requirements, all occurring together, with an inlet solid concentration of not more than 45% or outlet of hydro-cyclones whichever is minimum: ▪ Outlet Moisture: 10% (maximum)

	▪ Chloride content: < 100 ppm ▪ Gypsum Purity: 90% (minimum)- by BHEL.
4.3.2	The Vacuum Belt Filters shall have the following characteristics: a) Very rigid frame and rolls, no deformation whatsoever may occur. b) All rolls shall be installed perfectly horizontally c) There shall be no vacuum under the slurry deposition zone. d) Deposit thickness control and directional stability control e) The slurry shall be put on the belt in counter current relative to the rotation of the band. f) The vacuum chambers shall be easily opened for inspection and cleaning.
4.3.3	The vacuum belt filter shall be proven design in operation for similar capacities. The filter cloth shall be polyester or polypropylene as per the proven design of the supplier and shall be guaranteed for **a minimum life of not less than 7000 hours**. In case the bidder does not stand guarantee for specified life, they shall supply additional sets of filter cloth(s) to meet the **cumulative life of 7000 hours**. The same is applicable for main as well as mandatory spares and shall be supplied along with main supplies and mandatory spares.
4.3.4	The complete frame of the filter and all parts in contact with gypsum shall be made with corrosion resistant material i.e Corten Steel or SS304.
4.3.5	In case, the contractor offers a design with an underlying belt for carrying the filter cloth, the same shall be endless, factory vulcanized rubber belts. The belt shrouds and the sealing belts shall provide a leak tight arrangement to prevent overflow of gypsum slurry. The sealing belt shall have **minimum life of not less than 7000 hours**. In case the bidder does not stand guarantee for specified life, they shall supply additional sets of wear belt(s) to meet the cumulative life of 7000 hours. The same is applicable for main as well as mandatory spares and shall be supplied along with main supplies and mandatory spares.
4.3.6	The vacuum box shall ensure tight sealing with the belt/cloth and shall be of proven design.
4.3.7	The belt filter shall have an automatic cloth tracking mechanism and shall be provided with all required instrumentation as per the bidder's proven practice. The belt filter shall have an automatic cloth tensioning mechanism. Pull chord switches shall be provided for each vacuum belt filter. Two (02) no.'s of Belt sway switches shall be provided for each vacuum belt filter. Cake thickness sensors with double redundancy shall be provided for each vacuum belt filter which shall control the speed of the vacuum belt filter in turn.
4.3.8	Differential Pressure indicator shall be provided at the discharge line of Belt filter wash Pump for each vacuum Belt filter. Flow indicator shall be provided for cloth washing line of each vacuum belt filter. Flow indicator shall be provided for cake washing line of each vacuum belt filter as per P&ID enclosed.
4.3.9	The filtrate from gypsum slurry and from cake washing shall be taken to a common or separate vacuum receiver tank(s) as per the proven practice of the supplier. Each belt filter shall have an independent vacuum pump.
4.3.10	The filtrate from gypsum slurry and from cake washing shall be taken to a separate vacuum receiver tank(s) as per the proven practice of the supplier. Each belt filter shall have an independent vacuum pump.
4.3.11	Gypsum cake from each belt filter shall be discharged through a hopper onto belt conveyor being provided by the Employer. Hopper means discharge chute only, Gypsum cake from

	each belt filter shall be discharged through a chute arrangement onto belt conveyor indicated in GA drawing.
4.3.12	A 2 m (min.) wide platform shall be provided around each belt filter for easy approach & maintenance or it may provide a common platform of **3.3m** (approx.) width. In case, common platform for VBF is provided, a movable platform along with access ladder shall be provided for approaching components on other side of VBF. The elevation of discharge point of vacuum belt filter shall be as per the Gypsum Dewatering Building Drawing provided in the Annexure-IV Sub Section-D of Section-I.
4.3.13	The service factor of the gear unit (if any) shall be minimum 1.5.
4.3.14	Piping and wiring within the skid should be in the vendor's scope.
4.3.15	All client end connection flanges shall be ANSI B 16.5/AWWA.
4.4	**Vacuum System**
4.4.1	The filtrate from each belt filter, cake washing & cloth washing shall be taken to separate receiver tank(s) as per the supplier's proven practice. Each belt filter shall be provided with an independent vacuum pump sized to meet the requirements of the belt filter operating at its maximum capacity. An additional 10% margin over the above shall be provided in each vacuum pump.
4.4.2	Each Vacuum pump shall have its own piping system, which connects the pump with the associated vacuum belt filter. Bidder to provide Equipment layout and General Arrangement (GA) of Gypsum dewatering building along with the offer.
4.4.3	The vacuum pump shall be of low speed liquid ring type of proven design. The design of the vacuum pumps shall avoid cavitation under all operating conditions. The seals shall be of proven design.
4.4.4	Silencers shall be provided, if required, to limit the noise level to values stipulated elsewhere in this specification.
4.4.5	The vacuum receiver and pump internals shall be suitably lined to protect against the corrosive environment. The material selected for vacuum pumps & vacuum receivers shall be proven for similar application and shall be subject to approval of BHEL/CUSTOMER.
4.4.6	Each vacuum receiver tank(s) shall be provided with slide plate type pneumatic vacuum breaker. The plate shall be stainless steel with a min. thickness of 3 mm.
4.5	**COMMON REQUIREMENTS FOR PUMPS (VACUUM PUMP, FILTRATE BELT FILTER, CAKE WASH)**
4.5.1	All the pump wear parts in contact with the slurry shall be provided with replaceable rubber/elastomer liners suitable for the fluid handled. The Bidder can also offer a hi-chrome alloy line pump if the Bidder has previous experience of the same for similar applications. The material used by the contractor shall be proven in previous installations.
4.5.2	All the slurry pumps shall be provided with motorized suction and discharge valves. As per bidder's proven practice, pneumatic can be provided. In addition, flushing water lines with motorized/ pneumatic valves shall be provided for each pump for automatic flushing of the pump after each shut down. The flushing water for the pumps shall be taken from the process water supply. The process water lines shall be provided with pneumatic/motorized valves as per the proven practice of the Bidder.
4.5.3	The pump shall be provided with seals of proven type and shall be designed for minimization of seal water consumption. The shaft shall be supported on heavy-duty ball/roller bearings.
4.5.4	All pumps shall be designed to withstand a test pressure of 1.5 times the maximum possible pump shut off pressure under maximum suction pressure conditions.

4.5.5	Product water flushing lines and drains are to be supplied for each pump handling the prevailing water to avoid corrosion if the pump is out of operation for extended periods.
4.5.6	Pumps must be carefully set to ensure that the net positive suction head available under all operating conditions will be adequate. The NPSH Values are to be referred to the least favorable operating conditions- lowest atmospheric pressure, lowest level of water on the suction side of the pump and highest temperature of the pumped fluid. An adequate safety margin of normally greater than 1 m to the max NPSH required shall be provided.
4.5.7	All pumps shall be fitted with suction and discharge pressure gauges. Pressure gauges shall be with diaphragm seal for slurry application. Pressure gauges for other medium shall be with gate valves. All the wetted parts shall be SS 316 or equivalent.
4.5.8	Venting valve shall be fitted to all pumps at suitable points on the pump casing unless the pump is self-venting due to the arrangement of the suction and discharge nozzles. Drainage facilities shall be provided on the pump casing or adjacent pipe work to facilitate the dismantling of pumps.
4.5.9	Design pumps not to be damaged during reverse rotation at up to 150% of design RPM, at full discharge head in the event that a pump trips while the other operating pump remain on line.
4.5.10	Pumps shall have stable head-capacity characteristics curve from run-off to shut-off. Shut-off head should be 115% of Best Efficiency Point (BEP).
4.5.11	Selection of Duty point should preferably be at BEP (Best Efficiency Point) or slightly at the left of BEP. Selection of Duty point beyond 115% of BEP will not be acceptable. It should be noted that head variation is due to level variation in tank. Pump has to run in the system without compromising its NPSH requirement at lowest water level in tank. Hence, when tanks are filled-up and are at normal water level, pump will operate at the right of BEP, pump's operating zone should be considered accordingly.
4.5.12	External flushing is required to remove the accumulated particles and all related information should be mentioned in datasheet.
4.5.13	Pump should have adjustment provision of axial clearance between casing and impeller for maintenance of performance at best efficiency when there is wear in between impeller and casing.
4.5.14	In case rubber or nonmetallic linings are used, these will be two piece molded under pressure and adjusted to the screwed metallic clamping which have been welded to the casting.
4.5.15	Each pump will have a coupling of adequate size, designed for full load and capable of supporting start –up on overload moments. Each half of the coupling will be factory mounted and locked to its shaft. The coupling must be able to accept the adjustment of the impeller.
4.5.16	The pumps shall have mechanical seals of cartridge type with self-lubrication sliding ring cartridges. The static part will be mounted on the seal plate with circumferential ring (O-ring) or another flexible sealing ring. Built in seal design will not be accepted.
4.5.17	The sealing areas shall be designed in such a way so that solids do not precipitate in them or affect the cooling or affect the adjustment and mechanical functioning of the seals. Seals which do not need jet cleaning are preferred.
4.5.18	Pump induced vibration due to flow pulsations shall be avoided through suitable design.
4.5.19	Each rotating equipment shall be first statically balanced and then dynamically balanced according to ISO 1940 (in the case of impellers this shall be done before and after mounting of the service rotor shaft).

4.5.20	The material and thickness of the liners of slurry pumps shall ensure a minimum service life of 2 years before replacement. All the wear parts of the pump shall be **guaranteed for a minimum wear life of not less than 14000 hours. (if applicable).**
4.5.21	Coupling halves shall be machine matched to ensure accurate alignment. Couplings must have a rated capacity of at least 120% of the maximum potential power transmission requirement.
4.5.22	All rotating parts such as coupling shall be covered with suitable protective guards. Guards shall be easily removable type. Coupling shall be of flexible type made of cast steel. The bidder shall furnish both halves of the coupling. Both the Coupling halves shall be bored and keyed to fit shafts of the pump and the motor by bidder. The coupling between shafts shall be so designed that they become tight during pump operation.
4.5.23	A common base plate shall be provided for pump assembly & Motor and the same shall be rigidly constructed, adequately braced and provided with finish pads for mounting pump.
4.5.24	Pump manufacturer is to supply base plate along with Foundation bolt & Nut, “Taper wedge” and the necessary fastener for Pump and Motor with Base plate.
4.5.25	**Nameplate:** All equipment shall be provided with name plates indicating the item number and service name. Nameplates shall be of 304 Stainless steel plate and placed at a readily visible location. Nameplate of main equipment shall have enough information, which will be confirmed during engineering phase. Stainless steel nameplates for all instruments and valves shall be provided.
4.5.26	Rotation arrows shall be cast in or attached with stainless steel plate on each item of rotation equipment at a readily visible location.
4.5.27	Unless otherwise specified, all equipment items where the weight exceeds 15 kg shall be provided with suitable lifting lugs, ears or ring bolts or tapped holes for lifting rings. Minimum shock factor for lifting lugs shall be 2.0. The position of lifting lugs and reference dimension shall be shown on GA and/or outline drawings. NDT shall be conducted for lifting lugs. When any spreader bars are required for lifting and laydown, the bidder shall provide spreader bar with equipment.
4.5.28	Skid Mount/Transportation: Equipment shall be fabricated as skid mount design as much as practical to minimize erection at the site.
4.5.29	Two pieces of stainless-steel earth lugs shall be provided with equipment diagonally. The position of earth lugs shall be shown on each GA and/or outline drawing.
4.5.30	Provide double nuts for anchor bolts.
4.5.31	Bidder shall provide allowable vibration level on foundation in foundation drawings and/or general arrangement drawings.
4.5.32	If the driver/driven equipment train is in the resonance condition or any vibration problems occur, the bidder shall solve the problems in a timely manner.
4.5.33	Bidder shall provide the mating flanges with the necessary gaskets.
4.5.34	All the surfaces of the carbon steel should be rust prevented before shipment for the period of at least 12 months for storage and construction.
4.5.35	Bidder to provide capacity of crane or hoist required for safe material handling and the details of heaviest component to be handled.
4.5.36	Bidder to provide Pipe & Valve Material as per the Annexure VIII, Sub-Section-D, Section-I of the Specification.
4.5.37	A 1000 mm wide platform with suitable approach shall be provided by the bidder for each hydro cyclone.
4.5.38	A 1500 mm space around all the pumps shall be provided by the bidder.
4.5.39	Equipments requiring monitoring during regular operation shall be approachable from the

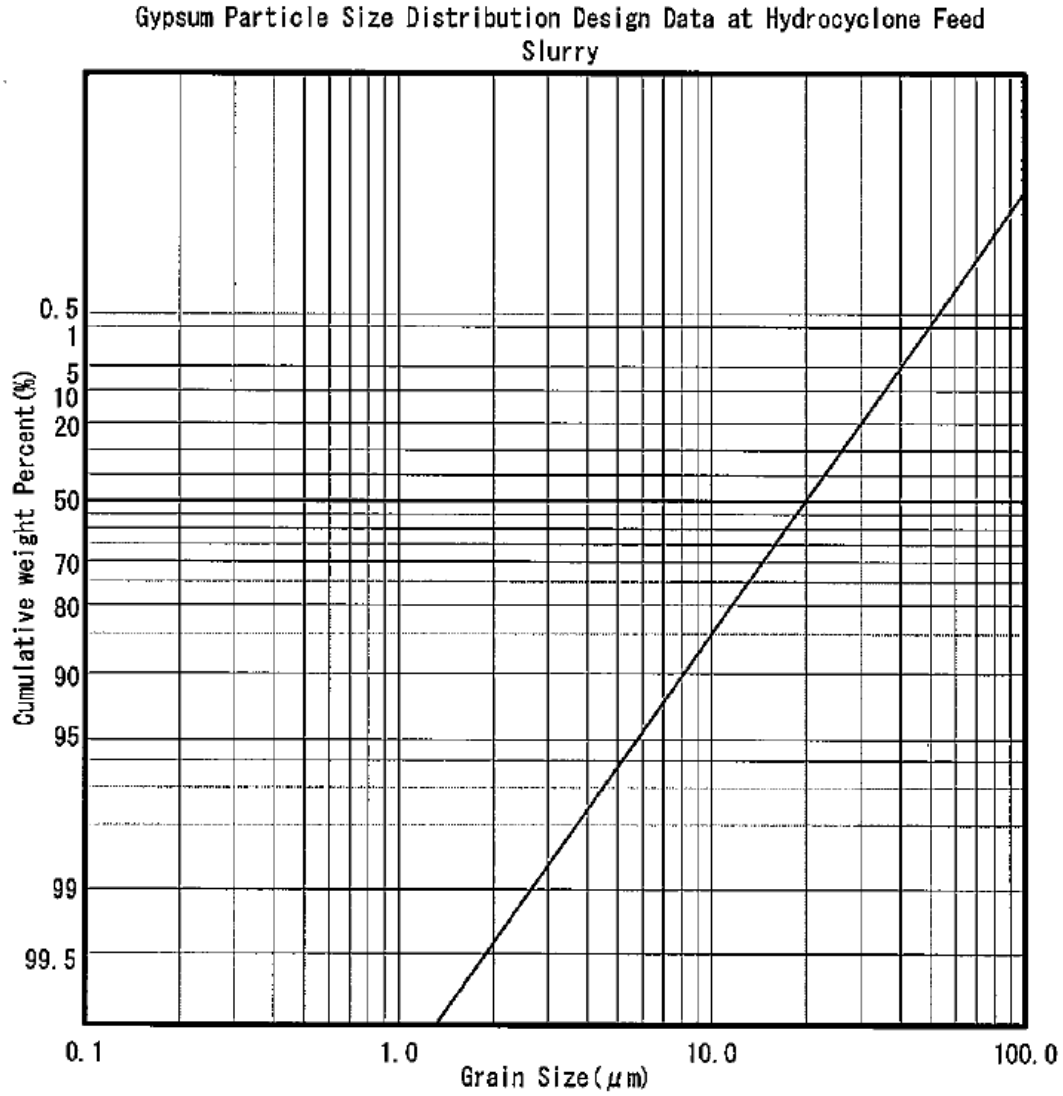
	ground floor through staircase. Staircase with minimum width of 1200 mm shall be provided for approach to elevated structures at 5 m height from the nearest platform. Below this height, a vertical ladder with minimum clear width of 600 mm may also be acceptable.
4.5.40	The list of all Bought out items with makes and country of origin and contact details of the manufacturers to be mentioned along with offer to be submitted. Acceptance of makes shall be subject to BHEL's Customer's acceptance during the detailed engineering without cost and delivery implication to BHEL.

5.0 PIPING & INSTRUMENTATION DIAGRAMs (P&IDs)

The Piping and Instrumentation Diagram are enclosed in in Annexure-IV, Sub-Section-D of Section-I.

5.1	PROCESS PARAMETERS FOR PRIMARY HYDROCYCLONE			
Sl. No.	**Parameters**	**Primary Hydro Cyclone Feed Slurry**	**Primary Hydro Cyclone Over Flow**	**Primary Hydro Cyclone Under Flow**
a.	Total Flow (m^3/hr.)	113.22	65.4 (*1)	47.82 (*1)
b.	Total Flow (t/hr.)	137.26	72.50 (*1)	64.76 (*1)
c.	Operating Temp (C)	61.5	61.5	61.5
d.	Design Temp (C)	70	70	70
e.	Solid (wt. %)	30	16.6 (*1)	> 45 (*2)
f.	Density (Kg/m^3)	1212	1108 (*1)	1354 (*1)
g.	pH	4-7	4-7	4-7
h.	Cl^-(mg/l)	<25000	<25000	<25000
i.	Number of hydro cyclones: 2 numbers (1 W + 1 S)			
j.	Back pressure of Primary hydro cyclones inlet shall be maintained <20 m L.C			
k.	Primary hydro cyclone to be sized for: 124.54 m3/hr. (including 10 % margin)			
l.	Each set of primary hydro cyclone shall be provided with 10% spare hydro cyclones as per clause 7.03.02 in Part-B subsection-I-M1, pg 24/50			
5.2	**PROCESS PARAMETERS FOR SECONDARY HYDROCYCLONE - OPERATION POINT**			
Sl. No.	**Parameters**	**Secondary Hydro cyclone – Feed Slurry**	**Secondary Hydro cyclone– Overflow**	**Secondary Hydro cyclone – Under flow**
a.	Total flow (m^3/hr)	65.40 (*1)	40.88 (*1)	24.52 (*1)
b.	Total flow (t/hr)	72.50 (*1)	41.68 (*1)	30.82 (*1)
c.	Operating Temp (°C)	61.5	61.5	61.5
d.	Design Temp (°C)	70	70	70
e.	Solid (% wt.)	16.6	3 (*2)	35 (*1)
f.	Density (kg/m^3)	1108 (*1)	1020	1256
g.	pH	4-7	4-7	4-7
h.	Cl^- (mg/l)	<25000	<25000	<25000
i.	Number of hydro cyclones: 2 numbers (1 W + 1 S)			
j.	Back pressure of Secondary hydro cyclones inlet shall be maintained <20 m L.C			
k.	Secondary hydro cyclone to be sized for: 71.94 m3/hr. (including 10 % margin)			
l.	10% spare hydrocyclones shall be provided in each secondary hydrocyclone set			

	as per clause 7.07.04 in Part-B subsection-I-M1, pg 27/50						
5.3	**DATA SHEET OF BELT FILTER**						
Sl. No.	**Parameters**	**Belt Filter Feed Slurry**	**Product Gypsum**	**Filtrate**	**Washing Water ****		
a.	Total Flow (m^3/hr)	47.82 (*1)					
b.	Total Flow (t/hr)-Wet	64.76 (*1)	32.2				
c.	Design Temp (°C)	70					
d.	Solid (% wt.)	>45 (*2)	>90 (*2)	<0.2			
e.	Density kg/m^3	1354 (*1)					
f.	pH	4~7	5~8				
g.	Cl	<25000	<100 ppm (*2)				
h.	Belt filter and the peripherals shall be designed at 36.33 TPH (wet cake) or 32.7 t/h (dry cake). Number of vacuum belt filters: 2 numbers (1 W + 1 S).						
i.	****Quantity of water shall be finalized by the vendor. Property of process water (Clarified water) is given below.** (*1) shall be finalized by vendor. (*2) Shall be guaranteed by vendor.						

5.4	GYPSUM PARTICLE SIZE AT HYDRO CYCLONE FEED SLURRY IS SHOWN BELOW:		
			
	Note: 1. Vendor to submit the PSD based on their design for PHC & SHC underflow and overflow 2. Hydro cyclone backpressure shall not exceed 20m H		
5.5	GYPSUM PARTICLE SIZE AT BELT FILTER FEED SLURRY IS SHOWN BELOW:		
	Vendor to submit PSD graph design data at VBF inlet / PHC outlet.		
5.6	DESIGN CONDITIONS OF PRIMARY & SECONDARY HYDRO CYCLONES:		
1	Primary Hydrocyclone quantity	:	2 sets (1W+1SB)
2	Secondary Hydrocyclone quantity	:	2 sets (1W+1SB)
3	Primary Hydrocyclone capacity	:	124.54 m^3/hr each

4	Secondary Hydrocyclone capacity	:	71.94 m^3/hr each
5	Type of Hydrocyclone	:	Vertical
6	Material (MOC) of Cyclone Clusters	:	Polyurethane/Urethane
7	MOC of Feed Chamber	:	CS+12 mm rubber lining
8	MOC of Overflow Chamber	:	CS+12mm rubber lining
9	MOC of Underflow Chamber	:	CS+12mm rubber lining

5.7 PROCESS WATER CHARACTERISTICS

A- CW BELOW DOWN WATER (Used for belt washing)

S. No.	Constituents	Unit	Water quality
1.	Calcium as $CaCo_3$	ppm	256
2.	Magnesium as $CaCo_3$	ppm	70
3.	Sodium + Potassium as $CaCo_3$	ppm	125
4.	Total cations CaCO3	ppm	451
5.	Bicarbonates CaCO3	ppm	178.5
6.	Carbonates CaCO3	ppm	0
7.	Nitrate as $CaCo_3$	ppm	0
8.	Chlorides as $CaCo_3$	ppm	75
9.	Sulphate as $CaCo_3$	ppm	197.5
10.	Total Anions $CaCo_3$	ppm	451
11.	Total Silica SiO_2	ppm	55
12.	Iron as Fe	ppm	1.5
13.	pH value	-	7.8 – 8.2
14.	Turbidity	NTU	100

B. Clarified water analysis (Used for cake washing)

S. No.	Constituents	Unit	Water quality
1	Calcium as $CaCo_3$	ppm	51.2
2	Magnesium as $CaCo_3$	ppm	14
3	Sodium + Potassium as $CaCo_3$	ppm	25
4	Total cations CaCO3	ppm	90.2
5	Bicarbonates CaCO3	ppm	35.7
6	Carbonates CaCO3	ppm	0
7	Nitrate as $CaCo_3$	ppm	0
8	Chlorides as $CaCo_3$	ppm	15*
9	Sulphate as $CaCo_3$	ppm	39.5
10	Total Anions $CaCo_3$	ppm	90.2

11	Total Silica SiO_2	ppm	11
12	Iron as Fe	ppm	0.3
13	pH value	-	6.8 – 8
14	Turbidity	NTU	20

Note: Any further water treatment required to achieve desired water quality is to be taken care by the bidder to meet the guaranteed parameters of the gypsum cake.

The chloride content is 10.7 ppm in the cake wash water

6.0	SPARES, TOOLS & TACKLES

6.1	START UP & COMMISSIONING SPARES
	Start-up & Commissioning Spares shall be part of the main supply of the GDWE. Start-up & commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares required for successful operation till commissioning of GDWE shall come under this category. Bidder shall provide an adequate stock of such start-up and commissioning spares to be brought by him to the site for the equipment erection and commissioning. The spares must be available at Site before the equipment's are energized. List shall be furnished by bidder along with bid as indicated at Section-III.
6.2	MANDATORY SPARES
a)	The list of mandatory spares considered essential by the BHEL's Customer/Employer is indicated in Annexure-II of Sub Section-D of Section-I in the specification. The bidder shall indicate the prices for each and every item (except for items not applicable to the bidder's design) in the 'Schedule of Mandatory Spares' whether or not he considers it necessary for the Employer to have such spares. If the bidder fails to comply with the above or fails to quote the price of any spare item, the cost of such spares shall be deemed to be included in the contract price. The bidder shall furnish the population per unit of each item in their Bid. Whenever the quantity is mentioned in "sets", the bidder has to give the item details and prices of each item.
b)	Whenever the quantity is indicated as a percentage, it shall mean percentage of total population of that item in the station (project), unless specified otherwise, and the fraction will be rounded off to the next higher whole number. One set for the particular equipment. e.g. 'set' of bearings for a pump would include the total number of bearings in a pump. Also the 'set' would include all components required to replace the item; for example, a set of bearings shall include all hardware normally required while replacing the bearings.
c)	The assembly / sub assembly which have different orientation (like left hand, right hand, top or bottom), different direction of rotation or mirror image positioning or any other regions which result in maintaining two different sets of spares to be used for subject assembly / sub-assembly shall be considered as different type of assembly/sub-assembly
d)	The prices of mandatory spares indicated by the Bidder in the Bid Proposal sheets shall be used for bid evaluation purposes.

e)	The Employer reserves the right to buy any or all the mandatory spare parts.
f)	Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until & unless specified otherwise.
Bidder to provide the split up price for mandatory spares during placement of order as per price format.	
6.3	RECOMMENDED SPARES:
	In addition to the spare parts mentioned above, the bidder shall also provide a list of recommended spares for 3 years of normal operation of the plant and indicate the list. This list shall take into consideration the mandatory spares specified in this Sub-Section and should be independent of the list of the mandatory spares.
6.4	SPECIAL TOOLS & TACKLES:
	Any special tools & tackles required for the entire equipment to disassemble, assemble or maintain the units, they shall be included in the quotation and furnished as part of the initial supply of the machine. List of special tools & tackles shall be decided by bidder as per his proven practice. When special tools are provided, they shall be packaged in separate, boxes with lugs and marked as "Special Tools for (tag / item number)." Each tool shall be stamped or tagged to indicate its intended usage. Levers and eye bolts for the removal of parts to be serviced shall be submitted with special tools. List shall be furnished by bidder along with bid as indicated at Section-III.

7.0	**FIRST FILL OF CONSUMABLES**
7.1	Bidder's scope shall include supply and filling of all chemicals, lubricants, grease, filters and consumable items for operation up to commissioning including top up requirements. All lubricants proposed for the plant operation shall be suitable for all operating and environmental conditions that will be met on site consistent with good maintenance procedures as instructed in the maintenance manuals.
7.2	Bidder shall also supply a quantity not less than 10% of the full charge or One (1) year of top-up requirement (whichever is higher) of each variety of lubricants, servo fluids, gases, chemicals etc. (as applicable) used which is expected to be utilized during the first year of operation. This additional quantity shall be supplied in separate containers.
7.3	Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals including items qualities and quantities required per month of the plant operation for the Customer/BHEL's approval herein shall be furnished within 2 months of placement of Order. On completion of erection, complete list of bearings/equipment giving their location and identification marks shall be furnished to BHEL along with lubrication requirements. All types of chemicals, consumables, lubricants and grease shall be readily obtainable locally and the number of different types shall be kept to a minimum. For each type and grade of lubricant recommended, bidder shall list at least three equivalent lubricants manufactured by alternative companies.

8.0	**LIST OF REFERENCE DRAWINGS BY BHEL**

The drawings specified in in Annexure-IV, Sub-Section-D of Section-I are being provided along with the tender specification for estimation and calculation purpose of the bidder.

9.0	**PAINTS /PAINTING**

Bidder shall follow BHEL/ Customer painting philosophy specified Sub-Section- C2-B Section-I in the specification. Bidder shall submit painting schedule as per customer specification for approval.

10.0 EXCLUSIONS

Below are excluded from scope of the GDWE Supplier:

a) All utilities such as instrument air and process water up to terminal point
b) Control System (excluding Junction box)
c) Lifting equipments for Material handling
d) 3D Modeling
e) Gypsum Conveyor from the discharge of chute.
f) Tanks and their instruments & Slurry Pumps (except Filtrate Extraction)
g) Vibration Monitoring System for HT motors.
h) Civil work

11.0 BID EVALUATION CRITERIA FOR POWER CONSUMPTION- Refer Annexure –IV of Price schedule.

Bidder is required to quote Guaranteed Power Consumption (GPC) in the price schedule format issued along with tender. In case of non-submission of filled up format, the bid shall be liable for rejection. Value for power consumption quoted by the bidder in the specified format, shall be considered as final and any request by bidder for any change in quoted power consumption at a later date, shall not be considered by BHEL.

SECTION: I

SUB-SECTION: C 2

CUSTOMER SPECIFICATION

5.00.00	**GYPSUM DEWATERING SYSTEM**
5.01.00	The employer envisages a common gypsum dewatering system for all the units. The common dewatering system shall receive the gypsum slurry from each absorber through slurry feed pipes and shall comprise of two sets of dewatering equipments.
5.02.00	Each set (suitable for handling /dewatering of all the unit) of dewatering equipment (01 working set + 01 standby set) shall comprise of the following items as a minimum requirement: i. One set of primary hydro-cyclones ii. One vacuum belt filter iii. One no. vacuum receiver iv. One no. vacuum pump v. One set of secondary hydro-cyclones vi. Complete piping and valves for the system along with wash water line.

5.03.00	This system shall be comprising of 2x100% gypsum dewatering system with each stream sized to dewater 110% of the maximum gypsum produced by all the units operating simultaneously at Design Point, with any range of limestone specified. All other stipulations with respect to sizing and design of the dewatering system, auxiliaries and other systems shall be in line with this specification.
5.04.00	The filtrate water from belt filter dewatering and wash water from washing system and the under flow from the secondary hydro-cyclone shall be taken to a common filtrate water tank. 2x100% pump shall be provided for belt washing to the belt filters. In addition, 2x100% Filtrate water pump (common for all units) shall be provided to recycle the filtrate to the absorber. The contractor shall include the necessary piping and valves in their scope.
5.05.00	The gypsum slurry from each Absorber shall be fed to a common Primary hydro cyclone feed tank (sized for minimum 1 hr storage capacity) from where it will be fed to each primary set of hydro-cyclone through 2x100% Primary hydro cyclone pumps. The overflow from the primary set of hydro-cyclone shall be taken to a common Secondary hydro cyclone feed tank. 2x100% Secondary hydro cyclone pumps shall be provided to feed 2x100% secondary hydro-cyclones. The underflow from the primary hydro-cyclone shall be fed to the 2X100% vacuum belt filter system.
5.06.00	The under flow from the secondary hydro-cyclone shall be taken to the filtrate water tank. The over flow from the secondary hydro-cyclone shall be taken to a waste water neutralization system to be provided by the Contractor. The waste water system shall be complete with lime feeding & storage system, neutralization tank, waste water tank, 2x100% waste water pumps along with complete piping, instrumentation, valves, piping support etc. to discharge waste water at required pressure to waste water terminal point as indicated in Sub-section IV, Part A, Section VI of the Technical Specification. All the piping with supports, trestles as required shall be in the contractors' scope. The contractor shall also include any other item not included above but necessary to make the system complete.
5.07.00	The complete Gypsum Dewatering System shall be installed inside a building to be provided by the Contractor as per specifications specified elsewhere. The building must be complete in all respect specially facilitating the smooth operation and maintenance of associated equipment's of above systems by providing adequate maintenance space, handling facilities, walkways, staircase & one (1) number passenger cum goods elevator of minimum capacity of 1000 kgs for easy access & movement of man/materials. etc. The building shall be sufficiently ventilated.

7.00.00	**GYPSUM DEWATERING SYSTEM**
7.01.00	A common gypsum dewatering system for all the units operating at Design point is envisaged. Contractor shall supply a two stage gypsum dewatering system, consisting of a primary stage of sets of hydro-cyclones and secondary stage of vacuum belt filters for dewatering of gypsum from absorber up to less than 10% moisture. All the equipments supplied shall be proven design with previous installations for similar capacities.
7.02.00	The Contractor shall provide 2x100% gypsum dewatering system with each stream sized to dewater 110% of the maximum gypsum produced by all the units operating at Design point. All other stipulations with respect to sizing and design of the dewatering system, auxiliaries and other systems shall be in line with this specification.
7.03.00	**Primary Dewatering Hydro-cyclones**
7.03.01	Each set of primary dewatering hydro-cyclone shall be sized to dewater the gypsum slurry produced by all the units operating at Design point with an additional 10% margin. The outlet water content in the gypsum shall be as per the requirement of the vacuum belt filters.
7.03.02	Each set of primary hydro-cyclone shall be provided with 10% spare hydro-cyclones. The capacity defined in the previous clause shall be met with spare hydro-cyclones out of service.
7.03.03	The primary hydro-cyclone shall be installed directly above the belt filters. The overflow of the hydro-cyclones shall be taken to Hydro-cyclone Waste Water tank via secondary hydro-cyclone feed tank and secondary waste water hydrocyclone as shown in the relevant tender drawing.
7.03.04	Hydro-cyclones shall be of modular construction. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose.

7.03.05 The hydro-cyclone shall be of proven design. The primary hydro-cyclone shall be made up of polyurethane or urethane or replaceable rubber linings. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose. The feed chamber shall be provided with a minimum rubber lining thickness of 12mm. The liners shall have a minimum wear life of not less than 8000 hrs.

7.04.00 Vacuum Belt Filters

7.04.01 Each vacuum belt filter shall be sized to meet the following requirements, all occurring together, with an inlet solid concentration of not more than 45% or outlet of hydro-cyclones whichever is minimum:

a.	Capcity	110% of gypsum produced by Absorbers of all the units operating at Design point.
b.	Outlet Moisture	10% max.
c.	Gypsum Purity	90% (minimum)
d.	Chloride content	< 100 ppm

7.04.02 The vacuum belt filter shall be proven design in operation for similar capacities. The design, manufacture, installation and testing of Vacuum Belt Filters shall follow the latest applicable Indian / International (ASME /EN / Japanese) Standards. The filter cloth shall be polyester or polypropylene as per the proven design of the supplier and shall be guaranteed for a minimum life of not less than 7000 hrs.

7.04.03 The complete frame of the filter and all parts in contact with gypsum shall be made with corrosion resistant material i.e Corten Steel or SS304.

7.04.04 In case, the contractor offers a design with an underlying belt for carrying the filter cloth, the same shall be single piece, factory or Site vulcanized rubber belts. The belt shrouds and the sealing belts shall provide a leak tight arrangement to prevent overflow of gypsum slurry. The sealing belt shall have minimum life of not less than 7000 hrs.

7.04.05 The vacuum box shall ensure tight sealing with the belt/cloth and shall be of proven design.

7.04.06 The belt filter shall have an automatic cloth tracking mechanism and shall be provided with all required instrumentation as per the supplier's proven practice. The belt filter shall have an automatic cloth tensioning mechanism.

7.04.07 The filter shall be provided with minimum 2 stages of cake washing for removing impurities in the gypsum. For cake washing only clarified water shall be used. For this purpose, one (1) clarified water storage tank (minimum 1 hr storage) shall be provided along with 2x100 cake washing pumps for each Vacuum Belt Filter . One

	stage of cloth washing arrangement shall also be provided along with 2x100 cloth washing pumps for each Vacuum Belt Filter.
7.04.08	The filtrate from gypsum slurry and from cake washing shall be taken to a common or separate vacuum receiver tank(s) as per the proven practice of the supplier. Each belt filter shall have an independent vacuum pump.
7.04.09	Gypsum cake from each belt filter shall be discharged through a hopper onto belt conveyor being provided by the Contractor.
7.04.10	A 2 m (min.) wide platform shall be provided around each belt filter for easy approach & maintenance. Handling facilities for replacement of heavy components of the belt shall also be provided.
7.04.11	The design and manufacturing of vacuum belt fil-ter shall follow the latest applicable Indian / Inter-national (ASME / EN / Japanese) Standards.
7.05.00	**Vacuum System**
7.05.01	The filtrate from each belt filter, cake washing & cloth washing shall be taken to a common or separate receiver tank(s) as per the supplier's proven practice.
7.05.02	Each belt filter shall be provided with an independent vacuum pump sized to meet the requirements of the belt filter operating at its maximum capacity. An additional margin of 10% (min.) over the above capacity shall be provided for each vacuum pump.
7.05.03	The vacuum pump shall be of low speed liquid ring type of proven design. The design of the vacuum pumps shall avoid cavitations under all operating conditions. The seals shall be of proven design.
7.05.04	Silencers shall be provided, if required, to limit the noise level to values stipulated elsewhere in this specification.
7.05.05	The vacuum receiver and pump internals shall be suitably lined to protect against the corrosive environment. The material selected for vacuum pumps & vacuum receivers shall be proven for similar application.
7.05.06	Each vacuum receiver tank(s) shall be provided with slide plate type pneumatic vacuum breaker. The plate shall be stainless steel with a min. thickness of 3 mm.
7.06.00	**Filtrate System**
7.06.01	Water from vacuum receiver tank(s) and the secondary waste water hydrocyclone underflow shall be taken to a common filtrate tank for recirculation to the absorber tanks.
7.06.02	2x100% horizontal centrifugal pumps shall be provided for recirculation of filtrate water to absorber. 2x100% horizontal centrifugal pumps shall be provided for wash

	water requirements of belt filter. Alternatively, wash water pump may take suction from the vacuums receiver tanks. Each pump shall be provided with 100% standby in such a case.
7.06.03	The pump shall be capable of pumping of filtrate water with solid concentration of not less than 10% & particle lumps of 6-7mm. A 10% margin shall be provided in each of the pump.
7.07.00	**Waste Water System**
7.07.01	The overflow of the primary hydro-cyclones shall be taken to a secondary hydrocyclone feed tank for feeding the secondary waste water hydro-cyclones.
7.07.02	The secondary hydrocyclone feed tank shall be sized to provide a minimum storage of 1 hr of primary hydro-cyclone overflow with all the units operating at Design Point and no outflow from the tank.
7.07.03	2x100% horizontal centrifugal pumps shall be provided to feed the secondary hydro-cyclones.
7.07.04	Each set of hydro-cyclone shall be sized to process the maximum discharge from the secondary hydro-cyclone feed pumps. A minimum 10% spare hydro-cyclones shall be provided in each set. Secondary Hydro-cyclones shall be of modular construction and of proven design. The secondary hydro-cyclone shall be made up of polyurethane or urethane or replaceable rubber lining. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose.
7.07.05	The secondary waste water underflow shall be taken to the adequately sized filtrate tank, while the overflow shall be taken to a waste water tank. In case Bidder opts to provide additionally Lamella separator before the waste water tank and after the secondary hydro cyclone for removing impurities from the system, the solids concentration in waste water up to max 10% can be acceptable .However, the required moisture content in Gypsum & required Gypsum quality shall be complied.
7.07.06	1x100% Waste water tank shall be provided which shall be sized for 8 hrs storage of waste water with all the units operating at Design point and no out flow from the tank. The Waste water Tank shall be complete with Agitator, level transmitters etc. The waste water collection tank shall be of Steel construction with Vinyl Ester based flake glass lining of minimum 3 mm thickness. 2x100% horizontal centrifugal pumps shall be provided for pumping the waste water from waste water tank at required pressure to waste water terminal point as indicated in Sub-section IV, Part A, Section VI of the Technical Specification. The material of Casing shall be rubber lined or Hi chrome steel. The impeller shall be made of Hi chrome steel. Shaft shall be 410 & Shaft Sleeves shall be of Stainless Steel - 316.

7.07.07	All piping, valves & instrumentation upto the employer's terminal point shall be in the contractor's scope. Contractor shall provide the complete lime dosing system to correct the pH of the waste water by lime (83% purity) dosing shall be provided and after mixing of the effluent (using re-circulation system of the pumping system), the effluent shall be discharged once the waste water has been neutralized to desired pH. A pH monitor shall be provided at the discharge of the pumps for measurement and control. Complete lime storage, feeding & dosing system shall be in contractor scope. The complete waste water neutralization system shall be automated and controlled from the control room.
7.07.08	Contractor shall provide 2x 100% Lime Neutralization tanks which shall be of minimum 8 hr capacity made of carbon steel with rubber lining along with 2x100% Lime storage silos. The tanks shall be provided with SS dissolving basket, Agitator of SS construction, drain, over flow and dosing connection, level transmitters, Agitators etc. The storage silos and hopper cones shall be fabricated of minimum 10 mm thick carbon steel with a SS lining of grade SS304 of minimum 4 mm thickness in the complete cones to ensure reliable discharge of material. The design of storage silos shall confirm to IS 9178 or any other proven international standards. The storage silo shall be capable of feeding the lime by motorized rotary feeding system to the Lime Neutralization tank.
7.07.09	Contractor shall provide 2x 100% Lime Storage Silos for feeding lime to the Lime Neutralization tanks. The lime storage silo shall be of minimum 24 hr capacity equivalent to the requirements of FGD system of all the units at Design point and shall be complete with supporting steel structure, platforms, power operated outlet gates, level switches, air relief devices, etc. Hydrated lime shall be supplied by the employer in the form of bags. For sizing purpose, bulk density of hydrated lime shall be considered as 480 kg/m3. For dust free operation each silo should be provided with a covering arrangement and a self cleaning bag filter system of suitable capacity containing blower, automatic/on-load cleaning system, etc.
7.07.10	Bucket conveyors shall be provided by the contractor to feed lime to each of the lime storage silos from ground level. The Bucket conveyors shall be sized to completely feed each lime silo within 2 hrs. Adequate storage and feeding system required for feeding the lime to the Bucket conveyors is also in the Contractor's scope.
7.07.11	A storage room for storing minimum one (1) month requirement of lime for all the units shall also be provided by the contractor.
7.08.00	**Auxiliary Absorbent Tank**
7.08.01	The Contractor shall provide an auxiliary absorbent tank, for the unit, sized to contain the complete slurry of one absorber tank at its maximum level equipped with all necessary pumps, valves, piping and controls to transfer the tank's contents back to the absorber to refill the absorber sump. It should be possible to discharge each absorber into the Auxiliary Absorbent tank within 2 hours up to the suction line of the intended pump. Further, Bidder to provide the portable pumps of suitable capacity to drain the remaining slurry from the tank in max 2 hour into absorber area sump.
7.08.02	The contractor shall provide 1 x100% pump to pump back the slurry from the sump back to the absorber in a maximum time of 8 hours.

7.08.03	Agitation shall be provided to prevent settlement of slurry by top entry agitators with emergency flush start system. Sufficient number of agitators shall be provided in the tank by the contractor to prevent the solids from settling down.
7.08.04	The Auxiliary Absorbent tank shall be made of minimum 7 mm thick carbon steel with minimum 4 mm thick rubber lining of best quality bromine butyl rubber and shall also be equipped with all necessary pumps, valves, piping and controls to transfer the tank's contents back to the absorber.
7.08.05	The Auxiliary Absorbent tank shall be equipped with an opening to enable easy entry of a man with wheelbarrow.
7.08.06	Suction screens shall be installed to protect the pump.
7.09.00	Hardness of rubber lining wherever applicable (tank, pipes etc) shall be 55±5 durometer (Shore A).

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SUB-SECTION: C 2A

CUSTOMER SPECIFICATIONS

PROJECT SPECIFIC GENERAL REQUIREMENTS

SUB-SECTION-VI

FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES

FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE AND PERFORMANCE GUARANTEE TESTS

1.00.00 GENERAL

The term "Performance Guarantees" wherever appears in the Technical Specifications shall have the same meaning and shall be synonymous to "Functional Guarantees". Similarly the term "Performance Tests" wherever appears in the Technical Specifications shall have the same meaning and shall be synonymous to "Guarantee Test(s)".

2.00.00 PERFORMANCE GUARANTEES / PERFORMANCE TESTS

2.01.00 **General Requirements**

2.01.01 The Contractor shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in these specifications.

2.01.02 The guaranteed performance parameters furnished by the Bidder in his offer, shall be without any tolerance values whatsoever. All margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures. No tolerance or allowance on the test result will be permitted for instrument errors or inaccuracy, the method of testing or any other causes.

2.01.03 The Contractor shall conduct performance test and demonstrate all the guarantees covered herein. The various tests which are to be carried out during performance guarantee tests are listed in this Sub-section. The guarantee tests shall be conducted by the Contractor at site in presence of Employer on each unit individually.

2.01.04 All costs associated with the tests including cost associated with the supply, calibration, installation and removal of the test instrumentation shall be included in the contract price.

2.01.05 The performance tests shall be performed using only the normal number of Employer supplied operating staff. Contractor, vendor or other subcontractor personnel shall be used only for instructional purposes or data collection. At all times during the Performance Tests the emissions and effluents from the Plant shall not exceed the Guaranteed Emission and Effluent Limits.

2.01.06 It shall be responsibility of the Contractor to make the plant ready for the performance guarantee tests.

2.02.00 **Test Instrumentation, Flow Measurement and their Calibration**

2.02.01 All instruments required for performance testing shall be of the type and accuracy required by the code and prior to the test, the Contractor shall get these instruments calibrated in an independent test Institute approved by the Employer and submit the same to Employer prior to commencement of test. All test instrumentation required for performance tests shall be supplied by the Contractor and shall be retained by him upon satisfactory completion of all such tests at site. All calibration procedures and standards shall be subject to the approval of the Employer prior to commencement of test. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes.

Tools and tackles, thermowells (both screwed and welded) instruments/devices including flow devices, matching flanges, impulse piping & valves etc. and any special equipment, required for the successful completion of the tests, shall be provided by the Contractor free of cost.

The Performance test shall be carried out as per the agreed procedure. The detailed PG test procedure shall be submitted within 90 days of the date of Notification of Award and finalization of the PG test procedure shall be done within 180 days from the date of Notification of Award.

All test instrumentation, Personal computer(s), necessary server and required interface, software for on line computation of test results & report as required for performance guarantee tests shall be supplied by the contractor and shall be retained by the Employer.

Category II guarantees, which shall not possible to demonstrate on line as per agreed PG test procedure, shall be excluded for on line demonstration.

2.02.02 The P&G test procedures shall be submitted for equipments/system & subsystem under Contractor's scope for all Guarantees as mentioned below, as per latest International codes / standard including correction curves, meeting the specification requirements along with sample calculations & detailed activity plan of preparation (including test instrumentation), conductance and evaluation of Guarantees.

2.02.03 The Contractor shall submit for Employer’s approval the detailed Performance Test procedure containing the following:

(a) Object of the test.

(b) Various guaranteed parameters & tests as per contract.

(c) Method of conductance of test and test code.

(d) Duration of test, frequency of readings & number of test runs.

(e) Method of calculation.

(f) Correction calculations & curves.

(g) Instrument list consisting of range, accuracy, least count, and location of instruments.

(h) Scheme showing measurement points.

(i) Sample calculation.

(j) Acceptance criteria.

(k) Any other information required for conducting the test.

2.03.00 **Test Reports**

After the conductance of Performance test, the Contractor shall submit the test evaluation report of Performance test results to Employer promptly but not later than one month from the date of conductance of Performance test. Preliminary test reports shall be submitted to the Employer after completing each test run. Four (4) hard copies and two (2) soft copies on CD-ROM of each test report of final conducted test on each equipment/plant/system shall be submitted to Employer for approval.

2.03.01 Performance Guarantee Tests on the equipments/systems not covered in this Sub-section shall be carried out as per the procedure/test codes specified in respective detailed specifications.

2.04.00 **Acceptance of Guarantee Test Results**

(i) For Category-I Guarantees

In case during performance guarantee test(s) it is found that the equipment/system has failed to meet the guarantees, the Contractor shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the Employer and re-conduct the performance guarantee test(s) with Employer's consent. In case the specified performance guarantee(s) are still not met but are achieved within the Acceptable Shortfall Limit as specified at **clause 3.00.00** of this sub-section, Employer will accept the equipment/system/plant after levying liquidated damages as per **clause 3.00.00** of this sub-section. However, if, the demonstrated performance guarantee(s) continue to be beyond the stipulated Acceptable Shortfall Limit, even after the above modifications/replacements within ninety (90) days or a reasonable period allowed by the Employer, after the tests have been completed, the Employer will have the right to either of the following:

Reject the equipment / system / plant and recover from the Contractor the payments already made

OR

Accept the equipment /system/ plant after levying Liquidated Damages. The liquidated damages for shortfall in performance indicated in clause 3.00.00 of this sub-section shall be levied separately for each unit. The rates indicated in clause 3.00.00 of this sub-section are on per unit basis. The liquidated damages shall be pro-rated for the fractional parts of the deficiencies.

(ii) For Category-II Guarantees

In case during performance guarantee test(s) it is found that the equipment/ system has failed to meet the guarantees, the Contractor shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the Employer and re-conduct the performance guarantee test(s) with Employer's consent. In case the specified performance guarantee(s) are still not met even after the above modifications/replacements with in ninety (90) days or a reasonable period allowed by the Employer, after the tests have been completed, the Employer will have the right to either of the following:

Reject the equipment /system / plant and recover from the Contractor the payments already made.

OR

Accept the equipment/system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the Employer. Such damages shall, however be limited to the cost of replacement of the equipment(s)/system(s), replacement of which shall remove the deficiency so as to achieve the guaranteed performance. These parameters/capacities shall be termed as “Category-II” Guarantees.

3.00.00 AMOUNT OF LIQUIDATED DAMAGES (LD) APPLICABLE FOR GUARANTEES FOR EACH PROJECT

The rate of liquidated damages and acceptable shortfall limits for different guarantees shall be as under and such liquidated damages shall be deducted from the Contract Price of the project.

SIPAT-II (2X500 MW)

Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
i)	**SO_2 Removal Efficiency** For shortfall in guaranteed SO_2 removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	**INR 2,525,692/-** (INR Two Million Five Hundred Twenty Five Thousand Six Hundred Ninety Two only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value.	(-)0.25% point from the guaranteed SO2 removal efficiency.
ii)	**Limestone Consumption** For increase in the limestone consumption of FGD system in Kg/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	**INR 16,422,350/-** (INR Sixteen Million Four Hundred Twenty Two Thousand Three Hundred fifty only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.
iii)	**Auxiliary Power Consumption** For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	**INR 107,730/-** (INR One Hundred Seven Thousand Seven Hundred Thirty only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)5% of the guaranteed auxiliary power consumption

NOTES APPLICABLE FOR EACH PROJECT:

i) Each of the liquidated damages specified above shall be independent and these liquidated damages shall be levied concurrently as applicable.

ii) All these liquidated damages for short fall in performance shall be deducted from the contract price as detailed in accompanying General Conditions of Contract (GCC)/ Special Conditions of Contract (SCC)

iii) Contractor's aggregate liability to pay Liquidated Damages (LD) for failure to attain the functional guarantee shall not exceed twenty five percent (25%) of the Contract Price.

iv) The LD values are applicable on per unit basis.

4.00.00 GUARANTEES PARAMETERS

4.01.00 **Guarantees Under Category-I**

The Performance Guarantees which attract Liquidated Damages (LD) are as follows:

The following shall be guaranteed by the Bidder under guarantee point condition of Sub- Section-V, Part-A of section- VI:

(i) SO_2 removal Efficiency

The Contractor shall guarantee that SO_2 removal efficiency shall not be less than the value specified under guarantee point conditions (as specified in Sub-section-V, Part-A of Section-VI applicable for respective project). (To be conducted as per the stipulation of Cl. no. 6.00.00 of this sub-section.)

(ii) Limestone Consumption

The Contractor shall guarantee that limestone consumption of FGD system in kg/hr shall not be more than the value specified under guarantee point conditions (as specified in Sub-section-V, Part-A of Section-VI applicable for respective project).

(iii) Auxiliary Power Consumption

The Contractor shall guarantee that total auxiliary power consumption for the unit in normal operation shall not be more than the value specified under guarantee point conditions (as specified in Sub-section-V, Part-A of Section-VI applicable for complete scope of work for the respective project), inline with the requirements stipulated in clause 5.00.00 of this Sub-Section.

iv) Transformer losses

The Contractor shall guarantee that total losses of following FGD Tie transformers & transformers for Owner's use supplied under this contract shall not exceed the values indicated in the table below:

S No.	Project	Rating (MVA)	Voltage ratio (kV)	Total Losses at 75°C : No load loss + Load Loss (@100%) + Aux losses (kW)
1	Rihand	50 MVA	132/34 .5	208
		12.5 MVA	33/11.5	80

For fulfilment of guarantee, the maximum losses measured during factory tests shall be considered. The rate of liquidated damages for shortfall in performance shall be as specified for Auxiliary power consumption in Clause 3.00.00 Sub-section-VI, Part-A of Section-VI as applicable for respective project.

4.02.00 Guarantees Under Category-II (applicable for Barauni & Kanti)

The parameters/capabilities shall be demonstrated for various systems/ equipments shall include but not limited to the following:-

(i) Wet ball Mill capacity at rated fineness

The contractor shall demonstrate the guaranteed capacity of each limestone pulverizer under the following conditions:

i) Limestone Output fineness : 90% or higher (as per the requirement of the absorber) through 325 mesh (for spray tower process)
(OR)
90% or higher (as per the requirement of the absorber) through 200 mesh (for bubbling process)

ii) Limestone Quality : All available quality from the specified range.

(ii) Wet ball Mill wear parts guarantee

Contractor shall demonstrate the life of wet ball Mill wear parts in line with requirements stipulated in Part B of the Technical Specification. The establishment of the above guarantee shall be based on the operating records available at the Power station and will be computed for each pulverizer based on actual total hours of operation.

(iii) Wet ball Mill ball consumption

b) Gypsum Handling Plant

The Bidder shall demonstrate the guaranteed conveying from belt filter to storage shed/silo including all intermediate equipment & conveyors.

5.00.00 AUXILIARY POWER CONSUMPTION (PA) FOR EACH PROJECT

The unit auxiliary power consumption shall be calculated using the following relationship.

Pan = Pun + TLu

Pan = Guaranteed Auxiliary Power Consumption for unit # n (Where "n" is the unit number e.g. 1, 2, ……)

Pun = Power consumed by the auxiliaries of the unit under test

TLu = Proportional Losses of transformers for one Unit/Block

TL = Losses of all the transformers supplied by bidder based on works test Reports (excluding FGD Tie transformers(220 kV & 132kV class) & transformers for Owner's use listed in Clause 4.01.00 iv) as applicable in respective project)

Tlu shall be calculated as below:

TLu=(TL / Total MW capacity under the present contract) x (capacity in MW for FGD (unit/block) under test)

While guaranteeing the auxiliary power consumption of each project the bidder shall necessarily include all continuously operating auxiliaries under this package. The auxiliaries to be considered shall include but not be limited to the following:

i. Absorber Recirculation Pump(s)/Gas Cooling Pumps

ii. Absorber Oxidation Air Blower(s)

iii. Absorber Oxidation Tank Agitators

iv. Gypsum Bleed Pumps

v. Limestone Gravimetric feeder, Wet ball mill and their integral Auxiliaries divided by the number of units in the project

vi. Limestone Slurry Pump(s)

vii. Vacuum Belt Filter, Vacuum Pump and its integral auxiliaries divided by the number of units in the project

viii. Power consumption of all working Booster water pumps (if provided) to ACW pumps after PHE divided by the number of units in the project

ix. Power consumption of Clarified water pumps (if provided) and Clarified booster water pumps (if provided) divided by the number of units in the project

x. Power consumption of Process water pump(s) divided by the number of units in the project

xi. Mist Eliminator Wash Water pump(s)

xii. Power consumption of Belt Filter Wash Water Pump divided by the number of units in the project

xiii. Power consumption of total number of DM Cooling (working) Water pump to supply cooling water on the primary (DM) side of the plate type heat exchangers in the closed loop Equipment cooling water system divided by the number of units (working) in the project

xiv. Power consumption of total number of Auxiliary Cooling (working) water pump/Permeate water pump to supply cooling water on the secondary side of the plate type heat exchangers in the closed loop Equipment cooling (unit auxiliary) water system divided by the number of units (working) in the project

xv. Booster Fans

xvi. Power consumption of Limestone Slurry Tank Agitator(s) divided by the number of units in the project

xvii. Power consumption of Filtrate Pump(s) divided by the number of units in the project

xviii. Power consumption of Cloth Wash Water Pump divided by the number of units in the project

xix. Power consumption of Hydro-cyclone and Waste Water Pump divided by the number of units in the project

xx. Power consumption of all other continuous running Agitators divided by the number of units in the project

xxi. Air Conditioning System (*)

Total Power consumption at motor input terminals of working units (i.e. excluding stand-by) at its rated duty point of compressor and condenser fans of air cooled condensing unit, Air handling unit (AHU) fans for the Air conditioning system of FGD Control Room Building divided by total nos. of units in respective project

xxii Total power consumption at motor input terminal at rated duty of fan of UAF divided by total nos. of units in respective project. (*)

((*) Above guaranteed power consumption values shall be at 20 deg C for centrifugal fans of AHUs and at 30 deg C for centrifugal fans of UAF units and at an elevation of RL (referring to GLP of respective projects) for both AHUs and UAF centrifugal fans.)

xxiii Total power consumption at motor input terminal at rated duty of Air compressor, Air drying plant (Heater and blower, as applicable) divided by total nos. of units in respective project.

xxviii. Power consumption for all the equipment's including auxiliaries with single stream operation of lime stone handling, crushing and gypsum handling plant as applicable at its guaranteed flow path capacity in T/Hr shall be considered. Loading factor to be considered as 0.25 for lime stone handling and crushing plant equipment and 1 for Gypsum handling plant.

For APC following equipment shall be considered in general for material handling system: Truck Tippler with Box feeder/Bulk material receiving unit/ /Surface Feeder, Paddle Feeder/Apron Feeder (as applicable), Vibrating feeders, Belt Conveyors and Belt Feeders, Bucket Elevators, Reversible belt feeder/Plough feeder, Travelling tripper, Any other equipment not included under exclusion.

Following equipment shall be under exclusion for purpose of APC: Lighting, Hoist, Lime Sampling unit, Sump Pumps, Elevators, DS, DE, SW System and Potable water

NOTE:

1. The equipment's listed above for calculating auxiliary power consumption are indicative. Any other equipment required for continuous operation of the system shall also be considered for calculation of auxiliary power consumption. Power consumption of all equipments provided on unitized basis shall be included in the unit auxiliary power consumption. For common station auxiliaries, the power consumption shall be assigned to each unit based on unit load for the purpose of calculating the unit auxiliary power consumption.

2. The bidder shall furnish a list of equipments to be covered under auxiliary power consumption, which shall be subject to Employer's approval.

3. Transformer losses (TL) shall be considered as per following (as applicable)- FGD HT/Aux/LT Outdoor/ LT Indoor Transformer: 100 % No load loss and 25 % of Copper Losses.

4. Auxiliary power shall be measured without SCR (De-NOx) system.

5. Auxiliary power shall be measured at the switchgear of the drives.

6.00.00 METHOD OF COMPUTING TEST EFFICIENCY OF FGD

NTPC Limited

(A Government of India Enterprise)

LOT-6 PROJECTS

PART - C

GENERAL TECHNICAL REQUIREMENTS

SECTION – VI

FOR

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

BIDDING DOCUMENT NO.: CS-0011-109(6)-9

PART - C

GENERAL TECHNICAL REQUIREMENTS

GENERAL TECHNICAL REQUIREMENTS

PART - C

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1.00.00 INTRODUCTION

This part covers technical requirements which will form an integral part of the Contract. The following provisions shall supplement all the detailed technical specifications and requirements brought out in Section-VI, the Technical Specification and the Technical Data Sheets.

2.00.00 **BRAND NAME**

Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific item mentioned shall be understood to be indicative of the function and quality desired, and not restrictive; other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.

3.00.00 **BASE OFFER & ALTERNATE PROPOSALS**

The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognised that the Contractor may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Employer. Sufficient amount of information for justifying such proposals shall be furnished to Employer alongwith the bid to enable the Employer to determine the acceptability of these proposals.

4.00.00 **COMPLETENESS OF FACILITIES**

4.01.00 Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure a completely engineered plant shall be provided.

4.02.00 All equipments furnished by the Contractor shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions.

All same standard components/ parts of same equipment provided, shall be interchangeable with one another.

4.03.00 For the C&I systems, the Contractor shall be required to provide regular information about future upgrades and migration paths to the Employer.

5.00.00 **RULES, REGULATIONS, CODES & STANDARDS**

5.01.00 In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India, NTPC rules/codes of practices as well as of the locality where they will be installed, including the following:

a) Indian Electricity Act

b) Indian Electricity Rules

c) Indian Explosives Act

d) Indian Factories Act and State Factories Act

e) Indian Boiler Regulations (IBR)

f) Regulations of the Central Pollution Control Board, India

g) Regulations of the Ministry of Environment & Forest (MoEF), Government of India

h) Pollution Control Regulations of Department of Environment, Government of India

i) State Pollution Control Board.

(j.) Rules for Electrical installation by Tariff Advisory Committee (TAC).

(k.) Building and other construction workers (Regulation of Employment and Conditions of services) Act, 1996

(l.) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998

(m.) Explosive Rules, 1983

(n.) Petroleum Act, 1984

(o.) Petroleum Rules, 1976,

	(p.) Gas Cylinder Rules, 1981
	(q.) Static and Mobile Pressure Vessels (Unified) Rules, 1981
	(r.) Workmen's Compensation Act, 1923
	(s.) Workmen's Compensation Rules, 1924
	(t.) NTPC Safety Rules for Construction and Erection
	(u.) NTPC Safety Policy
	(v.) Any other statutory codes / standards / regulations, as may be applicable.
5.02.00	Unless covered otherwise in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply:
	a) Bureau of Indian standards (BIS)
	b) Japanese Industrial Standards (JIS)
	c) American National Standards Institute (ANSI)
	d) American Society of Testing and Materials (ASTM)
	e) American Society of Mechanical Engineers (ASME)
	f) American Petroleum Institute (API)
	g) Standards of the Hydraulic Institute, U.S.A.
	h) International Organisation for Standardisation (ISO)
	i) Tubular Exchanger Manufacturer's Association (TEMA)
	j) American Welding Society (AWS)
	k) National Electrical Manufacturers Association (NEMA)
	l) National Fire Protection Association (NFPA)
	m) International Electro-Technical Commission (IEC)/European Norm (EN)
	n) Expansion Joint Manufacturers Association (EJMA)
	o) Heat Exchange Institute (HEI)

	p) IEEE standard
	q) JEC standard
5.03.00	Other International/ National standards such as DIN, JIS, VDI, EN, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English.
5.04.00	Not used.
5.05.00	In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.
5.06.00	Two (2) English language copies of all national and international codes and/or standards used in the design of the plant, equipment, civil, structural and architectural works shall be provided by the Contractor to the Employer within two calendar months from the date of the Notification of Award.
5.07.00	In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.
5.08.00	A detailed list of standards apart from those mentioned in the respective detailed specifications in other parts of Section-VI to which all equipment/systems/civil works should conform as indicated in this Part C and elsewhere in the specification.
6.00.00	**EQUIPMENT FUNCTIONAL GUARANTEE**
6.01.00	The functional guarantees of the equipment under the scope of the Contract is given in Section-VI Part - A of Technical Specifications. These guarantees shall supplement the general functional guarantee provisions covered under Defect liabilities Section-IV, General Conditions of Contract.
6.02.00	Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Contractor as specified elsewhere in this specification.

7.00.00 **DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS**

7.01.00 **DESIGN OF FACILITIES**

All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere.

The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical or close to the operating range of the unit.

7.02.00 **MAINTENANCE AND AVILABILITY CONSIDERATIONS**

Equipment/works offered shall be designed for high availability, low maintenance and ease of maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability/ availability and ease of maintenance. The Bidder shall also furnish details of availability records in the reference plants stated in his experience list.

Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely inspection of the furnace, inspection of the entire hot gas path and the minor and major overhauls shall be specified in terms of fired hours , clearly defining the spare parts and man-hour requirement for each stage.

Lifting devices i.e. hoists and chain pulley jacks ,etc. shall be provided by the contractor for handling of any equipment or any of its part having weight in excess of 500 Kgs during erection and maintenance activities.

Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist / crane shall be provided by the contractor for lifting the equipment and accessories covered under the specification.

8.00.00 **DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR**

8.01.00 Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required to ensure a completely

engineered plant shall be provided in respect of mechanical, electrical, control & instrumentation, civil & structural works as per the scope.

Each main and auxiliary equipment/item of the plant including instruments shall be assigned a unique tag number. The assignment of tag numbers shall be in accordance with KKS system. In all drawings/documents/data sheet etc. KKS tag number of the equipment/item/instrument etc. shall be indicated.

The Contractor shall furnish engineering data /drawings in accordance with the schedule of information as specified in Technical Data Sheets and Technical Specification.

A comprehensive engg and quality coordination procedure shall be finalized with the successful bidder covering salient features as described in this section of specifications.

8.02.00 The number of copies/prints/CD-ROMs/manuals to be furnished for various types of document is given in **Annexure-VI** to this Part-C, Section-VI of the Technical Specification.

8.03.00 The documentation that shall be provided by the Contractor is indicated in the various sections of specification. This documentation shall include but not be limited to the following:

8.03.01 A) **BASIC ENGINEERING DOCUMENTATION**

Prior to commencement of the detailed engineering work, the Contractor shall furnish a Plant Definition Manual within 12 weeks from the date of the Notification of Award. This manual shall contain the following as a minimum:

i) System description of all the mechanical, electrical, control & instrumentation & civil systems.

ii) Technology scan for each system / sub-system & equipment.

iii) Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options.

iv) Optimisation studies including thermal cycle optimisation.

v) Sizing criteria of all the systems, sub-systems/ equipments/ structures/ equipment foundations alongwith all calculations justifying and identifying the sizing and the design margins.

vi) Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups.

vii) Operation Philosophy and the control philosophy of the equipments/system covered under the scope.

ix) General Layout plan of the FGD System incorporating all facilities in Bidder's as well as those in the Employer's scope. This drawing shall also be furnished in the form of CD-ROMs to the Employer for engineering of areas not included in bidder's scope.

x) Basic layouts and cross sections of the main plant building (various floor elevations), boiler, fuel oil area and other areas included in the scope of the bidder.

xi) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.

The successful bidder shall furnish within three (3) weeks from the date of Notification of Award, a list of contents of the Plant Definition Manual (PDMs) including techno-economic studies, which shall then be mutually discussed & finalised with the Employer.

B) **DETAILED ENGINEERING DOCUMENTS**

i) General layout plan of the FGD System.

ii) Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant.

iii) Flow diagram, process and instrumentation diagrams along with write up and system description.

iv) Performance curves for Absorber

v) Piping isometric, composite layout and fabrication drawings.

vi) Piping engineering diagrams, pipe and fittings schedules, valve schedules, hanger and support schedules, insulation schedules.

vii) Technical data sheets for all bought out and manufactured items. Contractor shall use the Employer's specifications as a base for placement of orders on their sub vendors.

viii) Detailed design calculations for components, system, piping etc., wherever applicable including sizing calculations for all auxiliaries like mills, fans etc. as per criteria specified elsewhere in specification.

ix) Absorber sizing calculations. Absorber performance data.

x) Mass Balance Diagram

xi) Characteristic Curves/ Performance Correction Curves.

xii) Comprehensive list of all terminal points which interface with Employer's facilities, giving details of location, terminal pressure, temperature, fluid handled & end connection details, forces, moments etc.

xiii) Power supply single line diagram, block logics, control schematics, electrical schematics, etc.

xiv) Protection system diagrams and relay settings.

xv) Cables schedules and interconnection diagrams.

xvii) Cable routing plan.

xviii) Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, and installation drawings for field mounted instruments, logic diagrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawings for open loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc.

xix) Alarm and annunciation/ Sequence of Event (SOE) list and alarms & trip set points.

xx) Sequence and protection interlock schemes.

xxi) Type test reports, insulation co-ordination study report

xxii) Control system configuration diagramsand card circuit diagrams and maintenance details.

xxiii) Detailed Control system manuals.

xxiv) Detailed flow chart for digital control system.

xv) Mimic diagram layout, Assignment for other application engg.drawings and documents.

xxvi) Civil and Structural works drawings and documents for all structures, facilities, architectural works, foundations underground and overground works and super-structural works as included in the

scope of the bidder civil calculation sheets including structural analysis and design alongwith output results.

xxvii) Underground facilities, levelling, sanitary, land scaping drawings.

xxviii) Geotechnical investigation and site survey reports (if and as applicable).

xxix) Model study reports wherever applicable.

xxx) Functional & guarantee test procedures and test reports.

xxxi) Documentation in respect of Quality Assurance System, and Documentation in respect of Commissioning, as listed out elsewhere in this specification.

xxxii) Maintenance schedule for Absorber & auxiliaries clearly indicating interval, duration if shutdown required, manhours required and tools & tackles required for maintenance.

The Contractor's while submitting the above documents/ drawings for approval/ reference as the case may be, shall mark on each copy of submission the reference letter alongwith the date vide which the submissions are made.

8.03.02 **INSTRUCTION MANUALS**

The Contractor shall make first submission of instruction manual for all the equipments covered under the Contract as per agreed engineering information schedule. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalisation and approval of the Employer the Instruction Manuals shall be submitted as indicated in **Annexure-IV.** The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following.

A) ERECTION MANUALS

The erection manuals shall be submitted atleast three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum.

a) Erection strategy.

b) Sequence of erection.

c) Erection instructions.

d) Critical checks and permissible deviation/tolerances.

e) List of tool, tackles, heavy equipments like cranes, dozers, etc.

f) Bill of Materials

g) Procedure for erection and General Safety procedures to followed during erection/installation.

h) Procedure for initial checking after erection.

i) Procedure for testing and acceptance norms.

j) Procedure / Check list for pre-commissioning activities.

k) Procedure / Check list for commissioning of the system.

l) Safety precautions to be followed in electrical supply distribution during erection.

B) OPERATION & MAINTENANCE MANUALS

a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side.

b) The arrangement and contents of O & M manuals shall be as follows:

1) Chapter 1 - Plant Description: To contain the following sections specific to the equipment/system supplied

(a) Description of operating principle of equipment / system with schematic drawing / layouts.

(b) Functional description of associated accessories / controls. Control interlock protection write up.

(c) Integrated operation of the equipment alongwith the intended system. (This is to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers).

(d) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment alongwith its accessories and auxiliaries.

(e) Design data against which the plant performance will be compared.

(f) Master list of equipments, Technical specification of the equipment/ system and approved data sheets.

(g) Identification system adopted for the various components, (it will be of a simple process linked tagging system).

(h) Master list of drawings (as built drawing - Drawings to be enclosed in a separate volume).

2) Chapter 2.0 - Plant Operation: To contain the following sections specific to the equipment supplied

(a) Protection logics provided for the equipment alongwith brief philosophy behind the logic, Drawings etc.

(b) Limiting values of all protection settings.

(c) Various settings of annunciation/interlocks provided.

(d) Startup and shut down procedure for equipment alongwith the associated systems in step mode.

(e) Do's and Don'ts related to operation of the equipment.

(f) Safety precautions to be take during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions.

(g) Parameters to be monitored with normal value and limiting values.

(h) Equipment isolating procedures.

(i) Trouble shooting with causes and remedial measures.

(j) Routine testing procedure to ascertain healthiness of the safety devices alongwith schedule of testing.

(k) Routine Operational Checks, Recommended Logs and Records

(l) Change over schedule if more than one auxiliary for the same purpose is given.

(m) Preservation procedure on long shut down.

(n) System/plant commissioning procedure.

3) Chapter 3.0 - Plant Maintenance- To contain the following sections specific to the equipment supplied.

(a) Exploded view of each of the equipments. Drawings alongwith bill of materials including name, code no. & population.

(b) Exploded view of the spare parts and critical components with dimensional drawings (In case of Electronic cards, the circuit diagram to be given) and spare parts catalogue for each equipment.

(c) List of Special T/ P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc.

(d) Stepwise dismantling and assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained etc. Clearance to be maintained etc.

(e) Preventive Maintenance schedules linked with running hours/calendar period alongwith checks to be carried out.

(f) Overhauling schedules linked with running hours/calendar period alongwith checks to be done.

(g) Long term maintenance schedules

(h) Consumables list alongwith the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling.

(i) List of lubricants with their Indian equivalent, Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at

longer intervals to ensure trouble free operation and quantity required for complete replacement.

(j) Tolerance for fitment of various components.

(k) Details of sub vendors with their part no. in case of bought out items.

(l) List of spare parts with their Part No, total population, life expediency & their interchangeability with already supplied spares to NTPC.

(m) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares.

(n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares.

(o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied.

8.03.03 After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in Annexure-VI. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals have been supplied to the Employer.

If after the commissioning and initial operation of the plant, the instruction manuals (Erection and /or O &M manuals) require modifications/additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Employer for records and number of copies shall be as mentioned in Annexure-VI.

8.03.03 **PLANT HANDBOOK AND PROJECT COMPLETION REPORT**

8.03.03.01 **PLANT HANDBOOK**

The Contractor shall submit to the Employer a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various plants, equipments and systems covering the complete project including

i) Design and performance data.

ii) Process & Instrumentation diagrams.

iii) Single line diagrams.

iv) Sequence & Protection Interlock Schemes.

v) Alarm and trip values.

vi) Performance Curves.

vii) General layout plan and layout of main plant building and auxiliary buildings

viii) Important Do's & Don't's

The plant handbook shall be submitted within twelve (12) months from the date of award of contract. After the incorporation of Employer's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.

8.03.03.02 **PROJECT COMPLETION REPORT**

The Contractor shall submit a Project Completion Report at the time of handing over the plant.

8.03.04 **DRAWINGS**

a) i) All the FGD plant layouts shall be made in computerised 3D modelling system. The Employer reserves the right to review the 3D model at different stages during the progress of engineering. The layout drawings submitted for Employer's review shall be fully dimensioned and extracted from 3D model after interference check.

ii) All documents submitted by the Contractor for Employer's review shall be in electronic form (soft copies) along with the desired number of hard copies as per **Annexure-VI** of Part-C. The soft copies shall be uploaded by the vendors in C-folders, a Web-based system of NTPC ERP, for which a username and password will be allotted to the new vendor by NTPC.

Similarly, the vendor can download the drawings/documents, approved/ commented by NTPC, through above site.

The soft copies of identified drawings/documents shall be in pdf format, whereas the attachments/reply to the submitted document(s) can be in .doc, .xls, .pdf, .dwg or .std formats.

iii) Final copies of the approved drawings along with requisite number of hard copies shall be submitted as per **Annexure-VI** of Part-C.

iv) Contractor shall prepare the model of all the facilities located in FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE (including all

facilities), and any other facility in an integrated & intelligent 3D software solution using rule-based, data centric 3D Design software with equipment drawings, data sheets, intelligent P&ID correlated with intelligent 3D Model, BOQ, schematics and logic diagrams etc. attached to the respective equipment / systems in the aforesaid 3D model. Contractor shall make a presentation on 3D model every 3 months from LOA to enable NTPC to review the progress of engineering. After the completion of engineering the corresponding complete 3D review model shall be handed over to the employer for its reference.

Contractor shall provide 3D model (which shall include visual interference check, walk-through animation, video simulation for major equipment placement and removal, visual effect, photo realism etc), which is extracted from intelligent 3D model, for employer's review as & when desired by employer. However, all piping layouts, equipment layouts, floor plans, ducting layout (Air/flue gas, A/C, Ventilation etc.), General Arrangement drawings of major buildings, structural arrangement drawings and RCC layout drawings shall necessarily be extracted from the aforesaid 3D model and submitted for employer's review along with the 3D review model to enable NTPC to review and approve these drawings.

b) All documents/text information shall be in latest version of MS Office / MS Excel / PDF FORMAT as applicable.

c) All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules.

d) Each drawing submitted by the Contractor (including those of subvendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

e) The drawings submitted by the Contractor (or their subvendors) shall bear Employer's drawing number in addition to contractor's (their sub-vendor's) own drawing number. Employer's drawing numbering system shall be made available to the successful bidder so as to enable him to assign Employer's drawing numbers to the drawings to be submitted by him during the course of execution of the Contract.

The Contractor shall also furnish a "Master Drawing List" which shall be a comprehensive list of all drawings/ documents/ calculations envisaged to be furnished by him during the detailed engineering to the Employer. Such list should clearly indicate the purpose of submission of these drawings i.e. "FOR APPROVAL" or "FOR INFORMATION ONLY".

Similarly, all the drawings/ documents submitted by the Contractor during detailed engineering stage shall be marked "FOR APPROVAL" or "FOR INFORMATION" prior to submission. Further, space shall be identified on each drawing for Approval stamp and electronic signature.

f) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the project. The review of these documents/ data/ drawings by the Employer will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipments provided by others and external connections & dimensions which might affect plant layout. The review by the Employer should not be construed to be a thorough review of all dimensions, quantities and details of the equipments, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or approval by the Employer/ Project Manager shall not relieve the Contractor of any of his responsibilities and liabilities under this contract.

g) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Employer.

h) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Contractor's risk. The Contractor is expected not to make any changes in the design of the equipment /system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipment/system at a later date, the Contractor may do so, but such changes shall promptly be brought to the notice of the Employer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification.

i) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Employer piror to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/ representative of Employer based on requirements of such piping indicated in approved/ finalised Flow Scheme/ Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package.

Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the contractor well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability.

j) As Built Drawings

After final acceptance of individual equipment / system by the Employer, the Contractor will update all original drawings and documents for the equipment / system to "as built" conditions and submit no. of copies as per **Annexure VI**.

k) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data/ drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.

l) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The Employer shall review the drawings and return soft copy to the Contractor authorizing either to proceed with manufacture or fabrication, or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Contractor to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule.

m) All engineering data submitted by the Contractor after final process including review and approval by the Project Manager/ Employer shall form part of the contract documents and the entire works covered under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the Project Manager in writing.

n) The Contractor shall submit drawings in line with the suggestive MDL covered in Part-B, Section-VI of Technical Specification and which shall be duly integrated with approved PERT network.

8.04.00 **ENGINEERING INFORMATION SUBMISSION SCHEDULE**

Prior to the award of Contract, a Detailed Engineering Information Submission Scheduler/Master Drawing List duly integrated with approved PERT network shall be tied up with the Employer. For this, the bidder shall furnish a detailed list of engineering information alongwith the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorized into the following parts.

i) Information that shall be submitted for the approval to the Employer before proceeding further, and

ii) Information that would be submitted for Employer's information only.

The Master Drawing List (MDL) shall be updated periodically and submitted to the employer, highlighting the changes made in MDL.

The schedule should allow adequate time for proper review and incorporation of changes/ modifications, if any, to meet the contract without affecting the equipment delivery schedule and overall project schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.

8.05.00 **ENGINEERING PROGRESS AND EXCEPTION REPORT**

8.05.01 The Contractor shall submit every month an Engineering progress and Exception Report giving the status of each engineering information including

a) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission

b) Drawings which were not submitted as per agreed schedule.

8.05.02 The draft format for this report shall be furnished to the Employer within four (4) weeks of the award of the contract, which shall then be discussed and finalised with the Employer.

8.06.00 Engineering Co-ordination Procedure

8.06.01 The following principal coordinators will be identified by respective organizations at time of award of contract:

NTPC Engineering Coordinator (NTPC EC):

Name :

Designation :

Address :

a) Postal :

b) Telegraphic / e-Mail :

c) FAX : TELEPHONE :

Contractor's/ Vendor's Engineering Coordinator (VENDOR EC):

Name :

Designation :

Address :

a) Postal :

b) Telegraphic / e-Mail :

c) FAX : TELEPHONE :

8.06.02 All engineering correspondence shall be in the name of above coordinators on behalf of the respective organizations.

8.06.03 Contractor's/Vendor's Drawing Submission and Approval Procedure:

a) All data/information furnished by Vendor in the form of drawings/ documents/catalogues or in any other form for NTPC's information/ interface and or review and approval are referred by the general term "drawings".

b) The 'Master drawings list' indicating titles, Drawing Number, Date of submission and approval etc. shall be finalised mutually between Contractor and Employer before the award of contract. This list shall be updated if required at suitable interval during detailed engineering.

c) All drawings (including those of subvendor's) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The Contractor shall furnish this format to his subvendor along with his purchase order for subvendor's compliance.

d) Employer and contractor shall follow their own numbering systems for the drawings. However, Employer shall intimate the contractor, NTPC drawing number on receipt of the first submission of each drawing. Vendor, thereafter, shall indicate NTPC's drawing number in subsequent Submission, in the space provided for this purpose in title plate, in addition to his own drawing number.

e) The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data / drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.

f) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper endorsement for checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission.

g) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The drawings submitted by the Contractor/vendor shall be reviewed by NTPC and their comments shall be forwarded within four (4) weeks of receipt of drawings. Upon review of each drawing, depending on the correctness and completeness of the drawing, the same will be categorized and approval accorded in one of the following categories :

CATEGORY- I:	Approved
CATEGORY- II	Approved, subject to incorporation of comments/ modification as noted. Resubmit revised drawing incorporating the comments.
CATEGORY –III	Not approved. Resubmit revised drawings for approval after incorporating comments/ modification as noted.
CATEGORY -IV	For information and records.

h) Contractor shall resubmit the drawings approved under Category II, III & IVR within three (3) weeks of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision Number

enclosed in a triangle (eg. 1, 2, 3 etc). Contractor shall not make any changes in the portions of the drawing other than those commented. If changes are required to be made in the portions already approved, the Contractor shall resubmit the drawing identifying the changes for Employer's review and approval. **Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents.**

i) In case, the Contractor/ Vendor does not agree with any specific comment, he shall furnish the explanation for the same to NTPC for consideration. In all such cases the Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.

j) It is responsibility of the Contractor/ Vendor to get all the drawings approved in the Category I & IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.

k) If Contractor/ Vendor fails to resubmit the drawings as per the schedule, construction work at site will not be held up and work will be carried out on the basis of comments furnished on previous issues of the drawing.

l) These comments will be taken care by the contractor while submitting the revised drawing.

The contractor shall use a single transmittal for drawings. Submission. This shall include transmittal numbers and date, number of copies being sent, names of the agencies to whom copies being sent, drawing number and titles, remarks or special notes if any etc.

9.00.00 **TECHNICAL CO-ORDINATION MEETING**

9.01.00 The Contractor shall be called upon to organise and attend monthly Design/ Technical Co-ordination Meetings (TCMs) with the Employer/Employer's representatives and other Contractors of the Employer during the period of contract. The Contractor shall attend such meetings at his own cost at NEW DELHI / NOIDA or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.

9.02.00 The Contractor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Contractor shall submit all drawings as per the agreed Engineering Information Submission Schedule. The drawings submitted by the Contractor will be reviewed by the Employer as far as practicable within three (3) weeks from the date of receipt of the drawing .The

comments of the Employer shall then be discussed across the table during the above Technical Co-ordination Meeting (s) wherein best efforts shall be made by both sides to ensure the approval of the drawing.

9.02.01 The Contractor shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Contractor shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.

9.02.02 Should any drawing remain unapproved for more than six (6) weeks after it's first submission ,this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.

9.03.0 Any delays arising out of failure by the Contractor to incorporate Employer's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Contractor to alter the Contract completion date.

10.00.00 **DESIGN IMPROVEMENTS**

The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly.

If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

11.00.00 **EQUIPMENT BASES**

A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base, unless otherwise specifically agreed to by the Employer. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.

12.00.00 **PROTECTIVE GUARDS**

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.

13.00.00	**LUBRICANTS, SERVO FLUIDS AND CHEMICALS**
13.01.00	I. All the first fills of consumables and one years topping requirement of consumables such as greases, oil, lubricants, servo fluids / control fluids, gases and essential chemicals etc. which will be required to put the equipment covered under the scope of specifications, into successful commissioning / initial operation and to establish completion of facilities shall be supplied by the Contractor. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum. Bidder shall supply a quantity not less than 10 % of the full charge or one (1) year topping requirement mentioned above (whichever is higher) of each variety of lubricants, servo fluids, gases, chemicals etc (as detailed above) which is expected to be utilized during the first year of operation. The additional quantity shall be supplied in separate container.
13.02.00	As far as possible lubricants marketed by the Indian Oil Corporation shall be used. The variety of lubricants shall be kept to a minimum possible. Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals etc. required for the complete plant covered herein shall be furnished. On completion of erection, a complete list of bearings/ equipment giving their location and identification marks shall be furnished to the Employer alongwith lubrication requirements.
14.00.00	**LUBRICATION**
14.01.00	Equipment shall be lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions.
15.00.00	**MATERIAL OF CONSTRUCTION**
15.01.00	All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilised for various components shall be those which have established themselves for use in such applications.
16.00.00	**RATING PLATES, NAME PLATES & LABELS**
16.01.00	Each main and auxiliary item of plant including instruments shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.

16.02.00 Each item of plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Employer or as detailed in appropriate section of the technical specifications.

16.03.00 Such nameplates or labels shall be of white nonhygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back. The name plates shall be suitably fixed on both front and rear side.

16.04.00 Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with enamel. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.

16.05.00 Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support. Suitable scale shall also be provided to indicate load on support or hanger.

16.06.00 Valves, steam traps and strainers shall be identified by Employer's tag number of a metal tap permanently attached to non pressure parts such as the yoke by a stainless steel wire. The direction of flow shall also be marked on the body.

16.07.00 Safety and relief valves shall be provided with the following:

a) Manufacturer's identification.

b) Nominal inlet and outlet sizes in mm.

c) Set pressure in Kg/cm^2 (abs).

d) Blowdown and accumulation as percentage of set pressure.

e) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.

16.08.00 All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

16.09.00 All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.

17.00.00 **TOOLS AND TACKLES**

The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required and other instruments for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment, checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer.

The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Contractor shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Contractor should bring his own tools and tackles. In case these tools and tackles are used by the Contractor during erection, commissioning or initial operation the same shall be refurbished repaired/replaced as required to the satisfaction of the Employer before handing over to the Employer. All the tools and tackles shall be of reputed make acceptable to the Employer.

18.00.00 **WELDING**

18.01.00 If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be per formed by others the requirements shall be submitted to the Employer in advance of commencement of erection work.

19.00.00 **COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES**

19.01.00 All equipment/ piping/ pipe services are to be painted by the Contractor in accordance with Employer's standard colour coding scheme, which will be furnished to the Contractor during detailed engineering stage.

20.00.00 **PROTECTION AND PRESERVATIVE SHOP COATING**

20.01.00 **PROTECTION**

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or over ground environment as the case may be. The requirements for

painting specification shall be complied with as detailed out in Part-A & B of the Technical Specification.

20.02.00 **PRESERVATIVE SHOP COATING**

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted as per the requirements covered in the relevant part of the Technical Specification.

Transformers and other electrical equipments, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Employer at a later date.

20.03.00 Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer.

20.04.00 All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Employer.

20.05.00 All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Employer. Lube oil piping or carbon steel shall be pickled.

20.06.00 Painting for Civil structures and equipment/system covered under this package shall be done as specified under technical requirements on civil works in relevant part of this specifications.

21.00.00 **QUALITY ASSURANCE PROGRAMME**

21.01.00 To ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor’s works or at his sub-contractor’s premises or at the Employer’s site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS-14001. A

quality assurance programme of the contractor shall generally cover the following:

a) His organisation structure for the management and implementation of the proposed quality assurance programme

b) Quality System Manual

c) Design Control System

d) Documentation Control System

e) Qualification data for Bidder's key Personnel.

f) The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.

g) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.

h) Control of non-conforming items and system for corrective actions.

i) Inspection and test procedure both for manufacture and field activities.

j) Control of calibration and testing of measuring testing equipments.

k) System for Quality Audits.

l) System for indication and appraisal of inspection status.

m) System for authorising release of manufactured product to the Employer.

n) System for handling storage and delivery.

o) System for maintenance of records, and

p) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per formats enclosed as **Annexure-I** and **Annexure-II** respectively.

22.00.00 **GENERAL REQUIREMENTS - QUALITY ASSURANCE**

22.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of

	inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award on enclosed format No. QS-01-QAI-P-1/F3-R0. Monthly progress reports shall be furnished.
22.02.00	Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media through C-folders, a web based system of NTPC ERP in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM (As per format at Annexure-I)
22.03.00	Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site (As per format at Annexure – II).
22.04.00	The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.
22.05.00	The contractor shall submit to the Employer Field Welding Schedule for field welding activities in the format enclosed at **Annexure-V.** The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site.
22.06.00	The contractor shall have suitable Field Quality Organization with adequate manpower at Employer's site, to effectively implement the Field Quality Plan (FQP)

	and Field Quality Management System for site activities. The contractor shall submit the details of proposed FQA setup (organizational structure and manpower) for employer's approval. The FQA setup shall be in place at least one month before the start of site activities.
22.07.00	No material shall be dispatched from the manufacturer's works before the same is accepted, by Employer's Project Manager/Authorised representative and duly authorised for dispatch by issuance of Material Dispatch Clearance Certificate (MDCC / CHP Clearance.
22.08.00	All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details
22.09.00	All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer. All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.
22.10.00	All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.
22.11.00	Welder qualification test results shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorized representative.
22.12.00	For all IBR pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. However, other piping system ASME B31.1 or other relevant code as applicable shall be followed. Similarly, any other statutory requirements for the equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding
22.13.00	All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
22.14.00	No welding shall be carried out on cast iron components for repair.
22.15.00	Unless otherwise proven and specifically agreed with the Employer, welding of

	dissimilar materials and high alloy materials shall be carried out at shop only.
22.16.00	All non-destructive examination shall be performed in accordance with written procedures as per International Standards. The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination) or equivalent. NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job. In general all plates of thickness greater than 40mm & for pressure parts plates of thickness equal to or greater than 25mm shall be ultrasonically tested otherwise as specified in respective equipment specification. All bar stock/Forging of diameter equal to or greater than 40 mm shall be ultrasonically tested.
22.17.00	The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the sub-contractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval on enclosed format No. QS-01-QAI-P-01/F3. The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Monthly progress reports on sub-contractor detail submission / approval shall be furnished preferably on enclosed format at **Annexure-IV.** Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.
22.17.00a	An indicative list of sub-vendors accepted by NTPC in the past for Corporate Awarded similar packages is enclosed for reference purpose as Indicative Sub-vendors List. The bidders' specific attention is drawn to the 'Disclaimer for the Indicative Vendor List' placed at the start of the Indicative Sub-vendor List. This is attached separately with the QA specification.
22.18.00	For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer

	and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. With in three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the monthly basis by the Contractor along with a report of the Purchase Order placed so far for the contract.
22.19.00	Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-contractor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.
22.20.00	The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.
22.21.00	Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.
22.22.00	For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.
22.23.00	Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.
22.24.00	**Environmental Stress Screening** Environmental stress screening test process / procedure for eliminating infant mortile components for DDCMIS / PLC based system & for other systems having substantial electronics components (as determined by employer) like Electronic transmitter, CCTV components, PA systems etc. shall be furnished for owner acceptance**.**
22.25.00	The Contractor / Sub-contractor shall carry out routine test on 100% item at contractor / sub-contractor's works. The quantum of check / test for routine & acceptance test by employer shall be generally as per criteria / sampling plan defined in referred standards. Wherever standards have not been mentioned

quantum of check / test for routine / acceptance test shall be as agreed during detailed engineering stage.

22.26.00 **Software Reliability / Quality Certification**

Certification from OEM's authorized signatory that software offered with DDCMIS, PLC, CCTV, PA, Pyrometer, CEMS, AAQMS, EQMS, BHMS etc. declaring that the all the offered software(s) had gone through the established software quality test and offered software is not of β-version and offered software is also free from all known bugs as on date of approval of systems documents by NTPC as a part of quality documentation review and approval process during detail engineering.

23.00.00 **QUALITY ASSURANCE DOCUMENTS**

23.01.00 The Contractor shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (✓)mark.

23.01.01 Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing.

The final quality document will be compiled and issued at the final assembly place of equipment before dispatch. However CD-Rom may be issued not later than three weeks.

23.02.00 Typical contents of QA Documentation is as below:-

(a.) Quality Plan

(b.) Material mill test reports on components as specified by the specification and approved Quality Plans.

(c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.

(d.) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.

(e.) Heat Treatment Certificate/Record (Time- temperature Chart)

(f.) All the accepted Non-conformance Reports (Major/Minor)/deviation, including complete technical details / repair procedure).

(g.) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.

(h.) Certificate of Conformance (COC) wherever applicable.

(i.) MDCC

23.03.00 Similarly, the contractor shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.

23.04.00 Before dispatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

(a.) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.

(b.) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.

(c.) If a decision is made for dispatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the dispatch of equipment.

23.05.00 **TRANSMISSION OF QA DOCUMENTATION**

On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Employer.

For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 3 weeks after the date of the last delivery of equipment.

24.00.00 **PROJECT MANAGER'S SUPERVISION**

24.01.00 To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Project Manager and without prejudice to the provisions of 'Arbitration' clause in Section GCC, the Contractor shall proceed to comply with the Project Manager's decision.

24.02.00 The work shall be performed under the supervision of the Project Manager.

The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following:

(a.) Interpretation of all the terms and conditions of these documents and specifications

(b.) Review and interpretation of all the Contractor's drawing, engineering data, etc

(c.) Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract

(d.) Inspect, accept or reject any equipment, material and work under the contract

(e.) Issue certificate of acceptance and/or progressive payment and final payment certificates

(f.) Review and suggest modifications and improvement in completion schedules from time to time, and

(g.) Supervise Quality Assurance Programme implementation at all stages of the works.

25.00.00 **INSPECTION, TESTING AND INSPECTION CERTIFICATES**

25.01.00 The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.

25.02.00	The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.
25.03.00	The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.
25.04.00	The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.
25.05.00	When the factory tests have been completed at the Contractor's or sub-contractor's works, the Project Manager /Inspector shall issue a certificate to this effect Ten (10) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within Ten (10) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Failure on the part of Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.
25.06.00	In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.

25.07.00	The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.
25.08.00	To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no 25.03.00 of this chapter, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.
25.09.00	All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.
25.10.00	**Associated document for Quality Assurance programme**
25.10.01	Manufacturing Quality Plan Format No. : QS-01-QAI-P-09/F1-R1 enclosed at **Annexure-I.**
25.10.02	Field Quality Plan Format No.: QS-01-QAI-P-09/F2-R1 enclosed at **Annexure-II.**
25.10.03	List of items requiring quality plan and sub supplier approval. Format No.: QS-01-QAI-P-01/F3-R0 **(Annexure-III).**
25.10.04	Status of items requiring Quality Plan and sub supplier approval. Format enclosed at **Annexure-IV.**
25.10.05	Field Welding Schedule Format enclosed at **Annexure-V.**
25.11.00	**Not Used**
25.12.00	**DEMONSTRATION OF APPLICATION ENGINEERING**
25.12.01	Based on NTPC inputs, the Contractor shall prepare and submit typical implemented scheme in their system (Control system & HMI) on sample basis. The typical cases to be covered shall include but not be limited to the following. (i) Logics/Loops: a) Drive logics implementation for each type of binary drive along with its display in HMI.

b) Sequence implementation along with its display in HMI.

c) Single non-cascade controller implementation.

d) Cascade loop implementation.

e) Master slave implementation with different slave combination.

f) Temperature & pressure compensation for flow signals & pressure compensation for level signals as applicable.

(ii) HMI Functions:

a) LVS Annunciation.

b) Graphics.

c) HSR

d) Logs/Reports.

e) Calculations (Basic & Performance Calculations).

25.12.02 The above typical cases shall be finalized with the Employer through Technical Co-ordination meetings.

After review and finalization of the typical cases, the implementation of each logic & control loop shall be carried out by the Contractor based on NTPC inputs. After implementation of these logics & loops, the Contractor shall test each logic /loop and record the observations in a format to be provided by the Employer and demonstrate to Employer at Employer premises during engineering finalization. Any modifications as a result of the demonstration shall be done and documented as part of the test report along with the final scheme. Similarly, HMI functions shall also be demonstrated by the Contractor at Employer premises & the results shall be documented as part of test report.

25.12.03 During the integrated testing at the Contractor's works, only sample checks shall be done by the Employer for the items covered in above application engineering demonstration.

26.00.00 **PRE-COMMISSIONING AND COMMISSIONING FACILITIES**

26.01.00 (a) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Employer and the Contractor for correctness of and completeness of facility or part thereof and acceptability for initial pre-

commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Contractor's quality assurance programme as well as those included in Part-D, Section-VI and elsewhere in the Technical Specifications.

(b) The Contractor's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall be commenced during which period the complete facilities, equipments shall be operated integral with sub-systems and supporting equipment as a complete plant.

(c) All piping system shall be flushed, steam blown, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures to accomplish this work shall be submitted for approval to the Employer six months prior to the respective implementations. The Employer will approve final verification of cleanliness.

(d) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period.

(e) The check outs during the pre - commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Employer's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed commissioning documentation [SLs(standard check list)/TS(testing schedule)/CS(commissioning schedule)] approved by the employer.

(f) The Contractor during initial operation and performance testing shall conduct vibration testing to determine the 'base line' of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable.

26.01.00 Contractor shall furnish the commissioning organization chart for review & acceptance of employer at least twelve months prior to the schedule date of commissioning of 1st unit. The chart should contain:

(1.) Biodata including experience of the Commissioning Engineers.

(2.) Role and responsibilities of the Commissioning Organisation members.

(3.) Expected duration of posting of the above Commissioning Engineers at site.

26.02.00 **Initial Operation**

(a) On completion of all pre-commissioning activities/ tests and as a part of commissioning the complete facilities shall be put on 'Initial Operation' during which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests.

(b) The 'Initial Operation' of the complete facility as an integral unit shall be conducted for 720 continuous hours. During the period of initial operation of 720 hours, the FGD System shall operate continuously at full load for a period not less than 72 hours.

The Initial Operation shall be considered successful, provided that each item/ part of the facility can operate continuously at the specified operating characteristics, for the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performance of the equipment/ facility.

The Contractor shall intimate the Employer about the commencement of initial operation and shall furnish adequate notice to the Employer in this respect.

(c) Any operational interruption in the FGD System due to constraints attributable to the Employer shall be construed as Deemed to be in operation.

(d) An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial Operation shall be prepared by the Contractor. This report, besides recording the details of the various observations during initial operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications/repairs to the plant shall be carried out by the Contractor to the full satisfaction of the Employer to enable the latter to accord permission to carry out the Guarantee tests on the facilities. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for with- holding the aforesaid permission.

26.03.00 **Guarantee Tests**

a) The final test as to prove the Functional Guarantees shall be conducted at Site by the Contractor in presence of the Employer. The contractor's

Commissioning, start-up Engineer shall make the unit ready to conduct such test before start of initial operation. Such test shall be conducted along with the Initial Operations.

b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the functional guarantee.

c) For performance/ demonstration tests instrumentations, of accuracy class shall be as per specified test codes. The numbers and location of the instruments shall be as per the specified test codes. In addition the values of parameters shall be logged from the information system provided under Employer's Distributed Digital Control Monitoring and Information system. Test will be conducted at specified load points.

d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Contractor, free of cost.

e) The Guarantee tests and specific tests to be conducted on equipments have been brought out in detail elsewhere in the specifications.

27.00.00 **TAKING OVER**

Upon successful completion of Initial Operations and all the tests conducted to the Employer's satisfaction, the Employer shall issue to the Contractor a Taking over Certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be with held nor will the Employer delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.

28.00.00 **TRAINING OF EMPLOYER'S PERSONNEL**

28.01.00 **Training for Employers O&M Personnel**

The scope of service under training of Employer's engineers shall include a training module covering upto six (6) man months in the areas of Operation & Maintenance.

Such training should enable the personnel to individually take the responsibility of operating and maintaining the FGD system in a manner acceptable to the Employer.

28.02.00 **Training for Employers Engineering Personnel**

The scope of services under training for Employer's engineering personnel shall also necessarily include three (3) man months. This shall cover all disciplines viz, Mechanical, Electrical, C&I, & QA etc. and shall include all the related areas like Design familiarization, training on product design features and product design softwares of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing, erection, welding etc. An indicative module of the training requirement of Employer's Engineering personnel is attached as Annexure-VII.

28.03.00 Bidder shall furnish in his offer, details of training module(s) covering above requirements which shall be subject to Employer's approval. Consolidated training period included above (i.e. 6 man months and 3 man months respectively for O&M and Engineering) is indicative only. Employer reserves the right to re appropriate the training period between O&M and engineering depending upon the details of training module proposed by the Bidder.

28.04.00 Exact details, extent of training and the training schedule shall be finalised based on the Bidder's proposal within two (2) months from placement of award.

28.05.00 In all the above cases, wherever the training of Employer's personnel is arranged at the works of the manufacturer's it shall be noted that the lodging and boarding of the Employer's personnel shall be at the cost of Contractor. The Contractor shall make all necessary arrangements towards the same.

28.06.00 Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Employer reserves the right to include or exclude these item(s) during placement of Award.

Note: For training purposes, one (1) man month implies 30 working days (excluding all intervening holidays) per person.

29.00.00 **SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION**

In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover:

i) Working platforms should be fenced and shall have means of access.

ii) Ladders in accordance with Employer's safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.

30.00.00 **NOISE LEVEL**

The equivalent 'A' weighted sound pressure level measured at a height of 1.5 m above floor level in elevation and at a distance of one (1) metre horizontally from the nearest surface of any equipment/machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA . However for Ball Mills the noise levels as per following shall also be acceptable:

a) Ball Mill 90 dBA

31.00.00 **PACKAGING AND TRANSPORTATION**

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Contractor shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting despatch of equipment. Before despatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & preassembly to bare minimum. The Employer's Inspector shall have right to insist for completion of works in shops before despatch of materials for transportation.

32.00.00 **ELECTRICAL EQUIPMENTS/ENCLOSURES**

32.01.00 All electrical equipments and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specifications.

33.00.00 **INSTRUMENTATION AND CONTROL**

All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.

33.01.00 All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale.

All scales and charts shall be calibrated and printed in Metric Units as follows:

1	Temperature	-	Degree centigrade (deg C)
2.	Pressure	-	Kilograms per square centimetre (Kg/cm^2). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.
3.	Draught	-	Millimetres of water column (mm wc).
4.	Vacuum	-	Millimeters of mercury gauge (mm Hg) or water column (mm Wcl).
5.	Flow (Gas)	-	Tonnes/ hour
6.	Flow (Steam)	-	Tonnes/ hour
7.	Flow (Liquid)	-	Tonnes / hour
8.	Flow base	-	760 mm Hg. 0 deg.C
9.	Density	-	Grams per cubic centimeter.

33.02.00 All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plan-in connection at rear.

33.03.00 All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalised & components shall be of industrial grade or better.

34.00.00 **ELECTRICAL NOISE CONTROL**

The equipment furnished by the Contractor shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Contractor's equipment which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-61000-2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems as per EN-50082-2 (1995).

35.00.00 **SURGE PROTECTION FOR SOLID STATE EQUIPMENT**

All solid state systems /equipment shall be able to withstand the electrical noise and surge as encountered in actual service conditions and inherent in a power plant and shall meet the requirements of surge protection as defined in ANSI C37.90.1-1989 on its suitable equivalent class of IEC 254-4. Details of the features incorporated and relevant tests carried out. The test certificates. etc. shall be submitted by the Bidder.

36.00.00 **INSTRUMENT AIR SYSTEM**

The instrument air supply system as supplied by the Bidder for various pneumatic control & instrumentation devices like pneumatic actuators, power cylinders, E/P converters, piping / tubing etc.

Each pneumatic instrument shall have an individual air shut - off valve. The pressure regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built-in filter housing blow down valve.

37.00.00 **TAPPING POINTS FOR MEASUREMENTS**

Tapping points shall include probes, wherever applicable, for analytical measurements and sampling.

For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Contractor will be intimated about thread standard to be adopted.

The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Contractor.

i) Temperature test pockets with stub and thermowell

ii) Pressure test pockets

38.00.00 **SYSTEM DOCUMENTATION**

The Bidder shall provide drawings, system overview & description, hardware/ software details, technical literature, functional & hardware schemes, bill of material, parts list, interconnection diagrams, data sheets, erection/ installation/ commissioning procedures, instruction/ operating manuals, etc. for each of the C& I system / sub-systems/ equipment supplied under this package. The documentation shall include complete details of the C&I systems/ sub-systems/ equipment to enable review by Employer during detailed engineering stage and to provide information to plant personnel for operation & Maintenance (including quick diagnostics & trouble shooting) of these C&I systems/ sub-systems/ equipment at site. The minimum documentation requirements for C&I systems shall be as stipulated under C&I

"Techncial Data Sheets" Part of specifications. In addition to this, system documentation for control system shall include as a minimum to that specified elsewhere in the Technical Specification.

The exact format, submission schedule and contents of various documents shall be as finalised during detailed engineering stage.

38.01.00 Bill of material (instrument list) for all C&I equipment/ devices shall be furnished by the bidder in standard formats as approved by the Employer.

39.00.00 **MAINTENANCE MANUALS OF ELECTRONIC MODULES**

The Contractor shall have to furnish two (2) sets of all maintenance manual of each and every electronic card/module as employed on the various systems and equipment including peripherals etc., offered by him. The Contractor will also have to furnish the data regarding the expected failure rate of various modules and other system components. Further , the contractor shall furnish a set of operating manuals which should include block diagrams ,make, model/type ,details wiring and external connection drawings etc as required to do the testing and maintenance of the electronic modules.

LIST OF CODES AND STANDARDS

Indian Standards	Title	International and Internationally recognised standards
IS:277	Galvanised steel sheets (plain or corrugated)	
IS:655	Specification for metal air duct	
IS:800	Code of practice for use of structural steel in general building construction	BS 449:1969 BS 5950 ASA A57, 1-1952
IS:807	Code of practice for design, manufacture, erection and testing (Structural portion) of cranes and hoists 6588 (Issued by Standards Association of Australia). DIN 120:1936 (Sheet 1) DIN 120:1936 (Sheet 2) 327 part-I, 1951 BS 466 part-II, 1960 BS 644:1960 BS 1757:1951 BS 2573:part-I:1960	Draft Revision of A.S. NO. CS.2 SAA Crane and Hoist code Doc:No. BU/4 Rev
IS:875	Code of practice for design loads (other than earthquake) for buildings and structures Leading standards (issued by Canadian Standard) DIN-1055-1955 (Issued by ASA)	National Building code of Canada (1953)-Part-IV Design section 4.1

IS:1239 Part-I	Mild steel tubes	(ISO/R 65-1957) (ISO/R-64-1958) (ISO/R-65-1958) (BS 1387 : 1957)
IS:1239 Part-II	Mild steel tubulars and other wrought steel pipe fittings	BS 1387 : 1967 BS 1387 :1967 BS 1740 :1965
IS:2825	Code for unfired vessels	
IS:1520	Horizontal centrifugal pumps for clear cold and fresh water	
IS:1600	Code for practice for performance of constant speed IC Engines for general purpose	
IS:1601	Specification for perform-ance of constant speed IC Engines for general Purpose	
IS:1893	Criteria for earthquake resistant design of structures	
IS1978-1971	Line Pipe April 1969.	API Standards 5L
IS:2254-1970	Dimensions of vertical shaft motor for pumps	IEC Pub 72-1 part I NEMA Pub MG 1 1954
IS:2266	Steel wire ropes for general engineering purposes	BS :302 : 1968
IS:2312	Propellant type Ventilation fans	
IS:2365	Steel wire suspension ropes for lifts and hoists	BS : 1957

IS:3346	Method for the determination of thermal conductivity of thermal insulation materials (two slab guarded hot plate method)	DIN 52612 (Deutscher Normenausschuss) ASTM C 163-1964 (American Society of Testing and materials) ASTM C 167-1974 ASTM C 177-1963
IS:3354	Outline dimensions for electric lifts.	
IS:3401	Silica gel	
IS:3588	Specification for electrical axial flow fans	
IS:3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000 mm Nominal Diametre)	
IS:3677	Unbonded rock and slag wool for thermal insulation	
IS:3815	Point hook with shank for general engineering purposes	BS 482 - 1968 Doc.:67/3 1284 (Revision of BS 2903) (Issued BS)
IS:3895	Specification for monocrystallines semiconductor rectifier cells and stacks	
IS:3963	Roof extractor unit	
IS:3975	Mild steel wires, strips and tapes for armouring cables	
IS:4503	Shell and tube type heat Exchanger	

IS:4540	Specification for monory-stallines rectifire assembly equipment	
IS:4671	Expanded polystyrene for thermal insulation purpose	
IS:4736	Hot dip zinc coating on steel tubes	
IS:4894	Centrifugal fans	
IS:5456	Code of practice for testing of positive displacement type air compressors and exhauster (For Test Tolerance Only)	
IS:5749	Forged ramshorn hooks	Entwurf DIN 15402 Blett 1 Entwurf DIN 15402 BS 3017-1958
IS:6392	Steel pipe flanges	BS 4504 : 1969
IS:6524 Part-I	Code of practice for design of tower cranes Static and rail mounted	BS 2799 : 1956
IS:7098	Cross linked Polyethylene insulated PVC sheathed cables	Standard No. 1 to IPCEA (USA) Pub. No. 5-66-524
IS:7373	Specification for wrought aluminium and aluminium sheet and strips	
IS:7938	Air receivers for compressed air installation	
ISO:1217	Displacement compressor-Acceplance test	
ASHRAE-33 and air heating coils.	Methods of testing for rating of forced circulation air cooling	
ASHRAE-52-76 particle matter.	Air cleaning device used in general ventilation for removing	

ASHRAE-22-72	Method of testing for rating of water cooled refrigerant condensers.
ASHRAE 23-67	Methods of testing for rating of positive displacement refrigerant compressors.
ARI-450-6	Standard for water cooled refrigerant condensers.
ARI-550	Standard for centrifugal water chilling packages.
ARI-410	Standard for forced circulation air cooling and air heating coils
ARI-430/435	Central station AHU/Application of Central Station AHU
BS:848 (Part-1,2)	Fans
BS:400	Low carbon steel cylinders for the storage & transport of permanent gases.
BS:401	Low carbon steel cylinders for the storage & transport of liquified gases.
CTI Code ACT-105	Acceptance test code for Water Cooling Tower.
ANSI-31.5	Refrigerant piping
ASME-PTC-23-1958	Atmospheric Water Cooling Equipment
AMCA A-21C	Test Code for air moving devices
API:618	Reciprocating Compressor for general refinary services.

HYDRAULIC INSTITUTE STANDARDS.

HYDRANT SYSTEM MANUALS OF TAC.

TAC MANUALS OF SPRAY SYSTEM

NFPA USA/ NSC UK/ UL USA/ FM USA STANDARDS.

INDIAN EXPLOSIVES ACT.

INDIAN FACTORIES ACT.

STANDARD OF TUBULAR EXCHANGER MANUFACTURER'S ASSOCIATION.

CODE AND STANDARD FOR CIVIL WORKS

Some of the applicable Standards, Codes and references are as follows:

Excavation & Filling

IS: 2720 (Part-II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL) Methods of test for soils-determination for water content etc.

IS: 4701 Code of practice for earth work on canals.

IS: 9758 Guide lines for Dewatering during construction.

IS: 10379 Code of practice for field control of moisture and compaction of soils for embankment and sub-grade.

Properties, Storage and Handling of Common Building Materials

IS: 269 Specification for ordinary Portland cement, 33 grade.

IS: 383 Specification for coarse and fine aggregates from natural sources for concrete.

IS: 432 Specification for mild steel and (Parts 1&2) medium tensile steel bars and hard-drawn steel wires for concrete reinforcement.

IS: 455 Specification for Portland slag cement.

IS: 702 Specification for Industrial bitumen.

IS: 712 Specification for building limes.

IS: 808 Rolled steel Beam channel and angle sections.

IS: 1077 Specification for common burnt clay building bricks.

IS: 1161 Specification of steel tubes for structural purposes.

IS: 1363 Hexagon head Bolts, Screws and nuts of production grade C.

IS: 1364 Hexagon head Bolts, Screws and Nuts of Production grade A & B.

IS: 1367 Technical supply conditions for Threaded fasteners.

IS: 1489 Specification for Portland-pozzolana cement:

(Part-I) Fly ash based.

	(Part-II)	Calcined clay based.
	IS: 1542	Specification for sand for plaster.
	IS: 1566	Specification for hard-drawn steel wire fabric for concrete reinforcement.
	IS: 1786	Specification for high strength deformed bars for concrete reinforcement.
	IS: 2062	Specification for steel for general structural purposes.
	IS: 2116	Specification for sand for masonry mortars.
	IS: 2386 (Parts-I to VIII)	Testing of aggregates for concrete.
	IS: 3150	Hexagonal wire netting for general purpose.
	IS: 3495 (Parts-I to IV)	Methods of tests of burnt clay building bricks.
	IS: 3812	Specification for fly ash, for use as pozzolana and admixture.
	IS: 4031	Methods of physical tests for hydraulic cement.
	IS: 4032	Methods of chemical analysis of hydraulic cement.
	IS: 4082	Recommendations on stacking and storage of construction materials at site.
	IS: 8112	Specification for 43 grade ordinary portland cement.
	IS: 8500	Medium and high strength structural steel.
	IS: 12269	53 grade ordinary portland cement.
	IS: 12894	Specification for Fly ash lime bricks.
	Cast-In-Situ Concrete and Allied Works	
	IS: 280	Specification for mild steel wire for general engineering purposes.
	IS: 456	Code of practice for plain and reinforced concrete.

	IS: 457	Code of practice for general construction of plain & reinforced concrete for dams & other massive structures.
	IS: 516	Method of test for strength of concrete.
	IS: 650	Specification for standard sand for testing of cement.
	IS: 1199	Methods of sampling and analysis of concrete.
	IS: 1791	General requirements for batch type concrete mixers.
	IS: 1838 (Part-I)	Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type).
	IS: 2204	Code of practice for construction of reinforced concrete shell roof.
	IS: 2210	Criteria for the design of reinforced concrete shell structures and folded plates.
	IS: 2438	Specification for roller pan mixer.
	IS: 2502	Code of practice for bending and fixing of bars for concrete reinforcement.
	IS: 2505	General requirements for concrete vibrators, immersion type.
	IS: 2506	General requirements for concrete vibrators, screed board type.
	IS: 2514	Specification for concrete vibrating tables.
	IS: 2645	Specification for Integral cement water proofing compounds.
	IS: 2722	Specification for portable swing weigh batches for concrete. (single and double bucket type)
	IS: 2750	Specification for Steel scaffolding.
	IS: 2751	Code of practice for welding of mild steel plain and deformed bars for reinforced concrete construction.
	IS: 3025	Methods of sampling and test waste water.
	IS: 3366	Specification for Pan vibrators.
	IS: 3370	Code of practice for concrete structures for the storage of

(Part I to IV)	liquids.
IS: 3414	Code of practice for design and installation of joints in buildings.
IS: 3550	Methods of test for routine control for water used in industry.
IS: 3558	Code of practice for use of immersion vibrators for consolidating concrete.
IS: 4014 (Parts I & II)	Code of practice for steel tubular scaffolding.
IS: 4326	Code of practice for earthquake resistant design and construction of buildings.
IS: 4461	Code of practice for joints in surface hydro-electric power stations.
IS: 4656	Specification for form vibrators for concrete.
IS: 4925	Specification for batching and mixing plant.
IS: 4990	Specification for plywood for concrete shuttering work.
IS: 4995 (Parts I & II)	Criteria for design of reinforced concrete bins for the storage of granular and powdery materials.
IS: 5256	Code or practice for sealing joints in concrete lining on canals.
IS: 5525	Recommendations for detailing of reinforcement in reinforced concrete work.
IS: 5624	Specification for foundation bolts.
IS: 6461	Glossary of terms relating to cement concrete.
IS: 6494	Code of practice for water proofing of underground water reservoirs and swimming pools.
IS: 6509	Code of practice for installation of joints in concrete pavements.
IS: 7861	Code of practice for extreme weather concreting. (Parts I & II)
IS: 9012	Recommended practice for shot concreting.
IS: 9103	Specification for admixtures for concrete.

IS: 9417	Recommendations for welding cold worked steel bars for reinforced concrete construction.
IS: 10262	Recommended guidelines for concrete mix design.
IS: 11384	Code of practice for composite construction in structural steel and concrete.
IS: 11504	Criteria for structural design of reinforced concrete natural draught cooling towers.
IS: 12118	Specification for two-parts poly sulphide.
IS: 12200	Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams.
IS: 13311	Method of non-destructive testing of concrete.
Part-1	Ultrasonic pulse velocity.
Part-2	Rebound hammer.
SP:23	Handbook of concrete mixes
SP: 24	Explanatory Handbook on IS: 456-1978
SP: 34	Handbook on concrete reinforcement and detailing.

Precast Concrete Works

SP: 7(PartVI/	National Building Code- Structural design of prefabrication and Sec.7) systems building.
IS: 10297	Code of practice for design and construction of floors and roofs using precast reinforced/prestressed concrete ribbed or cored slab units.
IS: 10505	Code of practice for construction of floors and roofs using pre-cast reinforced concrete units.

Masonary and Allied Works

IS: 1905	Code of Practice for Structural Safety of Buildings-Masonry walls.
IS: 2212	Code of Practice for Brickwork.

IS: 2250	Code of Practice for Preparation and use of Masonry Mortar.
SP: 20	Explanatory hand book on masonry code.
Sheeting Works	
IS:277	Galvanised steel sheets (plain or corrugated).
IS: 459	Unreinforced corrugated and semi-corrugated asbestos cement sheets.
IS: 513	Cold-rolled carbon steel sheets.
IS: 730	Specification for fixing accessories for corrugated sheet roofing.
IS: 1626	Specification for Asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roofing fittings.
IS: 2527	Code of practice for fixing rain water gutters and down pipe for roof drainage.
IS: 3007	Code of practice for laying of asbestos cement sheets.
IS: 5913	Methods of test for asbestos cement products.
IS: 7178	Technical supply conditions for tapping screw.
IS: 8183	Bonded mineral wool.
IS: 8869	Washers for corrugated sheet roofing.
IS: 12093	Code of practice for laying and fixing of sloped roof covering using plain and corrugated galvanised steel sheets.
IS: 12866	Plastic translucent sheets made from thermosetting polyster resin (glass fibre reinforced).
IS: 14246	Specification for continuously pre-painted galvanised steel sheets and coils.
Fabrication and Erection of Structural Steel Work	
IS: 2016	Specification for plain washers.

IS: 814	Specification for covered Electrodes for Metal Arc Welding for weld steel.
IS: 1852	Specification for Rolling and Cutting Tolerances for Hot rolled steel products.
IS: 3502	Specifications for chequered plate.
IS: 6911	Specification for stainless steel plate, sheet and strip.
IS: 3757	Specification for high strength structural bolts
IS: 6623	Specification for high strength structural nuts.
IS: 6649	High Tensile friction grip washers.
IS: 800	Code of practice for use of structural steel in general building construction.
IS: 816	Code of practice for use of Metal Arc Welding for General Construction.
IS: 4000	Code of practice for assembly of structural joints using high tensile friction grip fasteners.
IS: 9595	Code of procedure of Manual Metal Arc Welding of Mild Steel.
IS: 817	Code of practice for Training and Testing of Metal Arc Welders.
IS: 1811	Qualifying tests for Metal Arc Welders (engaged in welding structures other than pipes).
IS: 9178	Criteria for Design of steel bins for storage of Bulk Materials.
IS: 9006	Recommended Practice for Welding of Clad Steel.
IS: 7215	Tolerances for fabrication steel structures.
IS: 12843	Tolerance for erection of structural steel.
IS: 4353	Recommendations for submerged arc welding of mild steel and low alloy steels.
SP: 6 (Part 1 to 7)	ISI Hand book for structural Engineers.

IS: 1608	Method of Tensile Testing of Steel products other than sheets, strip, wire and tube.
IS: 1599	Method of Bend Tests for Steel products other than sheet, strip, wire and tube
IS : 228	Methods of chemical Analysis of pig iron, cast iron and plain carbon and low alloy steel.
IS : 2595	Code of Practice for Radio graphic testing.
IS : 1182	Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates.
IS : 3664	Code of practice for Ultra sonic Testing by pulse echo method.
IS : 3613	Acceptance tests for wire flux combination for submerged Arc Welding.
IS : 3658	Code of practice for Liquid penetrant Flaw Detection.
IS : 5334	Code of practice for Magnetic Particle Flaw Detection of Welds.

Plastering and Allied Works

IS : 1635	Code of practice for field slaking of Building lime and preparation of putty.
IS : 1661	Application of cement and cement lime plaster finishes.
IS : 2333	Plaster-of-paris.
IS : 2402	Code of practice for external rendered finishes.
IS : 2547	Gypsum building plaster.
IS : 3150	Hexagonal wire netting for general purpose.

Acid and Alkali Resistant Lining

IS : 158	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali & heat resisting.
IS : 412	Specification for expanded metal steel sheets for general purpose.

IS : 4441	Code of practice for use of silicate type chemical resistant mortars.
IS : 4443	Code of practice for use of resin type chemical resistant mortars.
IS : 4456	Method of test for chemical resistant tiles. (Part I & II)
IS : 4457	Specification for ceramic unglazed vitreous acid resistant tiles.
IS : 4832	Specification for chemical resistant mortars.
	Part I Silicate type
	Part II Resin type
	Part III Sulphur type
IS : 4860	Specification for acid resistant bricks.
IS : 9510	Specification for bitumasitc, Acid resisting grade.

Water Supply, Drainage and Sanitation

IS : 458	Specification for concrete pipes.
IS : 554	Dimensions for pipe threads, where pressure tight joints are made on thread.
IS : 651	Specification for salt glazed stoneware pipes.
IS : 774	Flushing cisterns for water closets and urinals.
IS : 775	Cast iron brackets and supports for wash basins and sinks.
IS : 778	Copper alloy gate, globe and check valves for water works purposes.
IS : 781	Cast copper alloy screw down bib taps and stop valves for water services.
IS : 782	Caulking lead.
IS : 783	Code of practice for laying of concrete pipes.

IS : 1172	Basic requirements for water supply, drainage and sanitation.
IS : 1230	Cast iron rain water pipes and fittings.
IS : 1239	Mild steel tubes, tubulars and other wrought steel fittings.
IS : 1536	Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage.
IS : 1537	Vertically cast iron pressure pipes for water, gas and sewage.
IS : 1538	Cast iron fittings for pressure pipe for water, gas and sewage.
IS : 1703	Ball valves (horizontal plunger type) including float for water supply purposes.
IS : 1726	Cast iron manhole covers and frames.
IS : 1729	Sand cast iron spigot and socket, soil, water and ventilating pipes, fittings and accessories.
IS : 1742	Code of practice for building drainage.
IS : 1795	Pillar taps for water supply purposes.
IS : 1879	Malleable cast iron pipe fittings.
IS : 2064	Code of practice for selection, installation and maintenance of sanitary appliances.
IS : 2065	Code of practice for water supply in building.
IS : 2326	Automatic flushing cisterns for urinals.
IS : 2470 (Part-I & II)	Code of practice for installation of septic tanks.
IS : 2501	Copper tubes for general engineering purposes.
IS : 2548	Plastic seat and cover for water-closets.
IS : 2556 (Part 1 to 15)	Vitreous sanitary appliances (vitreous china).
IS : 2963	Non-ferrous waste fittings for wash basins and sinks.

IS : 3114	Code of practice for laying of cast iron pipes.
IS : 3311	Waste plug and its accessories for sinks and wash basins.
IS : 3438	Silvered glass mirrors for general purposes.
IS : 3486	Cast iron spigot and socket drain pipes.
IS : 3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000mm nominal diameter).
IS : 3989	Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 4111 (Part I to IV)	Code of practice for ancillary structure in sewerage system.
IS : 4127	Code of practice for laying of glazed stone-ware pipes.
IS : 4764	Tolerance limits for sewage effluents discharged into inland-surface waters.
IS : 4827	Electro plated coating of nickel and chromium on copper and copper alloys.
IS : 5329	Code of practice for sanitary pipe work above ground for buildings.
IS : 5382	Rubber sealing rings for gas mains, water mains and sewers.
IS : 5822	Code of practice for laying of welded steel pipes for water supply.
IS : 5961	Cast iron grating for drainage purpose.
IS : 7740	Code of practice for road gullies.
IS : 8931	Cast copper alloy fancy bib taps and stop valves for water services.
IS : 8934	Cast copper alloy fancy pillar taps for water services.
IS : 9762	Polyethylene floats for ball valves.
IS : 10446	Glossary of terms for water supply and sanitation.

IS : 10592	Industrial emergency showers, eye and face fountains and combination units.
IS : 12592	Specification for precast concrete manhole covers and frames.
IS : 12701	Rotational moulded polyethylene water storage tanks.
SP: 35	Hand book on water supply and drainage.
-	Manual on Sewerage and sewage treatment (Published by CPH & EEO) As updated.

Doors, Windows and Allied Works

IS : 204	Tower Bolts
Part-I	Ferrous metals.
Part-II	Nonferrous metals.
IS : 208	Door Handles.
IS : 281	Mild steel sliding door bolts for use with padlocks.
IS : 362	Parliament Hinges.
IS : 420	Specification for putty, for use on metal frames.
IS : 1003 Part-I door	Specification for timber panelled and glazed shutters- (Part-I) shutters.
IS : 1038	Steel doors, windows and ventilators.
IS : 1081	Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators.
IS : 1341	Steel butt hinges.
IS : 1361	Steel windows for industrial buildings.
IS : 1823	Floor door stoppers.
IS : 1868	Anodic coatings on Aluminium and its alloys.
IS : 2202 (Part-II)	Specification for wooden flush door shutters (solid core type); particle board face panels and hard board face panels

	IS:2209	Mortice locks (vertical type).
	IS:2553	Safety glass
	IS:2835	Flat transparent sheet glass.
	IS:3548	Code of practice for glazing in buildings.
	IS:3564	Door closers (Hydraulically regulated).
	IS : 3614	Fire check doors; plate, metal covered and rolling type.
	IS:4351	Steel door frames.
	IS:5187	Flush bolts.
	IS:5437	Wired and figured glass
	IS:6248	Metal rolling shutters and rolling grills.
	IS:6315	Floor springs (hydraulically regulated) for heavy doors.
	IS:7196	Hold fasts.
	IS:7452	Hot rolled steel sections for doors, windows and ventilators.
	IS:10019	Mild steel stays and fasteners.
	IS:10451	Steel sliding shutters (top hung type).
	IS:10521	Collapsible gates.
	R oof Water Proofing and AlliedWorks	
	IS:1203	Methods of testing tar and bitumen.
	IS:1322	Specification for bitumen felts for water proofing and damp proofing.
	IS:1346	Code of practice for water proofing of roofs with bitumen felts.
	IS:1580	Specification for bituminous compound for water proofing and caulking purposes.

IS:3067	Code of practice for general design details and preparatory work for damp proofing and water proofing of buildings.
IS:3384	Specification for bitumen primer for use in water proofing and damp proofing.
Floor Finishes and Allied Works	
IS:1237	Specification for cement concrete flooring tiles.
IS:1443	Code of practice for laying and finishing of cement concrete flooring tiles.
IS:2114	Code of practice for laying in-situ terrazzo floor finish.
IS:2571	Code of practice for laying in-situ cement concrete flooring.
IS:3462	Specification for unbacked flexible PVC flooring.
IS:4971	Recommendations for selection of industrial floor finishes.
IS:5318	Code of practice for laying of flexible PVC sheet and tile flooring.
IS:8042	Specification for white portland cement.
IS:13801	Specification for chequered cement concrete flooring tiles.
Painting and Allied Works	
IS:162	Specification for fire resisting silicate type, brushing, for use on wood, colour as required.
IS:1477	Code of practice for painting of ferrous metals in buildings.
Part-I	Pretreatment.
Part-II	Painting.
IS:1650	Specification for colours for building and decorative finishes.
IS:2074	Specification for red oxide-zinc chrome, priming, ready mixed paint air drying.
IS:2338	Code of practice for finishing of wood and wood based materials.
Part-I	Operations and workmanship

	Part-II	Schedules
	IS:2395	Code of practice for painting concrete, masonry and plaster surfaces.
	Part-I	Operations and workmanship.
	Part-II	Schedule.
	IS:2524	Code of practice for painting of nonferrous metals in buildings.
	Part-I	Pretreatment.
	Part-II	Painting.
	IS:2932	Specification of synthetic enamel paint, exterior, under-coating and finishing.
	IS:2933	Specification enamel paint, under coating and finishing.
	IS:4759	Code of practice for hot dip zinc coating on structural steel and other allied products.
	IS:5410	Specification for cement paint
	IS:5411 (Part-I)	Specification for plastic emulsion paint-for exterior use
	IS:6278	Code of practices for white washing and colour washing.
	IS:10403	Glossary of terms relating to building finishes.
	Piling and Foundation	
	IS:1080	Code of practice for design and construction of simple spread foundations.
	IS:1904	Code of practice for design and construction of foundations in Soils; General Requirements.
	IS:2911	Code of practice for designs and construction of Pile foundations (Relevant Parts).
	IS:2950 (Part-I)	Code of practice for designs and construction of Raft foundation.
	IS:2974 (Part-I TO V)	Code of practice for design and construction of machine foundations.
	IS:6403	Code of practice for determination of Allowable Bearing pressure on Shallow foundation.

	IS:8009	Code of practice for calculation of settlement of foundation subjected to symmetrical vertical loads.
	Part-I	Shallow foundations.
	Part-II	Deep foundations.
	IS:12070	Code of practice for design and construction of shallow foundations on rocks.
	DIN:4024	Flexible supporting structures for machines with rotating machines.
	VDI:2056	Criteria for assessing mechanical vibrations of machines.
	VDI:2060	Criteria for assessing rotating imbalances in machines.
	Stop Log and Trash Rack	
	IS:4622	Recommendations for fixed - wheel gates structural design.
	IS:5620	Recommendations for structural design criteria for low head slide gates.
	IS:11388	Recommendations for design of trash rack for intakes.
	IS:11855	General requirements for rubber seals for hydraulic gates.
	Roads	
	IRC:5	Standard specifications and Code of practice for road bridges, section-I general Features of Design.
	IRC:14	Recommended practice of 2cm thick bitumen and tar carpets.
	IRC:16	Specification for priming of base course with bituminous primers.
	IRC:19	Standard specifications and code of practice for water bound macadam.
	IRC:21	Standard specifications and Code of practice for road bridges, section-III - Cement concrete (plain and reinforced).
	IRC:34	Recommendations for road construction in waterlogged areas.
	IRC:36	Recommended practice for the construction of earth embankments for road works.
	IRC:37	Guidelines for the Design of flexible pavements.
	IRC:56	Recommended practice for treatment of embankment slopes for erosion control.
	IRC:73	Geometric design standards for rural (non-urban) highways.
	IRC:86	Geometric Design standards for urban roads in plains.

IRC:SP:13	Guidelines for the design of small bridges & culverts.
IRC - Publication	Ministry of Surface Transport (Roads Wing), Specifications for road and bridge works.
IS:73	Specification for paving bitumen
Loadings	
IS:875 (Pt. I to V)	Code of practice for design loads other than earthquake) for buildings and structures.
IS:1893	Criteria for earthquake resistant design of structures.
IS:4091	Code of Practice for design and construction of foundation for transmission line towers & poles.
IRC:6	Standard specifications & code of practice for road bridges, Section-II Loads and stresses.
M.O.T.	Deptt. of railways Bridge Rules.
Safety	
IS:3696 (Part I & II)	Safety code for scaffolds and ladders.
IS:3764	Safety code for excavation work.
IS:4081	Safety code for blasting and related drilling operations.
IS:4130	Safety code for demolition of buildings.
IS:5121	Safety code for piling and other deep foundations.
IS:5916	Safety code for construction involving use of hot bituminous materials.
IS:7205	Safety code for erection on structural steelwork.
IS:7293	Safety code for working with construction machinery.
IS:7969	Safety code for handling and storage of building materials
IS:11769	Guidelines for safe use of products containing asbestos.
- Indian Explosives Act. 1940 as updated.	
Architectural design of buildings	
SP:7	National Building Code of India
SP:41	Hand book on functional requirements of buildings (other than industrial buildings)

Miscellaneous

IS:802	Code of practice for use of structural steel in
(Relevant parts)	overhead transmission line towers.
IS:803	Code of practice for design, fabrication and erection of vertical mild steel cylindrically welded in storage tanks.
IS:10430	Creteria for design of lined canals and liner for selection of type of lining.
IS:11592	Code of practice for selection and design of belt conveyors.
IS:12867	PVC handrails covers.
CIRIA Publication	Design and construction of buried thin-wall pipes.

REFERENCE CODES AND STANDARDS FOR CONTROL AND INSTRUMENTATION

The design, manufacture, inspection, testing & installation of all equipment and system covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable VDE, IEEE, ANSI, ASME, NEC, NEMA, ISA AND Indian Standards and their equivalents.

Temperature Measurements

1. Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974).
2. Temperature measurement - Thermocouples ANSI MC 96.1 - 1982.
3. Temperature measuremnet by electrical Resistance thermometers - IS:2806.
4. Thermometer - element - Platinum resistance - IS:2848.

Pressure Measurements

1. a) Instruments and apparatus for pressure measurement - ASME PTC 19.2 (1964).

   b) Electonic transmitters BS:6447.
2. Bourdon tube pressure and vacuum gauges - IS:3624 - 1966.
3. Process operated switch devices (Pr. Switch) BS-6134.

Flow Measurements

Instruments and apparatus for flow measurements - ASME PTC 19.5 (1972) Interim supplement, Part-II.

Measurement of fluid flow in closed conduits - BS-1042.

Electronic Measuring Instrument & Control Hardware/ Software

1. Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973): IS:9319.
2. Safety requirements for electrical and electronic measuring and controling instrument - ANSI C 39.5 - 1974.
3. Compatability of analog signals for electronic industrial process instruments - ISA - S 50.1 (1982) ANSI MC 12.1 - 1975.
4. Dynamic response testing of process control instrumentation ISA - S 26 (1968).

5. Surge Withstand Capability (SWC) tests - ANSI C 37.90 a/IEEE-472 or suitable class of IEC-255-4 equivalent to ANSI C37.90a/IEEE-472.

6. Printed circuit boards - IPC TM - 650, IEC 326 C.

7. General requirement and tests for printed wiring boards - IS 7405 (Part-I) 1973.

8. Edge socket connectors - IEC 130-11.

9. Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2.

10. Dimensions of attachment plugs & receptacles - ANSI C 73 - 1973 (Supplement ANSI C 73 a - 1980).

11. Direct acting electrical indicating instrument - IS:1248 - 1968 (R).

12. Standard Digital Interface for Programmable Instrumentation - IEEE-488.2 - 1990.

13. Information Processing Systems - Local Area Networks - Part 2 : Logical Link Control - IEEE-802.2 - 1989.

14. Standard for Local Area Networks : Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1985.

15. Supplements A, B, C and E to Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1988.

16. Standard for Local Area Networks : Token - Passing Bus Access Method - IEEE-802.4 - 1985.

17. Standard for Local Area Networks : Token - Ring Access Method and Physical Layer Specification - IEEE-802.5 - 1985.

18. IEEE Guide to Software Requirements Specifications - IEEE-830 - 1984.

19. Hardware Testing of Digital Process Computers - ISA RP55.1 - 1983.

20. Electromagnetic Susceptibility of Process Control Instrumentation - SAMA PMC 33.1 - 1978.

21. Interface Between the Data Terminal Equipment and Data Circuit - Terminating Equipment Employing Serial Binary Data Interchange - EIA-232-D-1987.

22. Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 3 : Radiated Electromagnetic Field Requirements - IEC 801-3-1984.

Instrument Switches and Contact

1. Contact rating - AC services NEMA ICS 2 - 1978 (with revision through May 1983), Part - 2-125, A6000.

2. Contact rating - DC services NEMA ICS 2-1978 Part-2 125, N600.

Enclosures

1. Type of Enclosures - NEMA ICS Part - 6 - 1978 (with Rev. 1 4/80) through 110.22 (Type 4 to 13).

2. Racks, panels and associated equipment - EIA : RS - 310 C- 1983 (ANSI C 83.9 - 1972).

3. Protection class for Enclosures, cabinets, control panels & desks - IS:2147 - 1962.

Apparatus, enclosures and installation practices in hazardous area

1. Classification of hazardous area - NFPA 70 - 1984, Article 500.

2. Electrical Instruments in hazardous dust location - ISA - 512.11, 1973.

3. Instrinsically safe apparatus - NFPA 493 1978.

4. Purged and pressurised enclosure for electrical equipment in hazardous location - NFPA 496-1982.

5. Enclosures for Industrial Controls and Systems - NEMA IS 1.1 - 1977.

Sampling System

1. Stainless steel material of tubing and valves for sampling system - ASTMA 296-82, Grade 7 P 316.

2. Submerged helical coil heat exchangers for sample coolers ASTM D11 92-1977.

3. Water and steam in power cycle - ASME PTC 19.11.

4. Standard methods of sampling system - ASTM D 1066-99.

Annunciators

1. Specifications and guides for the use of general purpose annunciators - ISA S 19.1, 1979.

2. Surge withstand capability tests - ANSI C 37.90a - 1989/IEEE-472 or suitable class of IEC 255-4 equivalent to ANSI C37.90a 1989/IEEE-472

3. Damp heat cycling test - IS:2106

4. Specification for Electromagnetic Susceptibility - SAMA DMC 33, 1/78

Protections

1. Relays and relay system associated with electric power apparatus. ANSI C 37.90, 1 - 1989.
2. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS:6875 (Part-I) - 1973.
3. Turbine water damage prevention - ASME TDP-1-1980.
4. Boiler safety interlocks - NFPA 85 - 2011 or latest version.

UPS System

1. Practices and requirements for semi-conductor power rectifiers - ANSI C 34.2, 1973.
2. Relays and relays system associated with electrical power apparatus - ANSI C 3.90 - 1983.
3. Surge withstand capability test - ANSI C 37.90 1 -1989.
4. Performance testing of UPS - IEC 146.
5. Stationary cells & Batteries Lead Acid type (with tubular positive plates) specification IS-1651-1991.
6. Recommended practice for sizing large lead storage batteries for generating stations & sub-stations - IEEE-485-1985.
7. Printed Circuit Board - IPC TM 650, IEC 326C.
8. General Requirements & tests for printed wiring boards, IS:7405 (Part-I) 1973.

Control Valves

1. Control valve sizing - Compressible & Incompressible fluids - ISA S 75.01-1985.
2. Face to face dimensions of control valves - ANSI B 16.00 - 1973.
3. ISA Hand Book of Control Valves - (ISBN : B: 1047-087664-234-2).
4. Codes for pressure piping - ANSI B 31.1
5. Control Valve leak class - ISA RP 39.6

Process Connection & Piping

1. Codes for pressure piping "power piping" - ANSI B 31.1.
2. Seamless carbon steel pipe ASTM - A - 106.
3. Forged & Rolled Alloy steel pipe flanges, forged fittings and valves and parts - ASTM - A - 182.
4. Material for socket welded fittings - ASTM - A - 105.
5. Seamless ferritic alloy steep pipe - ASTM - A - 335.
6. Pipe fittings of wrought carbon steel and alloy steel - ASTM - A - 234.
7. Composition bronze of ounce metal castings - ASTM - B - 62.
8. Seamless Copper tube, bright annealed - ASTM - B - 168.
9. Seamless copper tube - ASTM - B - 75.
10. Dimension of fittings - ANSI - B - 16.11.
11. Valves flanged and butt welding ends - ANSI - B - 16.34.

Instrument Tubing

1. Seamless carbon steel pipe - ASTM - A 106.
2. Material of socketweld fittings - ASTM - A105.
3. Dimensions of fittings - ANSI - B - 16.11.
4. Code for pressure piping, welding, hydrostatic testing - ANSI B 31.1.

Cables

1. Thermocouples extension wires/cables - ANSI MC 96.1 - 1992.
2. Requirements for copper conductor-Wiring cables for telecommunications & information processing system - VDE:0815.
3. Colour coding of single or multi-pair cables - ICEA - S - 61-402 (third edition) NEMA WCS - 1979 with revisions thorugh 2/83.
4. Insulation & Sheathing compounds for cables : VDE 0207 (Part-4, 5 & 6).
5. Guide design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422-1977.

6. Rules for Testing insulated cables and flexible cables : VVDE - 0472

7. Requirements of vertical flame propagation test - IEEE 383 - 1974 (R 1980)

8. Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B-33-81.

9. Oxygen index and temperature index test - ASTM D - 2863.

10. Smoke density measurement test - ASTMD - 2843.

11. Acid gas generation test - IEC - 754 - 1.

12. Swedish Chimney test - SEN - 4241475 (F3).

13. Teflon (FEP) insulation & sheath test - ASTMD - 2116.

14. Thermocouple compensating cables - Testing requirements & sampling plan IS:8784.

15. PVC insulated electric cables for working voltage upto and including 1100 V - IS:1554 (Part-I).

Cable Trays, Conduits

1. Guide for design and installation of cable systems in power generating staiton (Cable trays, support systems, conduits) - IEEE Std. 422, 1977, NEMA VE-1 1979, NFPA 70-1984.

2. -do- Test Standards. NEMA VE-1-1979.

3. Zinc coating "hot dip" on assembled products for galvanising of carbon steel cable trays - ASTMA - 386-78.

Public Address System

1. Specifications for loud speakers - IS:7741 (Part-I, II and III)

2. Code of safety requirement for electric mains operated audio amplifiers - IS:1301

3. Specification for Public Address Amplifiers - IS:10426.

4. Code of practice for outdoor installation of PA system - IS:1982.

5. Code of practice for installation for indoor amplifying and sound distribution system - IS:1881.

6. Basic environmental testing procedures for electronic and electrical items - IS:9000.

7. Characteristics and methods of measurements for sound system equipment - IS:9302

8. Code of practice of electrical wiring installations (System voltage not exceeding 650 volts) - IS:732

9. Rigid steel conduits for electric wiring - IS:9537 (Part-I and II)

10. Fittings for rigid steel conduits for electrical wiring - IS:2667

11. Degree of protection provided by enclosure for low voltage switchgear and control gear - IS:2147.

Vibration Monitoring System

1. API 670 - 1994

2. BS : 4675 Part-2

ANNEXURE-I

MFGR.'s LOGO	MANUFACTURER'S NAME AND ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT :
		ITEM :	QP NO.:	PACKAGE :
			REV.NO.:	CONTRACT NO. :
		SUB-SYSTEM:	DATE:	MAIN-SUPPLIER:
			PAGE: …. OF….	

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C / N					M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	**	10.		11.

		LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUM "N" AS ' W"		DOC. NO.:		REV…… CAT…..
MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER		FOR NTPC USE	REVIEWED BY	APPROVED BY	APPROVAL SEAL
SIGNATURE						

FORMAT NO.: QS-01-QAI-P-09/F1-R1 1/1 ENGG. DIV./QA&I

ANNEXURE-II

SUPPLIER'S LOGO	SUPPLIER'S NAME AND ADDRESS	FIELD QUALITY PLAN		PROJECT :
		ITEM :	QP NO.:	PACKAGE :
		SUB-SYSTEM:	REV. NO.:	CONTRACT NO. :
			DATE:	MAIN-SUPPLIER:
			PAGE: …. OF….	

Sl. No	ACTIVITY AND OPERATION	CHARACTERISTICS / INSTRUMENTS	CLASS OF CHECK #	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D*	REMARKS
1.	2.	3.	4.	5.	6.	7.	8.	9.		10.

MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER	LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. **LEGEND TO BE USED: CLASS # : A = CRITICAL, B=MAJOR, C=MINOR;** **'A'** SHALL BE WITNESSED BY NTPC FQA, **'B'** SHALL BE WITNESSED BY NTPC ERECTION / CONSTRUCTION DEPTT. AND **'C'** SHALL BE WITNESSED BY MAIN SUPPLIER (A & B CHECK SHALL BE NTPC CHP STAGE)	FOR NTPC USE	DOC. NO.:		REV……
SIGNATURE				REVIEWED BY	APPROVED BY	APPROVAL SEAL

ANNEXURE-II

SUPPLIER'S LOGO	SUPPLIER'S NAME AND ADDRESS	FIELD QUALITY PLAN		PROJECT : PACKAGE : CONTRACT NO. : MAIN-SUPPLIER:
		ITEM : SUB-SYSTEM:	QP NO.: REV. NO.: DATE: PAGE: …. OF….	

FORMAT NO.: QS-01-QAI-P-09/F2-R1 1/1 ENGG. DIV./QA&I

ANNEXURE-III

एनटीपीसी NTPC	Project : Stage : Package : Supplier : Contractor No. :	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL SUB-SYSTEM :	DOC. NO.: REV. NO.: DATE : PAGE : OF

S. N.	Item	QP/ Insp. Cat.	QP No.	QP Sub. Schedule	QP approval schedule	Proposed sub-supplier	Place	Sub-suppliers approval status / category	Sub-supplier Details submission schedule	Remarks

LEGENDS

SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY NTPC)

A – **For these items proposed vendor is acceptable to NTPC. To be indicated with letter "A" in the list alongwith the condition of approval, if any.**

DR **– For these items "Detailed required" for NTPC review. To be identified with letter "DR" in the list.**

NOTED **– For these items vendors are approved by Main Supplier and accepted by NTPC without specific vendor approval from NTPC. To be identified with "NOTED.'**

QP/INSPN CATEGORY:

CAT-I **: For these items the Quality Plans are approved by NTPC and the final acceptance will be on physical inspection witness by NTPC.**

CAT-II **: For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis review of documents as per approved QP.**

CAT-III **: For these items Main Supplier approves the Quality Plans. The final acceptance by NTPC shall be on the basis certificate of conformance by the main supplier.**

UNITS/WORKS **: Place of manufacturing Place of Main Supplier of multi units/works.**

FORMAT NO.: QS-01-QAI-P-1/F3-R0 1/1 Engg. Div. / QA&I

ANNEXURE-IV

एनटीपीसी NTPC	Project : Stage : Package : Contractor : Contractor No. :	STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL	DOC. NO.: REV. NO.: DATE : PAGE : OF

S. N.	Item / Service	QP/ Insp. Cat.	QP Sub. Schedule Approval schedule	Date of sub-missio n	Date of comm t Appl.	Status Code C/II/I	Proposed Sub-suppliers	Place of manufacturing works	Approva l Status	Sub-supplier detail submissio n schedule	Remarks

FORMAT 1/1 Engg. Div. / QA&I

ANNEXURE-V

एनटीपीसी NTPC	Project : Stage : Contractor : Contractor No. : System :	FIELD WELDING SCHEDULE (To be raised by the contractor) Welding Code: ……	DOC. NO.: REV. NO.: DATE : PAGE : OF

Sl. No.	DRG No. for Weld Location and Identification mark	Description of parts to welded	Matl. Spec.	Dimensions		Process of welding	Type of Weld	Electrode filler spec.	WPS. No.	Min. pre-heat	Heat treatment		NDT method/ Quantum	REF		Remarks
											Temp.	Holding time		Spec. No.	ACC Norm Ref.	

NOTES:

SIGNATURE

FORMAT	1/1	**Engg. Div. / QA&I**

S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk
1	Drawings, Data sheets, Design calculations, Purchase specifications and other documents		
	First submission and submission with major changes		
	▪ Layout (A0&A1 sizes)	4	-
	▪ Other Drawings/Documents (A0&A1 sizes)	2	-
	▪ P&ID (All sizes)	4	-
	a) Final drawings/documents (Directly to site)	6	2
	b) "As Built" Drawing/Documents (Directly to site)	6	2
	c) Analysis reports of Equipments / piping /structures components/system employing software packages as detailed in the specifications.	2	2
2	Erection Manual (Directly to site)	4 sets	2
3	Operation & Maintenance manual i) First Submission	1 set	--
	ii) Final Submission (Directly to site)	4 sets	2
4	Plant Hand Book i) First Submission	1	1
5	Commissioning and Performance Test Procedure manual i) First Submission	1 set	--
	ii) Final Submission (Directly to site)	4 sets	2

S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk
6	Performance and Functional Guarantee Test Report i) First Submission	2 sets	--
	ii) Approved Copies (Direct to Site)	4 sets	2
7	Project Completion Report (Directly to site)	6 sets	2
8	QA programme including Organisation for implementation and QA system manual(with revisions)	1	--
9	Vendor details in respect of proposed vendors including contractor's evaluation report.	2	--
10	Manufacturing QPs, Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc i) For review/comment	1	--
	ii) Approved final copies of Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc (Direct to Site)	4	2
11	Welding Manual, Heat Treatment Manuals, Storage & preservation manuals i) For review/comment	1 set	--
	ii) Approved copies (Direct to Site)	4 sets	2
12	QA Documentation Package for items / equipment manufactured and despatched to site	2 sets	2
13	QA Documentation Package for field activities on equipment/systems at site	2 sets	2

PRODUCT	AREAS OF TRAINING REQUIEMENT			
	PRODUCT DESIGN	**Plant Visit**	**Visit to Manufacturer's Work**	**Operation & Maintenance of Plant**
FGD	Layout & model of FGD area, cable & piping trestles etc. **FGD** • Mass balance, Design, selection and sizing calculations of FGD • Training on factors affecting sizing/ efficiency of FGD system, equipments & auxiliaries • Materials for FGD & selection • Basic concepts, Design and sizing calculations on slurry systems including piping, valves, etc.. • FGD electrical system • FGD control system Erection strategies, erection procedures Performance as per applicable code and demonstration tests.	Familiarization with various system and equipment Performance, data collection analysis and review O&M feed back Operation history of various equipments and system Failure analysis	Manufacturing process of Absorber and equipments Welding process Testing facilities Product development in process Future plan for technology induction R&D work in progress	Control philosophy operation, notices, logic & protection schemes, O&M manual familiarization O&M issues. Familiarization of special maintenance techniques Special tool and tackles familiarization
MANMONTH	**2**	**0.5**	**0.5**	**6**

SUB-SECTION-VII

MANDATORY SPARES

1.00.00 GENERAL

The Bidder shall include in his scope of supply all the necessary Mandatory spares, Start-up and commissioning spares and Recommended spares and indicate these in the relevant schedules of the Bid Forms & Price Schedules. The general requirements pertaining to the supply of these spares is given below:

1.01.00 **MANDATORY SPARES**

a) The list of mandatory spares considered essential by the Employer is indicated in the list enclosed to this Sub-Section. The bidder shall indicate the prices for each and every item (except for items not applicable to the bidders design) in the 'Schedule of Mandatory Spares' whether or not he considers it necessary for the Employer to have such spares. If the bidder fails to comply with the above or fails to quote the price of any spare item, the cost of such spares shall be deemed to be included in the contract price. The bidder shall furnish total population of each item for the project in the Bid Forms & Price Schedules. Whenever the quantity is mentioned in "sets" the bidder has to give the item details and prices of each item.

b) Whenever the quantity is indicated as a percentage, it shall mean percentage of total population of that item in the station (project), unless specified otherwise, and the fraction will be rounded off to the next higher whole number. Wherever the requirement has been specified as a 'set' (marked by **) it will include the total requirement of the item for a unit, module or the station as specified. Where it is specified as 'set' (marked by*) it would mean the requirement for the single equipment / system as the case may be. Also one set for the particular equipment. e.g. 'set' of bearings for a pump would include the total number of bearings in a pump. Also the 'set' would include all components required to replace the item; for example, a set of bearings shall include all hardware normally required while replacing the bearings.

c) The assembly / sub assembly which have different orientation (like left hand, right hand, top or bottom), different direction of rotation or mirror image positioning or any other regions which result in maintaining two different sets of spares to be used for subject assembly / sub-assembly shall be considered as different type of assembly/sub-assembly.

d) The Employer reserves the right to buy any or all the mandatory spare parts.

e) The prices of mandatory spares indicated by the Bidder in the Bid Proposal sheets shall be used for bid evaluation purposes.

f) All mandatory spares shall be delivered at site at least two months before scheduled date of initial operation of the first unit. However, spares shall not be dispatched before dispatch of corresponding main equipments.

g) Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until & unless specified otherwise.

1.02.00 **RECOMMENDED SPARES**

a) In addition to the spare parts mentioned above, the Contractor shall also provide a list of recommended spares for 3 years of normal operation of the plant and indicate the list and total prices in relevant schedule of the Bid Forms & Price Schedules. This list shall take into consideration the mandatory spares specified in this Sub-Section and should be independent of the list of the mandatory spares. The Employer reserves the right to buy any or all of the recommended spares. The recommended spares shall be delivered at project site at least two months before the scheduled date of initial operation of first unit. However, the spares shall not be dispatched before the dispatch of the main equipment.

b) Prices of recommended spares will not be used for evaluation of the bids. The price of these spares will remain valid up to 6 months after placement of Notification of Award for the main equipment. However, the Contractor shall be liable to provide necessary justification for the quoted prices for these spares as desired by the Employer.

1.03.00 **START-UP & COMMISSIONING SPARES**

a) Start-up & commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares used till the Plant is handed over to the Employer shall come under this category. The Contractor shall provide for an adequate stock of such start up and commissioning spares to be brought by him to the site for the plant erection and commissioning. They must be available at site before the equipments are energized. The unused spares, if any, should be removed from there only after the issue of Taking Over certificate. All start up spares which remain unused at the time shall remain the property of the Contractor.

1.04.00 The Bidder shall include in his scope of supply all the necessary Mandatory spares, Start-up and commissioning spares and indicate these in the relevant schedules of the Bid Forms & Price Schedules. The general requirements pertaining to the supply of these spares is given below:

2.00.00	The Contractor shall indicate the service expectancy period for the spare parts (both mandatory and recommended) under normal operating conditions before replacement is necessary.
3.00.00	All spares supplied under this contract shall be strictly inter-changeable with the parts for which they are intended for replacements. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site e.g. small items shall be packed in sealed transparent plastic with desiccators packs as necessary.
4.00.00	All the spares (both recommended and mandatory) shall be manufactured along with the main equipment components as a continuous operation as per same specification and quality plan.
5.00.00	The Contractor will provide Employer with cross-sectional drawings, catalogues, assembly drawings and other relevant documents so as to enable the Employer to identify and finalize order for recommended spares.
6.00.00	Each spare part shall be clearly marked or labeled on the outside of the packing with its description. When more than one spare part is packed in a single case, a general description of the content shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification.
7.00.00	All cases, containers or other packages are to be opened for such examination as may be considered necessary by the Employer.
8.00.00	The Contractor will provide the Employer with all the addresses and particulars of his sub-suppliers while placing the order on vendors for items/components/ equipments covered under the Contract and will further ensure with his vendors that the Employer, if so desires, will have the right to place order for spares directly on them on mutually agreed terms based on offers of such vendors.
9.00.00	The Contractor shall warrant that all spares supplied will be new and in accordance with the Contract Documents and will be free from defects in design, material and workmanship.
10.00.00	In addition to the recommended spares listed by the Contractor, if the Employer further identifies certain particular items of spares, the Contractor shall submit the prices and delivery quotation for such spares within 30 days of receipt of such request with a validity period of 6 months for consideration by the Employer and placement of order for additional spares if the Employer so desires.
11.00.00	The Contractor shall guarantee the long term availability of spares to the Employer for the full life of the equipment covered under the Contract. The Contractor shall

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11.00.00	The Contractor shall guarantee the long term availability of spares to the Employer for the full life of the equipment covered under the Contract. The Contractor shall

guarantee that before going out of production of spare parts of the equipment covered under the Contract, he shall give the Employer at least 2 years advance notice so that the latter may order his bulk requirement of spares, if he so desires. The same provision will also be applicable to Sub-contractors. Further, in case of discontinuance of manufacture of any spares by the Contractor and/or his Sub-Contractors, Contractor will provide the Employer, two years in advance, with full manufacturing drawings, material specifications and technical information including information on alternative equivalent makes required by the Employer for the purpose of manufacture/procurement of such items.

SECTION: I

SUB-SECTION: C 2B

PAINTING SPECIFICATION

BIDDER TO SUBMIT PAINTING SCHEDULE FOR ALL THE COMPONENTS FOR BHEL / CUSTOMER APPROVAL.

SECTION: I

SUB-SECTION: C-3

TECHNICAL SPECIFICATION (ELECTRICAL PORTION)

2X500 MW NTPC SIPAT TPS, STAGE-II
(FGD PACKAGE)

TECHNICAL SPECIFICATION

GYPSUM DEWATERING EQUIPMENT

(ELECTRICAL PORTION)

BHARAT HEAVY ELECTRICALS LIMITED

POWER SECTOR

PROJECT ENGINEERING MANAGEMENT

NOIDA, UP [INDIA]

CONTENTS

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The requirements mentioned in Section-I shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section-II.

TECHNICAL SPECIFICATION

FOR

GYPSUM DEWATERING EQUIPMENT

(ELECTRICAL PORTION)

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

a) Services and equipment as per "Electrical Scope between BHEL and Vendor".

b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.

c) Supply of mandatory spares as specified in the specifications of mechanical equipments.

d) Electrical load requirement for GYPSUM DEWATERING EQUIPMENT (all AC & DC loads at different voltage levels like HV, 415V AC, 240 V AC, 220 V DC etc).

e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.

f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL

g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.

h) Motor shall meet minimum requirement of motor specification.

i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.

j) Cable BOQ worked out based on routing of cable listing provided by the vendor for " both end equipment in vendor's scope"shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer "Electrical Scope between BHEL and Vendor".

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.

3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 List of enclosures :

a) Electrical scope between BHEL & vendor (Annexure –I)
b) Technical specification for motors.
c) Datasheets & quality plan for motors.
d) Electrical Load data format (Annexure –II)
e) BHEL cable listing format (Annexure –III)

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGES: GYPSUM DEWATERING EQUIPMENT

SCOPE OF VENDOR: SUPPLY & SUPERVISION OF VENDOR'S EQUIPMENT

PROJECT: 2X500 MW NTPC SIPAT TPS, STAGE-II (FGD PACKAGE)

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	11 kV / 3.3 KV / 415 V Switchgear	BHEL	BHEL	HT motor (If applicable), (Motor feeder) power supply shall be provided by BHEL For all LT motor & Auxiliary supply, 415 V AC (3 ph. 4 wire)/240 V AC (supply feeder) shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	 BHEL BHEL BHEL	 BHEL BHEL BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	BHEL	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC etc.	Vendor	BHEL	
6	Cable trays, accessories & cable trays supporting system 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL BHEL	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage.
7	a. Cable glands b. Lugs and bimetallic strip for equipment supplied by Vendor	Vendor Vendor	BHEL BHEL	a. Double compression Ni-Cr plated brass cable glands b. Solder less crimping type heavy duty tinned copper lugs for power and control cables.

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGES: GYPSUM DEWATERING EQUIPMENT

SCOPE OF VENDOR: SUPPLY & SUPERVISION OF VENDOR'S EQUIPMENT

PROJECT: 2X500 MW NTPC SIPAT TPS, STAGE-II (FGD PACKAGE)

8	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	BHEL	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	
10	Equipment grounding (including electronic earthing) & lightning protection	BHEL	BHEL	
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware.	Vendor	BHEL	Makes shall be subject to customer/ BHEL approval at contract stage.
13	HT Motor with base plate and foundation hardware.	Vendor	BHEL	Makes shall be subject to customer/ BHEL approval at contract stage.
14	HT cable & Cable termination kit for HT Motor	BHEL	BHEL	
15	Mandatory spares	Vendor	-	Vendor to quote as per specification.
16	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
17	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	BHEL	
18	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
19	Electrical Equipment & cable tray layout drawings	-	-	Vendor to furnish drawing (both in print form as well as in AUTOCAD) of Gypsum Dewatering Building layout clearly indicating all motors, panels, JB's etc. which require cabling along with their terminal box/location/ Foundation etc.
20	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.	VERIFICATION FROM MOTOR DATASHEET (Y/N)	KKS NO
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

ANNEXURE-II

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER

2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V

: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

		PROJECT TITLE	2X500 MW SIPAT TPS STAGE-II (FGD PACKAGE)	NAME		DATA FILLED UP ON	
		SYSTEM	GYPSUM DEWATERING EQUIPMENT	SIGN.		DATA ENTERED ON	
		DEPTT. / SECTION	MAX	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE	

CABLE SCHEDULE FORMAT

ANNEXURE III

UNITCABLENO	FROM	TO	PURPOSE	CABLE SCOPE (BHEL PEM/ VENDOR)	REMARKS	CABLESIZE	PATHCABLENO	TENTATIVE CABLE LENGTH

SUB-SECTION-II-E2

MOTORS

MOTORS

1.00.00 GENERAL REQUIREMENTS

1.01.00 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.

1.02.00 All equipment's shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.

1.03.00 Contactor shall provide fully compatible electrical system, equipment's, accessories and services.

1.04.00 All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.

1.05.00 Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor equipment.

1.06.00 The responsibility of coordination with electrical agencies and obtaining all necessary clearances for Contactors equipment and systems shall be under the Contactor scope.

1.07.00 Degree of Protection

Degree of protection for various enclosures as per IEC60034-05 shall be as follows :-

i)	Indoor motors	-	IP 54
ii)	Outdoor motors	-	IP 55
iii)	Cable box-indoor area	-	IP 54
iv)	Cable box-Outdoor area	-	IP 55

2.00.00 CODES AND STANDARDS

1)	Three phase induction motors	:	IS/IEC:60034
2)	Single phase AC motors	:	IS/ IEC:60034
3)	Crane duty motors	:	IS:3177, IS/IEC:60034
4)	DC motors/generators	:	IS:4722, IS/IEC:60034
5)	Energy Efficient motors	:	IS 12615, IEC:60034-30

3.00.00 **TYPE**

3.01.00 **AC Motors:**

a) Squirrel cage induction motor suitable for direct-on-line starting.

b) Continuous duty LT motors upto 200 KW Output rating (at 50 deg.C ambient temperature), shall be **Premium Efficiency class-IE3**, conforming to IS 12615, or IEC:60034-30. HT motors shall have minimum design efficiency of 95 %. However, tolerance on this efficiency value shall be applicable as per IEC 60034

c) Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement.

d) Motor operating through variable frequency drives shall be suitable for inverter duty with VPI insulation. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable.

e) Motors operating through variable frequency drives shall also meet the requirements mentioned in subsection for VFD.

3.02.00 DC Motors Shunt wound.

4.00.00 **RATING**

(a) Continuously rated (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor.

(b) Whenever the basis for motor or driven equipment ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.

5.00.00 **TEMPERATURE RISE**

Air cooled motors

70 deg. C by resistance method for both thermal class 130(B) & 155(F) insulation.

Water cooled

80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method for both thermal class 130(B) & 155(F) insulation.

6.00.00	**OPERATIONAL REQUIREMENTS**
6.01.00	**Starting Time**
6.01.01	For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.
6.01.02	For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.
6.01.03	For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.
6.01.04	Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.
6.02.00	**Torque Requirements**
6.02.01	Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor rated torque.
6.02.02	Pull out torque at rated voltage shall not be less than 205% of rated torque. It shall be 275% for crane duty motors.
6.03.00	**Starting voltage requirement** (a) Up to 85% of rated voltage for ratings below 110 KW (b) Up to 80% of rated voltage for ratings from 110 KW to 200 KW (c) Up to 85% of rated voltage for ratings from 201 KW to 1000 KW (d) Up to 80% of rated voltage for ratings from 1001 KW to 4000 KW (e) Up to 75 % of rated voltage for ratings above 4000KW
7.00.00	**DESIGN AND CONSTRUCTIONAL FEATURES**
7.01.00	Suitable single phase space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided. However for flame proof motors, space heater terminals inside the main terminal box may be acceptable.
7.02.00	All motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). The method of movement of primary and secondary coolant shall be self-circulated by fan or pump directly mounted on the rotor of the main motor as per

IEC 60034-6. However VFD driven motors can be offered with forced cooling type with machine mounted fan or pump driven by separate electric motor. Motors and EPB located in hazardous areas shall have flame proof enclosures conforming to IS:2148 as detailed below

(a) Fuel oil area : Group – IIB

(b) Hydrogen generation : Group - IIC or (Group-I, Div-II as per plant area NEC) or (Class-1, Group-B, Div-II as per NEMA /IEC60034)

7.03.00 Winding and Insulation

(a) Type : Non-hygroscopic, oil resistant, flame resistant

(b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature.

(c) 11kV, 6.6 KV & 3.3 kV AC motors : Thermal class 155 (F) insulation.
The winding insulation process shall be total Vacuum Presure Impregnated i.e resin poor method. The lightning Impulse & interturn insulation surge withstand level shall be as per IEC-60034 part-15.

(d) 240VAC, 415V AC & 220V DC motors : Thermal Class (B) or better

7.04.00 Motors rated above 1000KW shall have insulated bearings/housing to prevent flow of shaft currents.

7.05.00 Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.

7.06.00 Noise level for all the motors shall be limited to 85 dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). Vibration shall be limited within the limits prescribed in IS:12075 / IEC 60034-14 . Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads.

7.07.00 In HT motors, at least four numbers simplex / two numbers duplex platinum resistance type temperature detectors shall be provided in each phase stator winding. Each bearing of HT motor shall be provided with dial type thermometer and minimum 2 numbers duplex platinum resistance type temperature detectors.

7.08.00 Motor body shall have two earthing points on opposite sides.

7.09.00 11 KV motors shall be offered with Separable Insulated Connector (SIC) as per IEEE 386. The offered SIC terminations shall be provided with protective cover and trifurcating sleeves. SIC termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.

7.10.00	3.3/6.6 KV motors shall be offered with dust tight phase separated double walled (metallic as well as insulated barrier) Terminal box. Contractor shall provide termination kit for the offered Terminal box. The offered Terminal Box shall be suitable for fault level of 250 MVA for 0.12 sec. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided.
7.11.00	The spacing between gland plate & centre of bottom terminal stud shall be as per Table-I.
7.12.00	All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.
7.13.00	The motors shall be suitable for bus transfer schemes provided on the 11kV, 6.6 KV, 3.3 kV /415V systems without any injurious effect on its life.
7.14.00	For motors rated 2000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.
7.15.00	The size and number of cables (for HT motors) to be intimated to the successful Contactor during detailed engineering and the Contactor shall provide terminal box suitable for the same.
8.00.00	The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance): (a) From 50KW & upto 110KW : 11.0 (b) From 110 KW & upto 200 KW : 9.0 (c) Above 200 KW & upto 1000KW : 10.0 (d) From 1001KW & upto 4000KW : 9.0 (e) Above 4000KW : 6 to 6.5
10.00.00	**TYPE TEST**
10.01.00	**HT MOTORS**
10.01.01	The Contactor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The Contactor shall indicate the charges for each of these type tests separately in the relevant schedule of Section - VII- (BPS) and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the Employer's engineer.
10.01.02	The type tests shall be carried out in presence of the Employer's representative, for which minimum 15 days notice shall be given by the Contactor. The Contactor shall obtain the Employer's approval for the type test procedure before conducting

the type test. The type test procedure shall clearly specify the test set–up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.

10.01.03 In case the Contactor has conducted such specified type test(s) within last ten years as on the date of bid opening, he may submit during detailed engineering the type test reports to the Employer for waival of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Employer reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the Contactor.

10.01.04 Further the Contactor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED" and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the Contactor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Contactor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.

10.01.05 **LIST OF TYPE TESTS TO BE CONDUCTED**

The following type tests shall be conducted on each type and rating of HT motor

(a) No load saturation and loss curves upto approximately 115% of rated voltage

(b) Measurement of noise at no load.

(c) Momentary excess torque test (subject to test bed constraint).

(d) Full load test(subject to test bed constraint)

(e) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp.,coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.

10.01.06 **LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED**

The following type test reports shall be submitted for each type and rating of HT motor

(a) Degree of protection test for the enclosure followed by IR, HV and no load run test.

(b) Terminal box-fault level withstand test for each type of terminal box of HT motors only.

(c) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15

(d) Surge-withstand test on inter-turn insulation shall be as per clause no. 4.2 of IEC 60034, part-15

10.02.00 **LT Motors**

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

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

10.02.03 **LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED**

The following type test reports shall be submitted for each type and rating of LT motor of above 100 KW only

1. Measurement of resistance of windings of stator and wound rotor.

2. No load test at rated voltage to determine input current power and speed

3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors)

4. Full load test to determine efficiency power factor and slip

5. Temperature rise test

6. Momentary excess torque test.

7. High voltage test

8. Test for vibration severity of motor.

9. Test for noise levels of motor(Shall be limited as per clause no 7.06.00 of this section)

10. Test for degree of protection and

11. Overspeed test.

12. Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1

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

10.04.00 The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and “No design Change”. Minor changes if any shall be highlighted on the endorsement sheet.

TABLE - I

DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS

Motor MCR in KW	Minimum distance between centre of bottom terminal stud and gland plate in mm
UP to 3 KW	**As per manufacturer's practice.**
Above 3 KW - upto 7 KW	85
Above 7 KW - upto 13 KW	115
Above 13 KW - upto 24 KW	167
Above 24 KW - upto 37 KW	196
Above 37 KW - upto 55 KW	249
Above 55 KW - upto 90 KW	277
Above 90 KW - upto 125 KW	331
Above 125 KW-upto 200 KW	385/203 (For Single core cables only)

For HT motors the distance between gland plate and the terminal studs shall not be less than 500 mm.

PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:

NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:

Motor MCR in KW	Clearance
UP to 110 KW	10mm
Above 110 KW and upto 150 KW	12.5mm
Above 150 KW	19mm

ANNEXURE-III

1.0	Design ambient temperature		:	50° C
2.0	Maximum acceptable kW rating of LV motor		:	200KW *
3.0	Installation (Indoors/ Outdoors)		:	As required
4.0	Details of supply system			
	a)	Rated voltage (with variation)	:	415V ± 10%
	b)	Rated frequency (with variation)	:	50 Hz + 3 % to - 5%
	c)	Combined voltage & freq. variation	:	10% (sum of absolute values)
	d)	System fault level at rated voltage	:	50 kA for 1 sec
	e)	Short time rating for terminal boxes		
		○ 110 kW and above (Breaker Controlled)	:	50 KA for 0.25 sec.
		○ Below 110 kW (Contactor Controlled)	:	50 KA protected by HRC fuse
	f)	LV System grounding	:	Solidly
5.0	Winding & Insulation		:	Class F with temp rise limited to class B
6.0	Minimum voltage for starting (As percentage of rated voltage)		:	85% for motor ratings below 110kW 80% for motor ratings from 110kW to 200kW.
7.0	Power cables data		:	Shall be given during detailed engg.
8.0	Earth Conductor Size & Material		:	Shall be given during detailed engg.
9.0	Space heater supply (for motors >=30kw)		:	240 V, 1ϕ, 50 Hz
10.0	Rating up to which Single phase motor		:	Acceptable below 0.2 kW
11.0	Locked rotor current			
	a)	Limit as percentage of FLC	:	As per IS 12615
12.0	Makes		: BHEL/ Customer approval (Package owner to take care)	
13.0	Paint shade		:	Blue (RAL 5012) – Corrosion proof
14.0	Degree Of protection for motor/ terminal box		:	Degree of protection for various enclosures as per IEC60034-05 shall be as follows:-

i) Indoor motors - IP 54
ii) Outdoor motors - IP 55
iii) Cable box-indoor area - IP 54
iv) Cable Box-Outdoor area - IP 55

* **LT motors of continuous duty shall be Premium Efficiency class-IE3 conforming to IS-12615**

15.0 TESTING REQUIREMENTS: IN LINE WITH SPECIFICATION

DE-1B	**LT MOTORS**	
A.	**GENERAL**	
5.	Manufacturer & Country of origin. (Shall be as per approved QA make)	
6.	Equipment driven by motor	
7.	Motor type	
8.	Quantity	
B.	**DESIGN AND PERFORMANCE DATA**	
18.	Frame size	
19.	Type of duty	
20.	Type of enclosure /Method of cooling/ Degree of	
21.	Applicable standard to which motor generally	
22.	Efficiency class as per IS 12615	
23.	(a)Whether motor is flame proof	Yes/No
	(b)If yes, the gas group to which it conforms as per IS:2148	
24.	Type of mounting	
25.	Direction of rotation as viewed from DE END	
26.	Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard (KW)	
27.	Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)	
28.	Maximum continuous load demand of driven	
29.	Rated Voltage (volts)	
30.	Permissible variation of :	
	a. Voltage (Volts)	
	b. Frequency (Hz)	
	c. Combined voltage and frequency	
31.	Rated speed at rated voltage and	
32.	At rated Voltage and frequency:	
	a. Full load current	

	b. No load current	
33.	Power Factor at	
	a. 100% load	
	b. NO load	
	c. Starting.	
34.	Efficiency at rated voltage and frequrecy,	
	a.100% load	
	b. 75% load	
	c. 50% load	
35.	Starting current (amps) at	
	a. 100 % voltage	
	b. 85% voltage	
	c. 80% voltage	
36.	Minimum permissible starting Voltage (Volts)	
37.	Starting time with minimum permissible voltage	
	a. Without driven equipment coupled	
	b. With driven equipment coupled	
38.	Safe stall time with 100% and 110% of rated	
	a. From hot condition	
	b. From cold condition	
39.	Torques :	
	a. Starting torque at min. permissible voltage(kg-	
	b. Pull up torque at rated voltage.	
	c. Pull out torque	
	d. Min accelerating torque (kg.m) available	
	e.Rated torque (kg.m)	
40.	Stator winding resistance per phase (ohms at 20	
41.	GD^2 value of motors	

42.	No of permissible successive starts when motor is in hot condition	
43.	Locked Rotor KVA Input	
44.	Locked Rotor KVA/KW	
45.	Vibration limit :Velocity (mm/s)	
46.	Noise level limit (dBA)	
C.	**CONSTRUCTIONAL FEATURES**	
1.	Stator winding insulation	
	a. Class & Type	
	b. Winding Insulation Process	
	c. Tropicalised (Yes/No)	
	d. Temperature rise over specified maximum ambient temperature of 50 deg C	
	e. Method of temperature measurement	
	f. Stator winding connection	
2.	Main Terminal Box	
	a. Type	
	b. Location(viewed from NDE side)	
	c. Entry of cables(bottom/side)	
	d. Recommended cable size(To be matched with cable size envisaged by owner)	
	e. Fault level (MVA),Fault level duration(sec)	
	f. Cable glands & lugs details (shall be suitable for	
3.	Type of DE/NDE Bearing	
4.	Motor Paint shade	
5.	Weight of	
	a. Motor stator (KG)	
	b. Motor Rotor (KG)	
	c. Total weight (KG)	

D.	**List of accessories.**	
1. 3.	Space Heaters (Applicable for 30 KW & above motor) (Nos./Power in watts/supply voltage)	
2.	Terminal Box for Space Heater (Yes/No)	
3.	Speed switch (Yes/No)	
4.	Insulation of bearing (Yes/No)	
5.	Noise reducer(Yes/No)	
6.	Grounding pads	
	i) No and size on motor body	
	ii) Nos on terminal Box	
7.	Vibration pads	
	i) Nos and size	
	ii) Location	
8.	Any other fitments	
E.	**List of curves.**	
1.	Torque speed characteristic of the motor	
2.	Thermal withstand characteristic	
3.	Starting. current Vs. Time	
4.	Starting. current Vs speed	
5.	P.F. and Effi. Vs Load	
F.	**Additional Data to be filled for each rating of DC Motor**	
1.	Rated armature voltage (Volt)	
2.	Rated field excitation (Amp)	
3.	Permissible % variation in voltage	
4.	Minimum Permissible Starting voltage (volt)	
5.	At rated voltage	
	i)Full load Armature current.(Amp)	

	ii)Full load Field current (Amp)	
	iii)No load Armature current (Amp)	
6.	Full load Field current (Amp)	
7.	No load Aramature current (Amp)	
8.	Minimum permissible field current(Amp) to avoid	
	i) Maximum permissible voltage	
	ii) Rated voltage	
	iii) Minimum Permissible Voltage	
9.	Resistance (indicative Values) in ohm	
	i)Armature winding(Arm + IP + Series) at 25	
	ii) Field Winding at 25 deg. C	
10..	Inductance (indicative values)	
	i) Armature winding	
	ii) Field winding	
11	Value of trimmer resistance (ohm) to be connected in series with the shunt field to	
	i) 220 V DC	
	ii) 250 V DC	
	iii) 187 V DC	
12	Value of the external resistance (ohm)required to be connected in series with armature during starting only	
13	Technical data sheet for external resistance box	
14	GA drawing of motor	
15	Starting time calculation	
16	Starter resistance design calculation	
17	Electrical connection diagram of motor	

S. No.	Description	Data to be filled by successful bidder
A.	**General**	
1	Manufacturer & country of origin	
2	Motor type	
3	Type of starting	
4	Name of the equipment driven by motor & Quantity	
5	Maximum Power requirement of driven equipment	
6	Rated speed of Driven Equipment	
7	Design ambient temperature	
B.	**Design and Performance Data**	
1	Frame size & type designation	
2	Type of duty	
3	Rated Voltage	
4	Permissible variation for	
5	a Voltage	
6	b Frequency	
7	c) Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)	
9	Synchronous speed & Rated slip	
10	Minimum permissible starting voltage	
11	Starting time in sec with mechanism coupled	
12	a) At rated voltage	
13	b) At min starting voltage	
14	Locked rotor current as percentage of FLC (including IS tolerance)	
15	Torque	
	a) Starting	
	b) Maximum	
16	Permissible temp rise at rated output over ambient temp & method	
17	Noise level at 1.0 m (dB	
18	Amplitude of vibration	
19	Efficiency & P.F. at rated voltage & frequency	
	a) At 100% load	
	c) At 75% load	

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	**Constructional Features**	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	**Characteristic curves/ drawings** (To be enclosed for motors of rating ≥ 55KW)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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

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.

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 mimimum 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: 4691and 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.

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.

4.9 **General**

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.

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN .		SPEC. NO :	DATE:27.02.2020
		CUSTOMER :		QP NO.: PED-506-00-Q-006, REV-02	
		PROJECT:		PO NO.:	
		ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 OF 2

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	-	MFG. SPEC.	MFG. SPEC.	-DO-		P	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-		P	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	-	MFG.SPEC./	MFG.SPEC.	-DO-		P	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	-	MFG. SPEC/ APPROVED DATASHEET	SAME AS COL.7	LOG BOOK		P	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST	MA	-DO-	100%	100%	IS-325 / IS-12615/ APPROVED DATA SHEET	SAME AS COL.7	TEST/ INSPN. REPORT		P	W	W	NOTE -1 & NOTE-2
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET	TEST/ INSPN. REPORT		P	W	W	NOTE -1 & NOTE-2

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/2/2020	Hema K.	Checked by:		KUNAL GANDHI
Reviewed by:	02/3/2020	P. Dutta	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

बीएचईएल BHEL	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:27.02.2020
		CUSTOMER :		QP NO.: PED-506-00-Q-006, REV-02	
		PROJECT:		PO NO.:	
		ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 OF 2

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	100%	IS-325 / IS-12615 / APPROVED DATA SHEET	SAME AS COL.7	TEST/ INSPN. REPORT		P	W	W	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MFG. STANDARD / APPROVED PACKING DRAWING.(#)	AS PER MFG. STANDARD / APPROVED PACKING DRAWING.(#).	INSPC. REPORT		P	W	-	(#) APPLICABLE FOR EXPORT JOBS

NOTES:

1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL/CUSTOMER SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON

2 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.

4 BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED.

5 AFTER PACKING AND PRIOR TO ISSUE MDCC, PHOTOGRAPHS OF ITEMS TO BE DESPATCHED SHALL BE SENT TO BHEL FOR REVIEW.

6 IN CASE , ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE SHALL BE CARRIED OUT BY BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **B**: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C**: CUSTOMER,
P: PERFORM, **W**: WITNESS, **V**: VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR, **CR**: CRITICAL
D: DOCUMENT

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/3/2020	Hema K.	Checked by:	2/3/20	KUNAL GANDHI
Reviewed by:	02/3/2020	P. Dutta	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:27.02.2020
		CUSTOMER :		QP NO.: PED-506-00-Q-007, REV-04	
		PROJECT:		PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.0	RAW MATERIAL & BOUGHT OUT CONTROL													
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	-DO-		P	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-	-DO-	-DO-	TEST REPORT		P/V	-		
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%	-		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-		P	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	SUPPLIERS TC & LOG		P/V	-	-	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%	-		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK		P/V	-		
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	SUPPLIER'S TC		P/V	-		HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P/V	-		

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	2/3/2020	Hema K.	Checked by:	2/3/20	MONAC GHOSH
Reviewed by:	2/3/2020	P. Dutta	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
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Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	
		CUSTOMER :		QP NO.: PED-506-00-Q-007, REV-04	DATE:27.02.2020
		PROJECT:		PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	-DO-		P	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S DRG./ STD.	SUPPLIER'S TC		P/V	-		
		3. DIMENSIONS	MA	MEASUREMENT	100%	-	-DO-	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
		4.INTERNAL FLAWS	CR	ULTRASONIC TEST	100%	100%	ASTM-A388	MANUFACTURER'S STD.	-DO-	✓	P/W	V	-	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNEC-TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	-	MANUFACTURER'S DRG./STD.	MANUFACTURER'S DRG./STD.	-DO-		P/V	-	-	
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-		P/V	-	-	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./ STD	MANUFACTURER'S DRG. / STD.	-DO-		P/V	-	-	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-	-DO-	-DO-	TEST REPORT		P/V	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/2/2020	Hema K.	Checked by:	27/2/20	KUNAL GANDHI
Reviewed by:	02/3/2020	P. Dutta	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:27.02.2020
	CUSTOMER :		QP NO.: PED-506-00-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 3 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS	TEST REPORT		P/V	-	-	
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK AND OR SUPPLIER'S TC		P/V	-	-	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK		P	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG.	MANUFACTURER'S DRG.	-DO-		P/V	-	-	
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	-	MANUFACTURER'S DRG./ STD.	MANUFACTURER'S DRG./ STD.	SUPPLIER'S TC		P/V	-	-	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		*P/V	-	-	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	SUPPLIERS TC & VENDOR'S TEST REPORTS		P/V	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/2/2020	Hema K.	Checked by:	27/2/20	KUNAL GANDHI
Reviewed by:	27/2/2020	P. Dutta	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:27.02.2020
		CUSTOMER :		QP NO.: PED-506-00-Q-007, REV-04	
		PROJECT:		PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 4 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		3.DIMENSIONS	MA	MEASUREMENT	-DO-	-	-DO-	-DO-	Log Book		P/V	-	-	
1.10	BEARINGS	1.MAKE & TYPE	MA	VISUAL	100%	-	MANUFACTURER'S DRG./ APPROVED DATASHEET	MANUFACTURER'S DRG./ APPROVED DATASHEET	-DO-		P/V	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	APPROVED DATASHEET	APPROVED DATASHEET/ BEARING MANUF'S CATALOGUES	-DO-		P/V	-	-	
		3.SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	-DO-		P/V	-	-	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-	-DO-	-DO-		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	-DO-		P	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	-	MANUFACTURER'S STD./ APPROVED DATASHEET	MANUFACTURER'S STD./ APPROVED DATASHEET	-DO-		P/V	-	-	
		4.HV/IR	MA	-DO-	100%	-	-DO-	-DO-	-DO-		P/V	-	-	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	-	MANUFACTURER'S DRG/SPECS	MANUFACTURER'S DRG./ SPECS.	-DO-		P	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	-DO-		P	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	-DO-		P	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/3/2020	Hema K.	Checked by:		KUNAL GANGULY
Reviewed by:	02/3/2020	P. Dutta	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Doc No:			
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Approved by:			

बीएचईएल BHEL	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN	SPEC. NO :	DATE:27.02.2020
		CUSTOMER :	QP NO.: PED-506-00-Q-007, REV-04	
		PROJECT:	PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) SYSTEM:	SECTION: II	SHEET 5 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
2.0	IN PROCESS													
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-	-DO-	GOOD FINISH	LOG BOOK		P/W	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	-DO-		P	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-	-DO-	GOOD FINISH	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	-DO-		P	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	100%	100%	MANUFACTURER'S STD./ ASTM-E165	MANUFACTURER'S STD./ APPROVED DATASHEET.	-DO-	✓	P	V	-	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	SAME AS COL.7	LOG BOOK		P	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-	-DO-	-DO-	-DO-		P	-	-	
		3.SHADE	MA	VISUAL	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/2/2020	Hema R.	Checked by:	28/2/20	KUNAL GHANDHI
Reviewed by:	02/3/2020	P. Dutta	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:27.02.2020
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	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 6 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK		P	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-	-DO-	-DO-	LOG BOOK		P	-	-	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	100%	100%	IS-325/IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	LOG BOOK	✓	P	V	-	
		4.RESISTANCE	CR	-DO-	100%	100%	IS-325/IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	LOG BOOK	✓	P	V	-	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-	MANUFACTURER'S STANDARD	MANUFR'S STANDARD	LOG BOOK		P	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		3.NO. OF DIPS	MA	-DO-	CONTINUOUS	CONTINUOUS	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✓	P	V	-	THREE DIPS TO BE GIVEN

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/3/2020	Hema K.	Checked by:	27/3/20	KUNAL GANDHI
Reviewed by:	02/3/2020	P.Dutta	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:27.02.2020
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	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 7 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		4.DURATION	MA	-DO-	CONTINUOUS	CONTINUOUS	-DO-	-DO-	LOG BOOK	✓	P	V	-	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-	-DO-	-DO-	LOG BOOK		P	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	100%	100%	-DO-	-DO-	LOG BOOK	✓	P	V	-	
		3.HV	MA	ELECT. TEST	100%	100%	-DO-	-DO-	LOG BOOK	✓	P	V	-	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	-	MANUFACTURER'S SPEC./ ISO 1940	MANUFACTURER'S DWG.	LOG BOOK		P	-	-	
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	100%	100%	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✓	P	V	-	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	
		3.AXIAL PLAY	MA	MEAS.	100%	100%	-DO-	-DO-	LOG BOOK	✓	P	V	-	
		4.DIMENSIONS	MA	-DO-	-DO-	-	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	MANUFACTURER'S DRG/ RELEVANT IS	LOG BOOK		P	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	100%	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✓	P	V	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/2/2020	Hema K.	Checked by:		KUNAL GANDHI
Reviewed by:	02/3/2020	P. Dutta	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
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	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

बीएचईएल BHEL	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN	SPEC. NO :	DATE:27.02.2020
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		PROJECT:	PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) SYSTEM:	SECTION: II	SHEET 8 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS	MA	ELECT.TEST	1/TYPE/SIZE	1/TYPE/SIZE	IS-325/IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT		P	W*	W*	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST	MA	-DO-	100%	100%	-DO-	-DO-	-DO-		P	V /W$	V /W$	$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	100%	IS: 12075 / IEC 60034-14 & IS-12065	IS: 12075 / IEC 60034-14 & IS-12065	-DO-		P	V /W$	V /W$	$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET &	TEST/INSPC. REPORT		P	W	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	1/TYPE/ SIZE	IEC 60034-5/IS-12615	APPROVED DATASHEET	TC	✓	P	V	V	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	100%	IS-325/IS-12615/IEC-60034 PART-1/IS: 12802	IS-325/IS-12615/IEC-60034 PART-1/IS: 12802	-DO-		P	V /W$	V /W$	$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	100%	IS-325/IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	-DO-		P	V /W$	V /W$	$ NOTE - 2
		8. NAME PLATE DETAILS	MA	VISUAL	100%	100%	IS-325/IS-12615& DATA SHEET	IS-325/IS-12615 & DATA SHEET	TEST/INSPC. REPORT		P	V /W$	V /W$	$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	1/TYPE	IS 2148 / IEC 60079-1	IS 2148 / IEC 60079-1	TC	✓	P	V	V	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	SAMPLE	APPROVED DATASHEET	APPROVED DATASHEET	TC		P	W$	W$	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY $ NOTE - 2

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	3/2/2020	Hema K.	Checked by:	3/2/20	KUNAL GANDHI
Reviewed by:	03/2/2020	P. Dutt	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:27.02.2020
		CUSTOMER :		QP NO.: PED-506-00-Q-007, REV-04	
		PROJECT:		PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 9 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MANUFACT. STANDARD / APPROVED CROSS SECTION DRAWING.	AS PER MANUFACT. STANDARD / APPROVED CROSS SECTION DRAWING.	INSPC. REPORT		P	W	-	IF APPLICABLE, REFER SEAWORTHY PACKING ALSO.

NOTES:

1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.

2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL/CUSTOMER SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.

4 BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED.

5 AFTER PACKING AND PRIOR TO ISSUE MDCC, PHOTOGRAPHS OF ITEMS TO BE DESPATCHED SHALL BE SENT TO BHEL PURCHASE GROUP FOR REVIEW.

6 IN CASE , ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE SHALL BE CARRIED OUT BY BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,

** M: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, C: CUSTOMER,

P: PERFORM. W: WITNESS. V: VERIFICATION. AS APPROPRIATE

MA: MAJOR, MI: MINOR, CR: CRITICAL

D: DOCUMENT

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	2/3/2020	Hema K.	Checked by:	2/3/20	KUNAL GHANDHI
Reviewed by:	02/3/2020	P. Dutta	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

SUB-SECTION-V-QE1

MOTORS

MOTOR

TESTS/CHECKS / TEMS/COMPONENTS	Visual	Dimensional	Make/Type/Rating /General Physical Inspection	Mech/Chem. Properties	NDT /DP/MPI/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	Routine & Acceptance tests as per IS-325/IS-4722 /IS- 9283/IS 2148/IEC60034\IEC 60079-I/ IS-12615	vibration	Over speed	Tan delta, shaft voltage & polarization index test	Paint shade, thickness & adhesion
Plates for stator frame, end shield, spider etc.	Y	Y	Y	Y	Y				Y										
Shaft	Y	Y	Y	Y	Y	Y			Y										
Magnetic Material	Y	Y	Y	Y			Y			Y		Y							
Rotor Copper/Aluminium	Y	Y	Y	Y			Y		Y										
Stator copper	Y	Y	Y	Y			Y		Y			Y							
SC Ring	Y	Y	Y	Y	Y		Y	Y	Y										
Insulating Material	Y		Y	Y			Y					Y							
Tubes, for Cooler	Y	Y	Y	Y	Y				Y		Y								
Sleeve Bearing	Y	Y	Y	Y	Y				Y		Y								
Stator/Rotor, Exciter Coils	Y	Y	Y				Y	Y											
Castings, stator frame, terminal box and bearing housing etc.	Y	Y	Y	Y	Y			Y											
Fabrication & machining of stator, rotor, terminal box	Y	Y			Y			Y	Y										

Wound stator	Y	Y					Y	Y											
Wound Exciter	Y	Y					Y	Y											
Rotor complete	Y	Y					Y						Y	Y					
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y												
Accessories, RTD, BTD,CT, Space heater, antifriction bearing, gaskets etc.	Y	Y	Y																
Complete Motor	Y	Y	Y												Y	Y	Y	Y1	Y

Note: 1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed along with relevant
supporting documents during QP finalization. However, following methodology to be followed for Inspection Categorisation:

a) Up to 50 KW: Cat-III: Acceptance of Motor up to 50 KW is based on COC of the manufacturer & the Main Contractor confir specifications.

b.i) Above 50 KW and up to 75KW: Cat-III : For manufacturers who have already supplied this range of motors to NTPC which have b no adverse feedback has been reported from RIO/project-site AND for skid mounted motor supplied with the driven equipment. Acce of Routine Test Inspection report as per IS-325 along with COC of the Manufacturer and Main Contractor confirming NTPC's technical

b.ii) Above 50 KW and up to 75KW: Cat-I: For Other Manufacturers, as per NTPC approved Quality Plan

c) Above 75 KW: Cat-I: as per NTPC approved Quality Plan

2. Additional routine tests for Flame proof motors shall be applicable as per relevant standard
3. Makes of major bought out items for HT motors will be subject to NTPC approval.
4. Y1 = for HT Motor / Machines only.

correspond to the terminal numbering in wiring diagrams. All metal parts shall be of non-ferrous material. In case of screw type terminals the screw shall be captive, preferably with screw locking design. All terminal blocks shall be suitable for terminating on each side the required cables/wire size. All internal wiring shall be of cu. Conductor PVC wire.

3.05.00 **Terminations & Straight Through Joints**

3.05.01 Termination and jointing kits for 33kV, 11 kV, 6.6 KV and 3.3 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits and jointing kits shall be Pre-moulded type or heat shrinkable type. Further Cold shrinkable type termination and jointing kits are also acceptable. The Cold shrinkable type kits shall be type tested as per relevant standards. Calculation to withstand the required fault level shall also be furnished in case of cold shrinkable type kits. 33 kV, 11 kV, 6.6 KV and 3.3kV grade joints and terminations shall be type tested and Type test reports as per IS:13573 Part-II and IEC60502 shall be furnished. Also, heat shrink material shall comply with requirements of ESI 09-13 (external tests). Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Cable joints and terminations should be with FRLS properties as per IEC 60754-1&2. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the tinned copper solderless crimping type cable lugs & ferrule or mechanical connectors (wherein bolts are tightened that shear off at an appropriate torque) as per DIN standard suitable for aluminium compacted conductor cables. (Tender drg. no 0000-211-POE –A-51-RA of cable lug attached at the end of this chapter).

3.05.02 Straight through joint and termination shall be capable of withstanding the fault level of 21 KA for 0.12 Sec. with dynamic peak of 52 KA for 33 KV system & of 40 kA for 0.12 sec with a dynamic peak of 100 kA for 11 kV, 6.6 KV & 3.3 KV system. Straight through joints shall have provisions for shield connection and earthing wherever required and complete with all accessories and consumables suitable for storage without deterioration at a temperature of 50 deg. C with shelf life of more than five years. 1.1 kV grade straight through joints shall also be of proven design

3.05.03 1.1 KV grade Straight Through Joint shall be of proven design.

3.06.00 **Cable glands**

3.06.01 Cable shall be terminated using double compression type cable glands. Testing requirements of Cable glands shall conform to BS:6121 and gland shall be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.

3.07.00 **Cable lugs/ferrules**

3.07.01 Cable lugs/ferrules shall be solderless crimping type suitable for power and control cables as per the DIN 46239. Aluminium solderless crimping lugs/ ferrules shall be used for Aluminium cables and Copper lugs/ferrules shall be used for Copper cables. Bimetallic washers or bimetallic type lugs shall be used for bimetallic connections.

Crimping tool for crimping (from 1.5sqmm cable to 630sqmm cables) above mentioned lugs shall be of Hexagonal Type crimp profile, with suitable die of crimp match code.
Characteristics of crimping tool:

1) To should generate enough pressure to pass pull out test as per IEC 61238-1. Relevant type test to be produced for the sizes specified in the tender.
2) Tool die shall be replaceable for assorted sizes and crimp code to be mentioned on both part the die.
3) Tool should be compliant of testing according to IEC, UL and GS standards.

Tool shall have features such as:

- Auto retraction system
- Manual retraction stop.
- Feedback signals for improper pressure
- Better battery capacity and with status display
- Flexible and rotating head for easy crimping.

3.08.00 **Trefoil clamps**

3.08.01 Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength, when installed at 1 mtr intervals, to withstand the forces generated by the peak value of maximum system short circuit current.

3.09.00 **Cable Clamps & Ties**

3.09.01 The cable clamps/ties required to clamp multicore cables shall be of SS-316 material, 12mm wide, polyster coated ladder lock type. The clamps/ties shall have self locking arrangement & shall have sufficient strength. The cable clamps/ties shall be supplied in finished individual pieces of suitable length to meet the site requirements.

3.10.00 **Receptacles**

3.10.01 Receptacles boxes shall be fabricated out of MS sheet of 2mm thickness and hot dipped gavanised or of die-cast aluminium alloy of thickness not less than 2.5 mm. The boxes shall be provided with two nos. earthing terminals, gasket to achieve IP55 degree of protection, terminal blocks for loop-in loop-out for cable of specified sizes, mounting brackets suitable for surface mounting on wall/column/structure, gland plate etc. The ON-OFF switch shall be rotary type heavy duty, double

1.00.00 CODES AND STANDARDS

1.01.00 All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable .

IS:513	Cold rolled low carbon steel sheets and strips.
IS:802	Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.
IS:1079	Hot Rolled carbon steel sheet & strips
IS:1239	Mild steel tubes, tubulars and other wrought steel fIttings
IS:1255	Code of practice for installation and maintenance of power cables upto and including 33 KV rating
IS:1367 Part-13	Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).
IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear
IS:2309	Code of Practice for the protection of building and allied structures against lightning.
IS:2629	Recommended practice for hot dip galvanising of iron & steel
IS:2633	Method for testing uniformity of coating on zinc coated articles.
IS:3043	Code of practice for Earthing
IS:3063	Fasteners single coil rectangular section spring washers.
IS:6745	Methods for determination of mass of zinc coating on zinc coated iron & steel articles.
IS:8308	Compression type tubular in- line connectors for aluminium conductors of insulated cables
IS:8309	Compression type tubular terminal ends for aluminium conductors of insulated cables.
IS:9537	Conduits for electrical installation.
IS:9595	Metal - arc welding of carbon and carbon manganese steels - recommendations.

IS:13573	Joints and terminations for polymeric cables.
BS:476	Fire tests on building materials and structures
IEEE:80	IEEE guide for safety in AC substation grounding
IEEE:142	Grounding of Industrial & commercial power systems
DIN 46267 (Part-II)	Non tension proof compression joints for Aluminium conductors.
DIN 46329	Cable lugs for compression connections, ring type ,for Aluminium conductors
BS:6121	Specification for mechanical Cable glands for elastomers and plastic insulated cables.
	Indian Electricity Act.
	Indian Electricity Rules.

1.02.00 Equipment complying with other internationally accepted standards such as IEC, BS, DIN, USA, VDE, NEMA etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards alongwith copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.

2.00.00 DESIGN AND CONSTRUCTIONAL FEATURE

2.01.00 **Inter Plant Cabling**

2.01.01 Interplant cabling for main routes shall be laid along overhead trestles. Cables from main plant to control room shall be laid in overhead trestles . However cable trenches/slit may also be acceptable, for some areas, if found to be required during detailed engineering. Two separate cable routes shall be provided for cable routing of working and standby drives or different set/group (say 50% capacity) of auxiliaries. Necessary statutory clearance if required shall be taken by Bidder. All HT, LT and control cable shall be armoured type.

2.01.02 **Transformer yard**

Deleted

2.01.03 **Trenches**

PCC flooring of built up trenches shall be sloped for effective drainage with sump pits and sump pumps.

2.01.04 No sub zero level cable vault/trenches shall be provided below control building/switchgear rooms.

2.01.05 **Cable Vault**

The cable vault/ / cable spreader room space below the HT / LT switchgear room, Control Rooms, unit control equipment room, Programmer room, UPS, Charger & Battery Rooms, shall have **800 mm wide** and 2.1 m high movement passage all around the cable trays in the cable vault/ cable spreader room for easy laying/maintenance of cables

Cable vaults shall be provided with adequate drainage facilities for drainage of fire water.

Each cable vault should have at least two doors.

Exit signs shall be provided near doors for personnel escape in case of emergency

2.01.06 **Boiler Area**

Deleted.

2.01.08 **OffSite Area**

For feeder in bidder's scope for offsite areas, overhead cable tray arrangement shall be followed. However cable trenches/slit may also be acceptable, for some areas, if found to be required during detailed engineering.

2.01.09 The cable slits to be used for motor/equipment power/control supply shall be sand filled & covered with PCC after cabling.

2.01.10 Sizing criteria, derating factors for the cables shall be met as per respective chapters. However for the power cables, the minimum conductor size shall be 6 sq.mm. for aluminium conductor and 2.5 sq.mm. for copper conductor cable.

2.01.11 Conscious exceptions to the above guidelines may be accepted under special conditions but suitable measures should be taken at such location to:

- Meet all safety requirements
- Safeguard against fire hazards, mechanical damage, flooding of water, oil accumulation, electrical faults/interferences, etc

3.00.00 EQUIPMENT DESCRIPTION

3.01.00 **Cable trays, Fittings & Accessories**

3.01.01 Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.) accessories (like side coupler plates, etc. and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables.

3.01.02 Cable trays, fittings and accessories shall be fabricated out of rolled mild steel sheets free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per Clause No. 3.13.00 of this chapter.

3.01.03 Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. Thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be 3 mm.

3.01.04 Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of thickness 2 mm and shall be hot dip galvanised as per Clause No. 3.13.00 of this chapter. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm.

3.01.05 The tolerance for cable tray and accessories shall be as per IS 2102 (Part-1).
Tolerance Class: - Coarse

3.02.00 **Support System for Cable Trays**

3.02.01 Cable tray support system shall be pre-fabricated out of single sheet as per enclosed tender drawings.

3.02.02 Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types : (i) C1:- having provision of supporting cable trays on one side and (ii) C2:-having provision of supporting cable trays on both sides. The support system shall be the type described hereunder

a. Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardwares such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc.

b. The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardwares fitings and accessories shall be prefabricated factory galvanised.

c. The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvansied surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied

d. All steel components, accessories, fittings and hardware shall be hot dip galvanised after completing welding, cutting, drilling and other machining operation.

e. The typical arrangement of flexible support system is shown in the enclosed drawings and described briefly below:

The main support channel and cantilever arms shall be fabricated out of 2.5 thick rolled steel sheet conforming to IS 1079.

f. Cantilever arms of 320 mm, 620mm and 750 mm in length are required, and shall be as shown in the enclosed drawing. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position.

g. Support system shall be able to withstand

- weight of the cable trays
- weight of the cables (75 Kg/Metre run of each cable tray)
- Concentrated load of 75 Kg between every support span.
- Factor of safety of minimum 1.5 shall be considered.

3.02.03 The size of structural steel members or thickness of sheet steel of main support channel and cantilever arms and other accessories as indicated above or in the enclosed drawings are indicative only. Nevertheless, the support system shall be designed by the bidder to fully meet the requirements of type tests as specified. In case the system fails in the tests, the components design modification shall be done by the Bidder without any additional cost to the Employer. The bidder shall submit the detailed drawings of the system offered by him alongwith the bid.

3.02.04 Four legged structure shall be provided wherever there is change in elevation and change in direction

3.02.05 FOR COAL HANDLING PLANT/**FGD PLANT/ ESP AREA** THE FOLLOWING SHALL ALSO BE APPLICABLE**:**

a) All overhead cable routes shall be along the route of the conveyor gallery on separate supporting structures and cables shall be laid in vertical trays. The bottom of the steel shall be such that the existing facilities, movement of trucks/human beings etc. does not get affected. The cable trestle shall have a minimum 600mm clear walk way and shall have maintenance platforms as required. The bottom of the steel supporting structure shall be generally at 3.0M above the grade level except for rail/road crossings where it shall be at 8.0M above grade level. Tap offs from the overhead cable trestle can be through shallow trenches with prior approval of the Employer. Directly buried cable, if essential, shall not have concentration of more than 4 cables on one route.

b) deleted

c) Cables shall not be routed through the conveyor galleries except for the equipment located in the conveyor galleries for a particular conveyor i.e. protection switches, receptacles etc.

d) Cables for PCS and BSS shall be routed along the conveyors through GI conduits.

3.03.00 **Pipes, Fittings & Accessories**

3.03.01 Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria

3.03.02 GI Pipes shall be of medium duty as per IS: 1239

3.03.03 Duct banks shall be High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.

3.03.04 Hume pipes shall be NP3 type as per IS 458.

3.03.05 TERNE Coated Flexible Steel Conduits shall be water proof and rust proof made of heat resistant lead coated steel. Conduit diameter shall be uniform throughout its length. Internal surface of the conduit shall be free from burrs and sharp edges. Conduits shall be complete with necessary accessories for proper termination of the conduit with junction boxes and lighting fixtures

3.03.06 HDPE pipes and conduits shall be PE-80, PN-10 type as per IS 4984/IS 8008 part-I.

3.04.00 **Junction Boxes**

3.04.01 Junction box shall be made of Fire retardant material. Material of JB shall be Thermoplastic or thermosetting or FRP type. The box shall be provided with the terminal blocks, mounting bracket and screws etc. The cable entry shall be through galvanized steel conduits of suitable diameter. The JB shall have suitable for installing glands of suitable size on the bottom of the box. The JB shall be suitable for surface mounting on ceiling/structures. The JB shall be of grey color RAL 7035. All the metal parts shall be corrosion protected. Junction box surface should be such that it is free from crazings, blisterings, wrinkling, colour blots/striations. There should not be any mending or repair of surface. JB's will be provided with captive screws so that screws don't fall off when cover is opened. JB's mounting brackets should be of powder coated MS. Type test reports for the following tests shall be furnished:-

(a) Impact resistance for impact energy of 2 Joules (IK07)as per BS EN50102

(b) Thermal ageing at 70deg C for 96 hours as per IEC60068-2-2Bb.

(c) Class of protection shall be IP 55.

(d) HV test.

3.04.02 Terminal blocks shall be 1100V grade, of suitable current rating, made up of unbreakable polyamide 6.6 grade. The terminals shall be screw type or screw-less (spring loaded) / cage clamp type with lugs. Marking on terminal strips shall

correspond to the terminal numbering in wiring diagrams. All metal parts shall be of non-ferrous material. In case of screw type terminals the screw shall be captive, preferably with screw locking design. All terminal blocks shall be suitable for terminating on each side the required cables/wire size. All internal wiring shall be of cu. Conductor PVC wire.

3.05.00 **Terminations & Straight Through Joints**

3.05.01 Termination and jointing kits for 33kV, 11 kV, 6.6 KV and 3.3 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits and jointing kits shall be Pre-moulded type or heat shrinkable type. Further Cold shrinkable type termination and jointing kits are also acceptable. The Cold shrinkable type kits shall be type tested as per relevant standards. Calculation to withstand the required fault level shall also be furnished in case of cold shrinkable type kits. 33 kV, 11 kV, 6.6 KV and 3.3kV grade joints and terminations shall be type tested and Type test reports as per IS:13573 Part-II and IEC60502 shall be furnished. Also, heat shrink material shall comply with requirements of ESI 09-13 (external tests). Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Cable joints and terminations should be with FRLS properties as per IEC 60754-1&2. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the tinned copper solderless crimping type cable lugs & ferrule or mechanical connectors (wherein bolts are tightened that shear off at an appropriate torque) as per DIN standard suitable for aluminium compacted conductor cables. (Tender drg. no 0000-211-POE –A-51-RA of cable lug attached at the end of this chapter).

3.05.02 Straight through joint and termination shall be capable of withstanding the fault level of 21 KA for 0.12 Sec. with dynamic peak of 52 KA for 33 KV system & of 40 kA for 0.12 sec with a dynamic peak of 100 kA for 11 kV, 6.6 KV & 3.3 KV system. Straight through joints shall have provisions for shield connection and earthing wherever required and complete with all accessories and consumables suitable for storage without deterioration at a temperature of 50 deg. C with shelf life of more than five years. 1.1 kV grade straight through joints shall also be of proven design

3.05.03 1.1 KV grade Straight Through Joint shall be of proven design.

3.06.00 **Cable glands**

3.06.01 Cable shall be terminated using double compression type cable glands. Testing requirements of Cable glands shall conform to BS:6121 and gland shall be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.

3.07.00 **Cable lugs/ferrules**

3.07.01

Cable lugs/ferrules shall be solderless crimping type suitable for power and control cables as per the DIN 46239. Aluminium solderless crimping lugs/ ferrules shall be used for Aluminium cables and Copper lugs/ferrules shall be used for Copper cables. Bimetallic washers or bimetallic type lugs shall be used for bimetallic connections.

Crimping tool for crimping (from 1.5sqmm cable to 630sqmm cables) above mentioned lugs shall be of Hexagonal Type crimp profile, with suitable die of crimp match code.
Characteristics of crimping tool:

1) To should generate enough pressure to pass pull out test as per IEC 61238-1. Relevant type test to be produced for the sizes specified in the tender.
2) Tool die shall be replaceable for assorted sizes and crimp code to be mentioned on both part the die.
3) Tool should be compliant of testing according to IEC, UL and GS standards.

Tool shall have features such as:

- Auto retraction system
- Manual retraction stop.
- Feedback signals for improper pressure
- Better battery capacity and with status display
- Flexible and rotating head for easy crimping.

3.08.00 **Trefoil clamps**

3.08.01 Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength, when installed at 1 mtr intervals, to withstand the forces generated by the peak value of maximum system short circuit current.

3.09.00 **Cable Clamps & Ties**

3.09.01 The cable clamps/ties required to clamp multicore cables shall be of SS-316 material, 12mm wide, polyster coated ladder lock type. The clamps/ties shall have self locking arrangement & shall have sufficient strength. The cable clamps/ties shall be supplied in finished individual pieces of suitable length to meet the site requirements.

3.10.00 **Receptacles**

3.10.01 Receptacles boxes shall be fabricated out of MS sheet of 2mm thickness and hot dipped gavanised or of die-cast aluminium alloy of thickness not less than 2.5 mm. The boxes shall be provided with two nos. earthing terminals, gasket to achieve IP55 degree of protection, terminal blocks for loop-in loop-out for cable of specified sizes, mounting brackets suitable for surface mounting on wall/column/structure, gland plate etc. The ON-OFF switch shall be rotary type heavy duty, double

break,AC23 category, suitable for AC supply. Plug and Socket shall be shrouded Die-cast aluminium. Socket shall be provided with lid safety cover. Robust mechanical interlock shall be provided such that the switch can be put ON only when the plug is fully engaged and plug can be withdrawn only when the switch is in OFF position. Also cover can be opened only when the switch is in OFF position. Wiring shall be carried out with 1100 V grade PVC insulated stranded aluminium/copper wire of adequate size. The Terminal blocks shall be of 1100 V grade. The Terminal blocks shall be of 1100 V grade made up of unbreakable polymide 6.6 grade with adequate current rating and size. The welding receptacles shall be provided with RCCB/RCD of 30mA sensitivity having facility for manual testing/checking of operation of RCCB/RCD.

3.11.00 **Cable Drum Lifting Jack**

The jack for cable drum lifting shall be of screw type with 10 ton capacity. The cable drum jacks shall be manufactured from fabricated steel. The spindles supplied with the cable drum jack shall be manufactured using BSEN-24 grade steel bar with locking collars. Jack nests shall be of SG cast steel. Cable drum jack supplied shall have undergone load testing and reports for the same shall be submitted. At least Two Nos. of jacks shall be supplied for NTPC use. Contractor has to make arrangements for his own jacks for cable reeling/unreeling under his scope of installation.

3.12.00 **Galvanising**

3.12.01 Galvanising of steel components and accessories shall conform to IS:2629 , IS4759 & IS:2633. Additionally galvanising shall be uniform, clean smooth, continuous and free from acid spots.

3.12.02 The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS:1367 . The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified

3.13.00 **Welding**

3.13.01 The welding shall be carried out in accordance with IS:9595. All welding procedures and welders qualification shall also be followed strictly in line with IS:9595

4.00.00 INSTALLATION

4.01.00 **Cable tray and Support System Installation**

4.01.01 Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures.

4.01.02 Horizontally running cable trays shall be clamped by bolting to cantilever arms and vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 2000 mm in general. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm in general. Fixing of cable trays to cantilever arms or main support

channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per the approved guidelines/ drawings. Vendor shall design the support system along with tray, spacing etc in line with tray loadings/drawings.

4.01.03 The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated.

4.01.04 The contractor shall fix the brackets/ clamps/ insert plates using anchor fasteners. Minimum size of anchor fasteners shall be M 8 X 50 and material shall be stainless steel grade 316 or better. Anchor fastener shall be fixed as recommended by manufacturer and as approved by site engineer. For brick wall suitable anchor fasteners shall be used as per the recommendations of manufacturer. Make of anchor fasteners subject to QA approval and the same shall be finalized at pre-award stage.

4.01.05 All cable way sections shall have identification, designations as per cable way layout drawings and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted/stenciled with identification numbers at every floor.

4.01.06 In certain cases it may be necessary to site fabricate portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may not be suitable. Fabricated sections of trays, supports and accessories to make the installation complete at site shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.

4.02.00 **Conduits/Pipes/Ducts Installation**

4.02.01 The Contractor shall ensure for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable trenches made for conduit installation shall be sealed and made water proof by the Contractor.

4.02.02 GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.

4.02.03 Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material

4.02.04 Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise

Conduit /pipe size (dia).	Spacing
Upto 40 mm	1 M
50 mm	2.0 M
65-85 mm	2.5 M
100 mm and above	3.0 M

4.02.05 For bending of conduits, bending machine shall be arranged at site by the contractor to facilitate cold bending. The bends formed shall be smooth.

4.03.00 **Junction Boxes Installation**

4.03.01 Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the drawings and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/ expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations.

4.04.00 **Cable Installation**

4.04.01 Cable installation shall be carried out as per IS:1255 and other applicable standards.

4.04.02 For Cable unloading, pulling etc following guidelines shall be followed in general:

a) Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall be drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cables. For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be provided with sealed plastic caps to prevent damage and ingress of moisture.

b) While laying cable, ground rollers shall be used at every 2 meter interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangements. Pulling tension shall not exceed the values recommended by cable manufacturer. Selection of cable drums for each run shall be so planned so as to avoid using straight through joints. Care should be taken while laying the cables so as to avoid damage to cables. If any particular cable is damaged, the same shall be repaired or changed to the satisfaction of Project Manager.

4.04.03 Cables shall be laid on cable trays strictly in line with cable schedule

4.04.04 Power and control cables shall be laid on separate tiers inline with the approved guidelines/drawings. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. In horizontal tray stacks, H.T. cables shall be laid on top most tier and cables of subsequent lower voltage grades on lower tiers of trays. Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil center lines and clamped at every two metre. All multicore cables shall be laid in touching formation. Power and control cables shall be secured fixed to trays/support with cable clamps/ties with self locking arrangement. For horizontal trays arrangements, multicore power cables and control cables shall be secured at every five meter interval. For vertical tray arrangement, individual multicore power cables and control cables shall be secured at every one meter. After completion of cable laying work in the particular vertical tray, all the control cables shall be binded to trays/supports by cable clamps/ties with self locking arrangement at every five meter interval and at every bend.
Fibre Optical cable shall be laid in trenches/trays or as decided by Employer.

4.04.05 Bending radii for cables shall be as per manufacturer's recommendations and IS:1255.

4.04.06 Where cables cross roads/rail tracks, the cables shall be laid in hume pipe/ HDPE pipe.

4.04.07 No joints shall be allowed in trip circuits, protection circuits and CT/PT circuits. Also joints in critical equipment in main plant area shall not be permitted. Vendor shall identify and accordingly procure the cable drum length.

4.04.08 In each cable run some extra length shall be kept at suitable point to enable one LT/two HT straight through joints to made, should the cable develop fault at a later stage. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing.

4.04.09 Wherever few cables are branching out from main trunk route troughs shall be used.

4.04.10 Wind loading shall be considered for designing support as well Cable trays wherever required.

4.04.11 Where there is a considerable risk of steam, hot oil or mechanical damage cable routes shall be protected by barriers or enclosures.

4.04.12 The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every day. Contractor shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time.

4.04.13 **Separation**

At least 300mm clearance shall be provided between:

- HT power & LT power cables,
- LT power & LT control/instrumentation cables,

4.04.14 **Segregation**

1) Segregation means physical isolation to prevent fire jumping.

2) All cables associated with the unit shall be segregated from cables of other units.

3) Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire. Power and control cables for AC drives and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set.

4) In switchyard, control cables of each bay shall be laid on separate racks/trays.

4.04.15 Minimum number of spare cores required to be left for interconnection in control cables shall be as follows:

Minimum number of spare cores required to be left for interconnection in control cables shall be as follows:

No. of cores in cable	No. of spare cores
2C,3C	NIL
5C	1
7C-10C	2
14C and above	3

4.04.16 **Directly Buried Cables**

a) Cable trenches shall be constructed for directly buried cables. Construction of cable trench for cables shall include excavation, preparation of sieved sand bedding, riddled soil cover, supply and installation of brick or concrete protective covers, back filling and compacting, supply and installation of route markers and joint markers. Laying of cables and providing protective covering shall be as per IS:1255 and the enclosed drawings showing cabling details.

b) RCC cable route and RCC joint markers shall be provided wherever required. The voltage grade of the higher voltage cables in route shall be engraved on the marker. Location of underground cable joints shall be

indicated with cable marker with an additional inscription "Cable Joint". The marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road crossings and drain crossings. Top of cable marker/joint marker shall be sloped to avoid accumulation of water/dust on marker.

4.04.17 Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry, and at every 20 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables. Cable tag shall be of 2 mm thick aluminum with number punched on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. Alternatively, the Contractor may also provide cable tags made of nylon, cable marking ties with cable number heat stamped on the cable tags. The cable tag requirements mentioned above shall prevail over Tag requirements mentioned elsewhere in this document for HT power, LT power & control cables.

4.04.18 While crossing the floors, unarmoured cables shall be protected in conduits upto a height of 500 mm from floor level if not laid in tray.

4.05.00 **Cable Terminations & Connections**

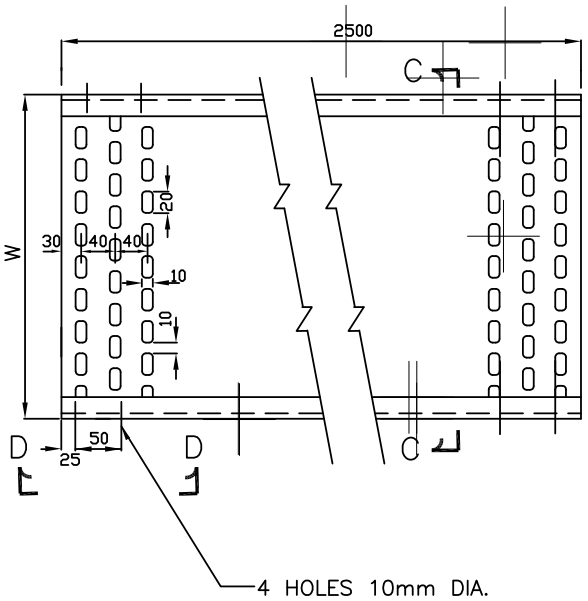
4.05.01 The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer" instructions, drawings and/or as directed by Project Manager. Cable jointer shall be qualified to carryout satisfactory cable jointing/termination. Contractor shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site.

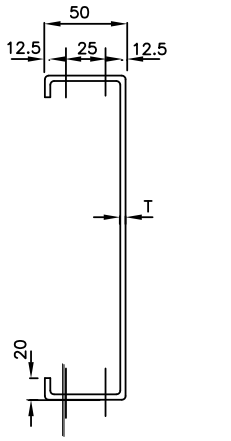
4.05.02 Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Project Manager.

4.05.03 The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2mm thick aluminium sheets.

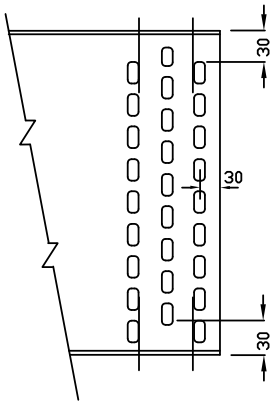
4.05.04 Control cable cores entering control panel/switchgear/MCC/miscellaneous panels shall be neatly bunched, clamped and tied with self locking type nylon cable ties with de interlocking facility to keep them in position.

4.05.05 All the cores of the control cable to be terminated shall have identification by providing ferrules at either end of the core, each ferrule shall be indelible, printed single tube ferrule and shall include the complete wire number and TB number as

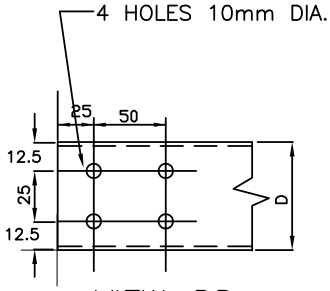




SECTION–CC
(100/50 TRAYS)



ARRANGEMENT OF
PERFORATIONS

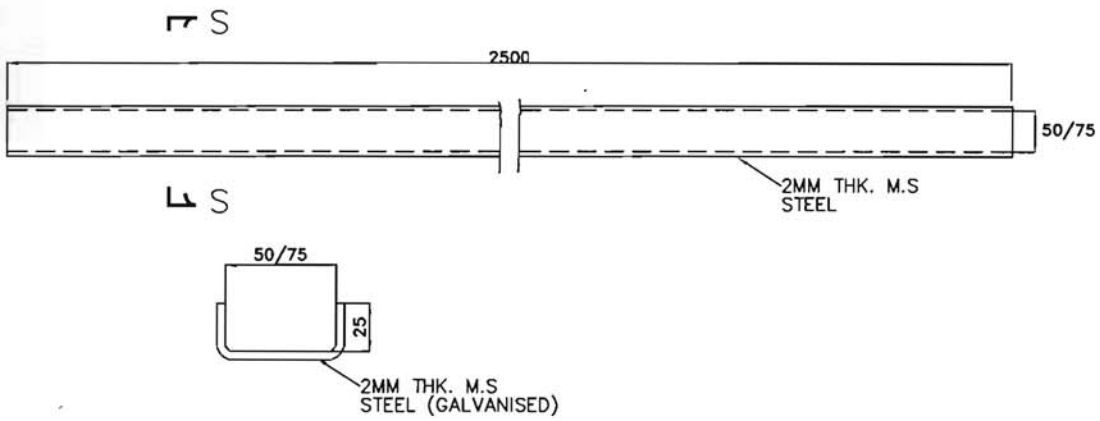


VIEW–DD
(100,50W TRAYS)

TRAY WIDTH W (mm)	100	50
TRAY DEPTH D (mm)	50	50
T (mm)	2	2

PERFORATED TYPE TRAY

BHEL	TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	DWG. NO.



SECTION S–S

CABLE TROUGHS

~~SEE GENERAL NOTES IN SHEET 11.~~

TYPICAL DETAILS OF
CABLE TRAY AND ACCESSORIES

BHEL DRAWING NO.

~~PE-DG-427-507-E005~~

SH ~~10 OF 11~~ | ~~REV 00~~

SECTION: I

SUB-SECTION: C-4

TECHNICAL SPECIFICATION (C&I PORTION)

C&I TECHNICAL SPECIFICATION
FOR GYPSUM DEWATERING SYSTEM

INDEX

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1	TITLE SHEET
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5	SIGNAL EXCHANGE BETWEEN DRIVES & DCS
6	INSTRUEMNT STUB DETAILS
7	INSTRUMENT INSTALLATION DRAWING
8	CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY
9	QUALITY ASSURANCE FOR INSTRUMENTS
10	MANDATORY SPARES
11	SUB VENDOR LIST

BHEL	**SIPAT STAGE-II (2X500 MW) FGD PROJECT** **C & I TECHNICAL SPECIFICATION FOR GYPSUM DEWATERING SYSTEM**	SPEC NO.:
		DOCUMENT NO.
		VOLUME
		SECTION
		ISSUE NO.
		REV. NO. 00 / DATE 12.12.2022

SPECIFIC TECHNICAL REQUIREMENTS (C&I)

SPECIFIC TECHNICAL REQUIREMENTS

1. GYPSUM DEWATERING SYSTEM (GDS) shall be operated from DCS (BHEL's scope).

2. The Contractor shall provide complete Instrumentation along with necessary fittings, accessories and valve manifold etc. for control, monitoring and operation of entire GDS except marked as BHEL's scope in P&ID attached in specification. All instruments shall be provided with durable epoxy coating for housing and all exposed surfaces of the instruments.

3. All the Electronic Transmitter for Pressure, Temperature and DP based Flow /Level measurements shall be genuine, verifiable PROFIBUS PA protocol compatible instruments. The transmitters shall be connected to DDCMIS through PROFIBUS PA protocol complying to IEC 61158 directly from transmitter. This is subject to customer approval and BHEL decision shall be final.

4. Electrical Actuators (as applicable) shall be Non-Intrusive type electric actuators envisaged with integral starter. The interface of these actuators with DCS shall be of two types viz. with Hardwired interface and with PROFIBUS DP interface. All actuator settings including torque, limit shall be possible without opening the actuator cover and LCD indication shall be available integral to actuator body. Open/Close command termination logic suitably built inside the actuator Details shall be referring in the specification.

5. All ON, OFF, and INCHING Type electric actuators shall be PROFIBUS DP compatible. However, the exact protocol shall be based on finalized protocol of DCS. If PROFIBUS DP protocol is envisaged, then actuator shall have two (redundant) PROFIBUS DP ports for connecting the redundant PROFIBUS DP cables. That is if one PROFIBUS DP cable is cut or not working/not available, then complete actuator functionality shall be available through the second redundant cable without any manual intervention.

6. The PROFIBUS protocol design shall be further validated by BHEL and approved by NTPC during detailed engineering and any variation/ changes required based on DDCMIS system requirements and actual field installation, operational philosophy etc. shall be considered by bidder without any implications.

7. The requirements given are to be read in conjunction with detailed Technical specification enclosed in the specification. Further in case of any discrepancy in the requirement within the same section noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of pre- bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per interpretation of customer shall prevail without any commercial implication.

8. The make of the items shall be from sub-vendor list. However, the make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial and delivery implication in this regard shall be

acceptable. In case of any conflict or repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

9. All transmitters shall be suitably grouped together and mounted inside (i) Local Instruments Enclosures (LIEs) in case of open areas of the plant and (ii) In Local Instrument Racks (LIRs) in case of covered areas.

10. All instruments (except PROFIBUS PA compatible transmitters) and control elements shall be terminated on JB/LCP in field and JB/LCP are in bidder's scope for bidder's supplied instrument and in BHEL's scope for BHEL's supplied instrument. Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 12-15 meters) and trunk cable.

11. The contacts of equipment mounted instruments; sensors, switches etc. For external connection including spare contacts shall be wired out to suitably located junction boxes by bidder.

12. For cable scope refer to electrical scope between BHEL and vendor defined in electrical specification.

13. The design, manufacture, inspection, testing, site calibration and installation of all C&I equipment and systems covered under this specification shall conform to the latest editions of applicable codes and standards.

14. Bidder to provide mandatory spares as per mandatory spares list.

15. The specifications for instruments mentioned in the specification are minimum requirements. The detail specifications shall be finalized during detail engineering. The bidders shall specifically mention any deviation they would like to take on the C&I specification. In absence of only deviation, a No deviation certificate is to be furnished.

16. The quantity of instruments for the system shall be as per tender P &ID wherever provided of 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.

17. Bidder to provide input/output list, drives list, junction box schedule and termination details, recommended control logics / write-up etc. the list of documents to be submitted after award of contract is to be referred by bidder.

18. All the transmitters supplied by Bidder shall be rack mounted. The transmitter racks shall be in Bidder's scope of supply. All transmitters shall be HART compatible.

19. Bidder to perform tests of C&I items/instruments/systems as per Quality plans/type test attached in the specification. However, if any test not specified in the quality plan but specified in specification Tests for I&C equipment included elsewhere in specification will have to perform by Bidder without any cost implication.

20. Instrument installation and accessories required for the same shall be in Bidder's scope and shall be submitted after award of contract. However, any instrument / analyzer installation not covered in the same shall be subject to customer and BHEL approval during detailed engineering. Bidder to provide erection hardware including junction boxes, canopies, structural steel as required.

21. Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.

22. All Temperature sensors shall be Duplex type and temperature transmitter shall be provided for all temperature measurement applications. Bidder to provide temperature transmitter, JB/Rack & other erection hardware.

23. Bidder to provide temperature sensor along with temperature transmitter for HT drives i.e. Pump and Motor for BRG and winding temp measurement.

24. Vibration Monitoring System, is envisaged for HT Motor, which is in BHEL scope. However, for mounting of vibration sensors/probe, vendor to provide vibration pad (of dimension of 80mm x 80mm x 10mm each) for mounting of sensors and a notch/slot for mounting of key phasor.

25. Bidder to provide Flow measuring device suitable for the service condition, which shall be decided by BHEL/customer during detail engineering. Bidder to comply the requirement without any commercial implication.

26. Bidder to furnish electrical load/UPS load data during detailed engineering.

27. 415VAC /230 V UPS Power supply shall be provided by BHEL at a single point, further distribution to various instruments/equipment of the system shall be in bidder scope. Bidder to include necessary power distribution board in his scope. Any power supply other than the above, if required by any instrument/equipment has to be derived by the bidder from the above supply & all necessary hardware for the same shall be in bidder scope. Bidder to submit the power requirement along with the bid.

28. Power supply derived for contact interrogation, interposing relay and solenoid shall generally be ungrounded 24 V D.C. only.

29. Interface of MCC, HT SWGR, Solenoid valves, field instruments, Actuators etc. with DDCMIS based control system shall be as per Drive Control Philosophy enclosed in specification.

30. Local control panel and VFD panel, if any required for operation shall be in bidder scope.

31. The solenoid operated valves/Dampers/Gate shall have a limit switch for open/close feedback. Solenoid Valve shall be rated for 24V Dc only.

32. All field instruments enclosure shall be IP65, local panel/cabinet enclosure shall be IP 55, unless otherwise specified.

33. Diaphragm seal shall be provided with Instruments having contact with corrosive media.

34. To ensure availability, adequate redundancy in system design shall be provided at hardware, software and sensor level. For the protection system, independent sensing device shall be provided to ensure adequate safety of plant equipment.

35. Redundancy of sensors shall be provided by bidder

    a) Triple redundancy for all Analog and binary inputs required for protection of system/drives.
    b) For all other control functions dual redundancy of the sensors shall be provided by the bidder.

36. Double root valve shall be provided for all pressure tapings where the pressure exceeds 40kg/cm2.

37. Use of process actuated shall be avoided unless unavoidable.

38. Number of pairs to be selected for Screen /Control cable
    a) F-Type: 2P/4P/8P/12P (Size: 0.5sqmm2)
    b) G-Type: 2P/4P/8P/12P (Size: 0.5sqmm2)
    c) Core Cable: 3CX2.5sqmm2/ 5CX2.5sqmm2/ 12CX1.5sqmm2

39. Instrument installation shall be as per the attached "Standard Hook-up diagram for instrument."

40. In addition to requirements specified here, all C&I systems/ sub-systems/ equipment/ devices shall also meet other requirements stipulated under other Sub-sections/ parts/ sections of specification. In case of any conflict and repetition of clauses in the specification, BHEL discretion will prevail. The requirements given are to be read in conjunction with detailed Technical specification enclosed.

41. All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. All the field instruments shall also be provided with SS tag nameplate and double compression type Nickel-plated brass

cable gland. Gaskets, Fasteners, Counter and mating flange (SS316 material), nuts & bolts etc. shall also be included, wherever required with the field instruments.

42. All the outdoor field instruments such as analyzers / transmitters/meters etc. shall be provided with suitable Free standing cabinet(s)/panel/rack/canopy so that the equipment are protected against rain/ sunlight etc.

43. All instruments should be supplied with valid calibration and test certificates provided by OEM.

44. At least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures, termination/marshalling cabinets, etc.

45. Drive control philosophy/signal exchange list attached elsewhere in the specification are Tentative. Shall be finalized during detailed engineering.

46. Contractor shall furnish Instrument Schedule, I/O list, Drive list, Cable Schedule, Cable interconnection (DCS end terminal details shall be provided to vendor during detail engineering to incorporate in cable interconnection), JB grouping, Annunciation list, SOE list, List of Instruments/devices for HART in BHEL approved format. Also reusable database format like MS Excel, MS Access etc. of these documents shall also be provided by Contractor in BHEL approved format. Soft copy of the formats shall be provided to the successful bidder.

Note: -

a. All equipment items shall be of latest design with proven on track record.

b. 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.

c. Documents of C&I System shall be submitted to end user/owner for approval during detail engineering. Changes, if any, shall be accommodated by the bidder without any price/time implication.

LIST OF DOCUMENTS/DELIVERABLES

SIPAT STAGE-II (2X500 MW) FGD PROJECT

LIST OF DELIVERABLES OF PEM - C&I DEPT. FOR GYPSUM DEWATERING SYSTEM (GDS)

Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY
1	PE-V0-491-571-I901	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM	A
2	PE-V0-491-571-I902	CONTROL SCHEME/LOGIC DIAGRAM(TO BE IMPLEMENTED IN DDCMIS)	A
3	PE-V0-491-571-I903	HMI PICTURES/PLANT SCHEMATICS	A
4	PE-V0-491-571-I904	INSTRUMENT SCHEDULE WITH SET POINTS	A
5	PE-V0-491-571-I905	I/O LIST (ANALOG & BINARY)	A
6	PE-V0-491-571-I906	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	A
7	PE-V0-491-571-I907	FIELD JB/LIE/LIR, DRIVES TERMINATIONS	A
8	PE-V0-491-571-I908	DATASHEETS FOR INSTRUMENTS, JBs, etc.	A
9	PE-V0-491-571-I909	QUALITY PLANS (INSTRUMENTS,LCP etc.)	A
10	PE-V0-491-571-I910	INSTRUMENT HOOK UP DRAWING	A
11	PE-V0-491-571-I911	THERMOWELL SIZING CALCULATION	A
12	PE-V0-491-571-I913	CABLE SCHEDULE & INTERCONNECTION	A
13	PE-V0-491-571-I914	ANNUNCIATION & SOE LIST	A

NOTES:

1) ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TIME IMPLICATION.

2) CONTRACTOR TO SUBMIT REUSABLE DATABASE FORMATS IN BHEL/CUSTOMER APPROVED FORMATS LIKE MS EXCEL,MS ACCESS OF DOCUMENTS LIKE INSTRUMENT SCHEDULE, I/O LIST, DRIVE LIST,FIELD JB TERMINATIONS, CABLE SCHEDULE & INTERCONNECTION, etc. SOFT COPY OF FORMATS SHALL BE PROVIDED TO SUCCESSFUL BIDDERS.

INSTRUMENTS & VALVES SPECIFICATIONS

SUB-SECTION-III-C2

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)

1.00.00 MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)

1.01.00 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. Refer Sub-section Basic Design Criteria. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance and shall comply with the acceptable international standards and shall be subject to Employer's approval.

1.02.00 Every panel-mounted instrument requiring power supply shall be provided with easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.

1.03.00 All transmitters, sensors, switches and gauges for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment in the system under the scope of specification shall be provided on as required basis with in quoted lump sum price. The Contractor shall furnish all Instrumentation / Control equipment & accessories under this specification as per technical specification, ranges, makes & model as approved by the Employer during detailed engineering.

1.04.00 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds 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 in flexible/rigid conduits, independently to suitably located common junction boxes. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm.

1.05.00 All instruments envisaged for sea water applications, shall be provided with wetted parts made of Monel/ Hastelloy C or any other material (if provenness experience of the proposed material for such applications is established by contractor).

For Chlorine application: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Hastelloy C. Also, filled liquid shall be Fluorolube oil/ Inert Hydrocarbon / CTFE etc., for these applications.

For applications of FECL3 solution: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Tantalum.

1.06.00 For coastal areas, all instruments shall be provided with durable epoxy coating for housings and all exposed surfaces of the instruments.

1.07.00 The instruments, for which technical specification is not attached, shall be supplied as per the standard and proven practice of the contractor. The same shall be established by the contractor during detailed engineering by providing detailed explanation/concepts, if required by the employer, of such implementation along with standard documentation.

2.00.00 **SPECIFICATION FOR ELECTRONIC TRANSMITTERS**

2.01.00 **SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, DIFF PRESS AND DP BASED FLOW / LEVEL MEASUREMENTS**

Sl.No.	Features	Essential/Minimum Requirements
1.	Type of Transmitter	Microprocessor based 2 wire type (loop powered), Hart protocol compatible.
2	Output signal	4-20 mA DC (Analog) along with superimposed digital signal based on HART protocol
3	Accuracy	± 0.060 % of calibrated range (minimum) for calibrated range greater than 400 mmwc. +0.065% of calibrated range (minimum) for calibrated range greater than 250 kg/cm2. ± 0.10 % of calibrated range (minimum) for calibrated range less than 400 mmwc
4.	Turn down (minimum)	50:1 for greater than or equal to span of 400mmwcl. 20:1 for span below 400mmwcl. 10:1 for span greater than 250 kg/cm2
5.	Stability	0.25 % of calibrated range for 10 years for calibrated range greater than equal to 400 mmwc on standard conditions of manufacturer. 0.2 % of calibrated range for 1 years for calibrated range less than 400 mmwc on standard conditions of manufacturer. 0.15% of calibrated range for 5 years for static pressure greater than 250 kg/cm2.
(Above mentioned (3, 4, 5) parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only). +/- 0.015% per deg.C at max span		
6.	Zero and span drift	+/- 0.015 per degC at max span
		+/-0.11% per degC at min. Span
	Power Supply	24V DC ± 10%.
7.	Load impedance	500 ohm (minimum)
8.	Housing	Weather proof as per IP-67, metallic housing with durable corrosion resistant coating
9.	Over Pressure	150% of max. Operating pressure

10.	Electrical Connection	Plug and socket type except in hazardous area
11.	Process connection	1/2 inch NPT (F)
12.	Span and Zero	Continuous, tamper proof, Remote as well as manual adjustability from instrument with zero suppression and elevation facility.
13.	Accessories	-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition.
	Diagnostics and Display	Self-Indicating feature and digital display
14.	Accessories	2 valve manifold for absolute & Gauge pressure transmitters, 3-valve manifold for Differential Pressure and 5 valve manifold for Level /Flow applications. The valve manifold shall be non integral type (except Fuel Oil area). -For hazardous area, enclosure as described in NEC article 500 -2 inch pipe for mounting with Enclosure /Rack/Canopy
15.	Certification	SIL 2 or Better
16.	Adjustment/calibration/maintenance	From hand held HART calibrator
Notes:		
1) LVDT type is not acceptable.		
2) For primary air/ secondary air/flue gas applications, DP type transmitters shall be provided for pressure measurement below range of 2000 mmwc.		
3) Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.		

2.02.00 **GUIDED WAVE RADAR TYPE LEVEL TRANSMITTER**

Type	Microprocessor based 2 wire type (loop powered), HART protocol compatible Guided wave radar transmitter.
Principle	TDR (Time domain reflectometry)
Probe Type &	(i) Coaxial probe of SS316/316L. If required, probe shall be

Material	suitable for overfill prevention. (ii) Rod probe, cable probe of SS316/SS316L can be used for applications wherever coaxial probe is not suitable.
Output signal	4-20 mA DC along with superimposed digital signal (based on HART protocol), suitable for over fill prevention.
Accuracy	+/- 0.5% of calibrated span or minimum 5mm.
Power supply	24 VDC +/- 10%.
Housing	Weather proof as per IP-65, metallic housing with durable corrosion resistance coating.
Adjustment/ calibration	Using hand held HART calibrator
Zero & span adjustment	Continuous, temper proof, remote as well as manual adjustability from instrument. It should be possible to calibrate the instrument without any level in the tank/sump etc.
Display	Integral digital display.
Load Impedance	500 ohms (minimum).
Electromagnetic compatibility	Shall meet EN 61326-1 (1997) and AmdtA1, class A equipment/EN 50081-2 & EN 5008 1-2 & EN 50082-2
Mounting	(i) External cage shall be provided where ever side mounting is required. External cage and other mounting accessories to be provided by the contractor. (ii) Where ever top mounting is required, all mounting accessories, stilling well (as required) etc., shall be provided by the contractor. (iii) All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations.

Note: Four wire type transmitters can also be provided for applications where 2- wire transmitter has some technical limitations, subject to employer's approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC.

2.03.00 **Ultrasonic Type level Transmitter**

S.No.	Features	Essential/Minimum requirement
1.	Type of Transmitter	Non-contact Microprocessor based 2 wire type (loop powered), HART protocol compatible Ultrasonic transmitter.
2.	Output signal	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol).
3.	Accuracy	+/- 0.5% of calibrated span or minimum 5mm.
4.	Power supply	24 V DC +/- 10%.
5.	Temperature compensation	To be provided within transducer.
6.	Housing	Weather proof as per IP-65, metallic housing with durable corrosion resistance coating.
7.	Adjustment/calibration/ maintenance	Using hand held HART calibrator
8.	Zero and Span adjustment	Continuous, tamper proof, remote as well as manual adjustability from instrument. It should be possible to calibrate the instrument without any level in the tank/sump etc.
9.	Sensor Material	Corrosion resistant material to suit individual application requirement.
10.	False signal tolerance	Transmitter shall be capable of ignoring false echoes from internal tank/sumps obstructions such as pipes, heating coils or agitator blades. Also transmitter shall have adjustable damping

		circuitry.
11.	Range	Range of transmitter shall be capable of covering the complete level span of tank taking care of blocking distance, frequency attenuation due to surface, obstructions, vapors etc.
12.	Display	Integral digital display
13.	Diagnostics	Loss of echo alarm etc.
14.	Load Impedance	500 ohms (minimum).
15.	Electrical Connection	Plug and socket
16.	Accessories	• All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations. • All mounting accessories required for erection and commissioning shall be provided. • For hazardous area, explosion proof enclosure as described in NEC article 500

Note:

1) Contractor can also provide Radar type transmitter as per above specification in place of ultrasonic transmitter subject to approval by Employer during detailed Engineering. Sonic frequency based transmitters can also be provided under “ultrasonic transmitters” category for fly ash silo level.

2) Four wire type transmitters can also be provided for applications where 2- wire transmitter has some technical limitations, subject to employer’s approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC.

3) For applications where transmitter location is not accessible, the transmitter shall have separate sensor unit and electronic unit for such applications. It shall be possible to mount the electronic unit at accessible location.

2.04.00 **Specification for ULTRASONIC TYPE FLOW TRANSMITTER**

S.No	Features	Essential/Minimum requirement
1.	Type of Transmitter	Non contact Microprocessor based 2 wire type, HART protocol compatible Ultrasonic transmitter. Insertion type.
2.	Output signal	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol).
3.	Sensor Accuracy	+/- 2% of calibrated span.
4.	Power supply	24 V DC +/-10%.
5.	Temperature compensation	To be provided within transducer.
6.	Housing	Weather proof as per IP-55 with durable corrosion resistance coating.
7.	Adjustment/calibration/ maintenance	From hand held calibrator
8.	Zero and Span adjustment	Continuous, tamper proof, remote as well as manual to calibrate the instrument without any process flow.
9.	Sensor Material	Corrosion resistant material to suit individual application requirement.
10.	False signal tolerance	Transmitter shall be capable of ignoring false echoes from internal tank/sumps obstructions such as pipes, heating coils or agitator blades. Also transmitter shall have adjustable damping circuitry.
11.	Range	Should be suitable for the required process range.
12.	Display	LCD display with integral keypad to be provided.
13.	Diagnostics	Loss of echo alarm etc.
14.	Load Impedance	500 ohms minimum
15.	Electrical Connection	Plug and socket
16.	Accessories	• All weather canopy for protection from direct sunlight and direct rain. • All mounting hardware and accessories required for erection and commissioning mounting fittings materials shall be SS 316. • For hazardous area, explosion proof enclosure as described in NEC article 500

2.05.00 **SPECIFICATION FOR ELECTRO-MAGNETIC TYPE FLOW TRANSMITTER**

S.No.	Features	Essential/Minimum requirement
1.	Type of Transmitter	Microprocessor based 2 wire type, HART protocol compatible, full bore type.
2.	Output signal	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol).
3.	Accuracy	+/- 0.5% of calibrated span.
4.	Power supply	24 V DC +/- 10%.
5.	Housing	Weather proof as per IP-65, metallic housing with durable corrosion resistance coating.
6.	Adjustment/calibration/ maintenance	Using hand held HART calibrator.
7.	Zero and Span adjustment	Continuous, tamper proof, remote as well as manual adjustability from instrument. It should be possible to calibrate the instrument without any process flow.
8.	Sensor Material	Corrosion resistant material to suit individual application requirement.
9.	Flow tube	SS304.
10.	Liner	Hard rubber or better material to suit the actual application.
11.	Range	Should be suitable for the required process range.
12.	Display	Integral digital display
13.	Load Impedance	500 ohms (minimum).
14.	Accessories	All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations. All mounting accessories required for erection and commissioning shall be provided. For hazardous area, explosion proof enclosure as described in NEC article 500

Note:-

Four wire type transmitters can also be provided for applications where 2- wire transmitter has some technical limitations, subject to employer's approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog)

output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC.

2.06.00 **HART Hand Held calibrator**

Hand held calibrator shall be provided for adjustment/calibration/maintenance of the HART compatible transmitters. The hand held calibrator shall be suitable for all types of transmitters supplied in the package. If one type of hand held type calibrator is not suitable for communicating with all types of transmitters then separate hand held calibrator will be provided for that specific type of transmitter.

3.00.00 **Temperature Elements and accessories**

3.01.00 **Thermocouple**

Sr. No.	Features		Essential/Minimum Requirements
1	Type of Thermocouple.	:	16 AWG wire of Chromel-Alumel (Type K) or 24 AWG wire Pt-Rhodium Pt (Type R) depending on operating temperature Range (ungrounded separate junction type).
2	No. of element	:	Duplex
3	Housing/Head	:	IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well.
4	Insulation and Sheathing of Thermocouple	:	Swaged type mineral (magnesium oxide) insulation and SS316 sheath.
5	Calibration and accuracy	:	As per IEC-584/ ANSI-MC-96.1 (special limits of errors/ class1) for T/C.
6	Accessories	:	Thermo well and associated fittings
7	Standard	:	IEC-584/ ANSI MC 96.1 for Thermocouple and ASME PTC-19.3 for Thermo-well

3.02.00 **Resistance Temperature Detector (RTD)**

Sr.	Features	Essential/Minimum Requirements

No.

1	Type of RTD.	:	Four wire, Pt-100 (100 Ohms resistance at zero degree Centigrade).
2	No. of element	:	Duplex
3	Housing/Head	:	IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well
4	Insulation and sheathing of RTD	:	Mineral (magnesium oxide) insulation and SS316 sheath,
5	Calibration and accuracy	:	As per As per IEC-751/ DIN-43760 Class-A for RTD
6	Accessories	:	Thermo well and associated fittings
7	Standard	:	IEC-751/ DIN-43760 for RTD and ASME PTC-19.3 for Thermo-well.

NOTES :

1) The specifications for RTDs of winding/ bearings of motor/pump, can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However the type of RTD shall be Pt100.

2) The specifications of temp elements for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.

3.03.00 Metal Temperature Thermocouples

Measuring Medium	Metal Temperature
Material of Thermocouple.	Chromel Alumel Type K
Type of Thermocouple	Duplex with ungrounded separate hot junctions
Insulation	Mineral Insulation (Magnesium Oxide).
Thermocouple wire gauge	16 AWG

	Protective sheath	SS 321
	Protective sheath dia	8 mm OD
	Calibration & accuracy	As per IEC-584/ ANSI-MC-96.1 (special limits of error) for T/C
	Mounting accessories	1/2" BSP SS sliding end connector, weld pad, clamps of heat resistant steel SS310. Adjustable gland fitting for connection at the junction box end as per manufacturer's standard.
	Cold end sealing	SS pot seal with colour coded PTFE Insulated flexible tails. Sealing compound- Epoxy resin. Length of PTFE insulated flying leads shall be minimum 750 mm.
	Minimum bending radius	30 mm
	Length of T/C	On as required basis considering location of measurement point and the JB/TTJB location.

Notes :

1) The specification for thermocouples of bearings metal temp measurements can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However type of thermocouples shall be K-type.

3.04.00 **Thermo well** (for all process temp. elements)

(a) Shall be one piece solid bored type of 316 SS of step-less tapered design. (As per ASME PTC 19.3, 1974)

(b) For Mill classifier outlet long life solid sintered tungsten carbide material of high abrasion resistance shall be provided.

(c) For Air & Flue gas 316 SS protecting tube with welded cap. (However contractor shall provide better material for Flue gas service if required based on the specified boiler design parameters).

(d) For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges.

3.05.00 **TEMPERATURE TRANSMITTER (TT)**

Following specifications are applicable for Dual input/ Single input temperature transmitter.

Temperature transmitter shall be 2-wire (loop powered) directly powered from 4-20mA input cards of DDCMIS. TT shall be fully compatible with thermocouples and RTDs being provided by the contractor. Temperature compensation for thermocouples shall be performed in the temperature transmitter itself.

S No.	Features	Essential/Minimum Requirements
1.	Output	2-wire (power supply from input card of control system) with 4-20mA output with superimposed HART protocol signal
2.	Input	Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K, R & ,S types (Selectable through HART terminal/calibrator)
	Isolation	Min 500 VAC
	EMC compatibility	As per EN 61326
	Power supply	24 V C +/- 10%
3.	Housing	Weather proof as per IP-67, metallic housing with durable corrosion resistant coating
4.	Electrical connection	Plug and Socket connector except hazardous area
5.	Diagnostics & display	Self-Indicating feature and digital display on transmitter
6.	Operating Ambient temperature	85 deg C without display. 70 deg C with display.
7.	Mounting	2 inch pipe mounting with Canopy.
8.	Accessories	As required by service and operating condition.
9.	Composite Accuracy	(Refer note 2) RTD =<0.25% of 0-250 deg C span T/C-K type =<0.2% of 0-600 deg C span CJC accuracy (for thermocouples) shall be =< 1 deg C

Notes:

1. In case of failure (open or burn-out) of RTD/thermocouple, transmitter shall provide low temperature output.

2. Dual input temperature transmitter shall have bump less changeover facility to second sensor in case first sensor fails. This changeover is to be alarmed in control system.

3. Composite accuracy is to be calculated as summation of all applicable accuracies of temperature transmitter for converting sensor input to output (e.g., A/D accuracy, basic accuracy, digital accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of temperature elements specified. All such accuracy/ temperature effect figures in

catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures. All temperature transmitters shall be interchangeable (i.e. can be used for either RTD or thermocouple) and composite accuracy shall be met for each type of input as specified above.

4. Above mentioned parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only.

5. Dual input temperature transmitters can also be accepted in place of single input TT.

4.00.00 **SPECIFICATIONS FOR PR. GAUGE, D.P. GAUGE, TEMP. GAUGE AND LEVEL GAUGE.**

Sl. No	FEATURES	ESSENTIAL/MINIMUM REQUIREMENTS		
		Pr. Gauge/ DP Gauge/ Draught gauges	Temperature Gauge	Level Gauge
1	Sensing Element	Bourdon for high pressure, Diaphragm/ Bellow for low pr.	Inert gas actuated/ Liquid filled other than mercury	Tempered * toughened Borosilicate gauge glass steel armoured reflex or transparent type.
2	Material of sensing element	SS 316	SS 316	
3	Material of movement	SS 304	SS 304	
4	Body material	Die-cast aluminium	Die-cast aluminium	Forged carbon steel/304 SS
5	Dial size	150mm	150 mm	Tubular covering entire range
6	End connection	1/2 inch NPT (M)	1/2 inch or 3/4 inch NPT (M).	Process connection as per ASME PTC and drain/vent 15 NB
7	Accuracy	±1% of span	± 1% of span	± 2%
8	Scale	Linear, 270° arc graduated in metric units	Linear, 270° arc graduated in °C	Linear vertical
9	Range selection	Shall cover 125% of max. operating press	Shall cover 125% of max. operating temp	Shall cover max. Operating level.

10	Over range	125% of FSD	125% of FSD	-
11	Housing	Weather and dust proof as per IP-55	Weather and dust proof as per IP-55	CS/304 SS leak proof
12	Zero/span adjustment	Provided	Provided	--
13	Identification	Engraved with service legend or laminated phenolic name plate		
14	Accessories	Blow out disc, siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve	SS Thermowell	Gasket for all KEL-F shield for transparent type vent and drain valves of Steel/SS as per CS/Alloy process Requirement.

Notes:-

*Bicolour type level gauges will be provided for applications involving steam and water except for condensate and feed water services.

Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.

Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

5.00.00 PROCESS ACTUATED SWITCHES

FEATURES	ESSENTIAL / MINIMUM REQUIREMENTS		
	Pressure/ Draft Switches/ DP Switches	Temperature switches	Level switches
Sensing Element	Piston actuated for high pressure and diaphragm or bellows for low pr./ vacuum.	Vapor pressure sensing, liquid filled bellow type with SS bulb and capillary (5 m minimum, to suit application)	Capacitance types, float type, conductivity type, RF type, Ultrasonic type as per suitability to the application.
Material	316 SS	Bulb 316 SS/ capillary 304 SS	316 SS
End connection	½ inch NPT (F)	½ inch NPT (F)	Manufacturer standard

Over range/ proof pressure	150% of maximum operating pr.	-	150% of maximum operating pr.
Repeatability	+/- 0.5% of full range		
No. of contacts	2 NO+ 2NC SPDT snap action dry contact		
Rating of contacts	60 V DC, 6 VA (or more if required by DDCMIS)		
Elect. Connection	Plug in socket.		
Set point adjustment	Provided over full range.		
Dead band adjustment	Adjustable/ fixed as per requirement of application.		
Enclosure	Weather and dust proof as per IP-55, metallic housing.		
Accessories	Siphon, snubber, chemical seal, pulsation dampeners as required by process	Thermo well of 316 SS and packing glands	All mounting accessories
Mounting	Suitable for enclosure/ rack mounting or direct mounting	Suitable for rack mounting or direct mounting	-
Power Supply (wherever required)	As per Contractor's Standard practice.		

Notes :-

1) Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

2) Pressure/ Diff pressure switches for very low press/ DP measurements can have sensor material other than SS316 in case of any technical limitation and the offered product is standard product of the manufacture for very low pressure applications.

3) Repeatability can be upto +/-1% of full range in case of switches with diaphragm seals or very low pressure/DP range.

4) The specifications of switches for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.

6.00.00 **SOLENOID VALVES**

Solenoid valves shall fulfill the following requirements: -

Type 2/3/4 way SS 316/ forged brass (depending on the application subject to Employer's approval during detailed engg.)

Power supply 24V DC.

Plug in connector connection.

Insulation : Class “H”

7.00.00 **Limit switches**

Limit switches shall be silver plated with high conductivity and non-corrosive type. Contact rating shall be sufficient to meet the requirement of Fire alarm Control System subject to a minimum of 60V, 6VA rating. Protection class shall be IP-55.

8.00.00 **SPECIFICATION FOR CORIOLIS FLOW TRANSMITTER**

Type	Coriolis
Material of Wetted Parts	316 SS
Material of Housing	304L SS
Accuracy	± 0.2% of Rate
Repeatability	± 0.1% of Rate
Output	4-20 mA DC, HART Compatible
Power Supply	230 VAC or 24VDC operated
Process Temperature range	0-200 degree Celsius
Others	Drain / purging arrangement shall be provided as per standard practice.

The offered Coriolis type flow transmitter shall be suitable for intended application. Contractor shall submit flow and sizing calculation for Employer’s approval. For each type of Coriolis type flow transmitter general arrangement and assembly drawing and cable wiring diagram shall be submitted for Employer’s approval.

9.00.00 **SPECIFICATION FOR FLOW ELEMENTS**

9.01.00 **Orifice Plate**

Features	Essential/Minimum Requirements
Type	Concentric as per ASME PTC-19.5 (Part-II), ISA RP-3.2, 1960 or BS-1042, ISO 5167
Material	316 SS
Thickness	3 mm for main pipe diameter up to 300 mm and6 mm for main pipe dia above300 mm.
Material of branch pipe	Same as main pipe
Root valve type	Globe
Root valve material	Same as pipe material

	Root valve size	1 / 2 inch or 1 inch (as applicable)
	Impulse pipe of same material up to root valve	Required
	Tappings	Flanged weld neck or D & D/2 with 3 pairs of tapping (as applicable). Root valves to be provided in all the tappings. However for flow elements in CPU, DM & PT plant- 2 Pairs of Tappings shall be provided as minimum.
	Beta Ratio	0.34 to 0.7
	Beta Ratio calculation to be submitted	Yes
	Assembly drg. and flow Vs DP Curves	Yes
	Accessories	Root valves, flanges, Vent/drain hole(As required)
	Contractor shall submit certified flow calculation and differential pressure vs. flow curves for each element for Employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Employer's approval.	
9.02.00	**Flow Nozzle**	
	Features	Essential/Minimum Requirements
	Type	Long radius, welded type as per ASME PTC-19.5 (Part-III) or BS-1042
	Material	316 SS
	Thickness	Suitable for intended application.
	Material of branch pipe	Same as main pipe
	Root valve type	Globe
	Root valve material	Same as pipe material
	Root valve size	1 inch
	Impulse pipe of same material up to root valve	Required
	Tapping	Flanged weld neck or D & D/2 with 3 pairs of tapping (as applicable). Root valves to be provided in all the tappings. However for flow elements in CPU, DM & PT plant- 2 Pairs of Tappings shall be provided as minimum.
	Beta Ratio	Around 0.7
	Beta Ratio calculation to be submitted	Yes

	Assembly drg. and flow Vs DP Curves	Yes
	Accessories	Root valves, vent and drain hole.

Contractor shall submit certified flow calculation and differential pressure vs. flow curves for each element for Employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Employer's approval.

9.03.00 **Venturi (For Liquid applications)**

Features	Essential/Minimum Requirements
Type	Rough Welded (for Pipe dia between 200mm to 1200mm) or Machined (for Pipe dia 50mm to 250mm) as per ISO 5167-4:2003,
Material	Same as Main Pipe
Thickness	Same as Main Pipe.
Root valve type	Globe Type
Root valve material	Same as Pipe material
Root valve size	1 inch
Impulse pipe of same material up to root valve	Required
Tapping	3 pairs of tappings for each Venturi as per ISO 5167-4:2003, However for some areas like CPU, DM & PT plant- 2 Pairs of Tappings shall be provided as minimum.
Beta Ratio	0.4 to 0.7
Beta Ratio calculation to be Submitted	Yes
Assembly drg. and flow Vs DP Curves	Yes
Accessories	Root valves, vent and drain hole.

Contractor shall submit certified flow calculation and differential pressure vs. Flow curves for each element for employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for employer's approval.

9.04.00 **ROTAMETERS**

Sr. No.	Features	Essential / minimum requirements
1.	Type	Variable Area Metal Tube
2.	Fluid media	Water/oil
3.	Tube body	SS316
4.	Material of float	316 SS
5.	Indicator	Linear scale
6.	Accessories	Flange, orifice in case of bypass Rota meter (for line size above 100 mm)
7.	Housing protection class	IP-55
8.	Accuracy	± 2% of measured value.

10.00.00 **ANALYSER INSTRUMENTS (OTHER THAN CEMS)**

10.01.00 **Common requirements:-**

1	Type	Microprocessor based with self-indicating type diagnostic feature. Output signal: 4-20 mA DC galvanically isolated. Binary Signal: 2NO+2NC
2	Display	Digital display with reading in engineering units. Display of the measurement values as well as all the information required for checking/maintenance of the analyzer.
3	Zero & span Adjustment	To be provided for all selectable ranges.
4	Ambient temp.	0-50°C unless defined otherwise.
5	Analyser enclosure Type/Material	Weather protection for analyser mounted inside analyser panel shall be IP-22 or better. For all other analysers, weather protection class shall be IP-55.
6	Calibration	Auto & Manual (from Remote).
7	Power Supply	To be arranged by Contractor subject to Employer's approval.
8	Others	i) All interconnection tubing and cabling between probe and analyser / analyser panel and cabling from analyser/ analyser panel to FGD Control system are to be provided by Contractor. ii) All the calibration gases (certified cylinder) required for one year continuous operation shall be provided. The calibration gas container material shall not contaminate the calibration gas.
9	Compliance to standards	USEPA, TUV, MCERTS or equivalent standards

13.00.00 **FIELD INSTRUMENTS BASED ON FIELDBUS**

The following instruments shall be connected to DDCMIS through fieldbus i.e. FOUNDATION Fieldbus/PROFIBUS PA protocol complying to IEC 61158 directly from transmitter. For all fieldbus based instru-ments, GSD and DTM files are to be provided which shall be con-figured/ tested with DCS for proper interfacing and diagnos-tics.

13.01.00 **Electronic Transmitter for Pressure, Differential Pressure and DP based Flow / Level measurements.**

S No.	Features	Essential/Minimum Requirements
1.	Type of Transmitter	FOUNDATION Fieldbus/PROFIBUS PA based output
2.	Accuracy	± 0.060 % of calibrated range (minimum) for calibrated range greater than 400 mmwc. +0.065% of calibrated range (minimum) for calibrated range greater than 250 kg/cm2. ± 0.10 % of calibrated range (minimum) for calibrated range less than 400 mmwc.
3.	Stability	0.25 % of calibrated range for 10 years for calibrated range greater than equal to 400 mmwc on standard conditions of manufacturer. 0.2 % of calibrated range for 1 years for calibrated range less than 400 mmwc on standard conditions of manufacturer. 0.15% of calibrated range for 5 years for DPT with static pressure greater than 250 kg/cm2.
4	Turn down	50:1 for greater than or equal to span of 400mmwcl. 20:1 for span below 400mmwcl. 10:1 for span greater than 250 kg/cm2
(Above mentioned (2,3,4) parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only).		

5	Housing	Weather proof as per IP-67, metallic housing with durable corrosion resistant coating
6.	Electrical connection	½" NPT(F) FOUNDATION Fieldbus/PROFIBUS PA compatible
7.	Process connection	½" NPT (F)
8.	Operating Ambient temperature	85 deg C without display. 70 deg C with display.
	Overpressure	150% of max operating pressure
9.	Accessories	-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition. -2 valve manifold for absolute & gauge pressure transmitters, -3-valve for DP and 5 valve manifold for level/flow applications. -The valve manifold shall be non-integral type. -For hazardous area, enclosure as described in NEC article 5.
10.	Mounting	2 inch pipe mounting with Enclosure/Rack/Canopy.
11.	Diagnostics & display	Self-Indicating feature and digital display on transmitter

Notes

- For primary air/ secondary air/flue gas/ furnace pressure applications, DP type transmitters shall be provided for pressure measurement below 2000 mmwc.
- LVDT type is not acceptable.
- Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

13.02.00 Temperature Transmitter

13.02.01 Single Input /Dual Input Temperature transmitter

Temperature transmitter shall be provided which shall be fully compatible with thermocouples and RTDs being provided by the contractor. Temperature compensation for thermocouples shall be performed in the temperature transmitter itself. Transmitters shall be capable of withstanding ambient temperature up to 85 deg C.

Following specifications are applicable for dual input/single input temperature transmitter.

S No.	Features	Essential/Minimum Requirements	
1.	Output	FOUNDATION fieldbus /PROFIBUS PA	
2.	Input	Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K, R & ,S types	
3.	Housing	Weather proof as per IP-67, metallic housing with durable corrosion resistant coating	
4.	Electrical connection	½" NPT(F) FOUNDATION Fieldbus/PROFIBUS PA compatible	
5.	Diagnostics & display	Self-Indicating feature and digital display on transmitter	
6.	Operating Ambient temperature	85 deg C without display. 70 deg C with display.	
7.	Mounting	2 inch pipe mounting with Canopy.	
8.	Accessories	As required by service and operating condition.	
9.	Composite Accuracy	(Refer note 2)	
		RTD	=<0.25% of 0-250 deg C span
		T/C-K type	=<0.2% of 0-600 deg C span
		CJC accuracy (for thermocouples) shall be =< 1 deg C	

Notes:

1. In case of failure (open or burn-out) of RTD/thermocouple, transmitter shall provide low temperature output.
2. Dual input temperature transmitter shall have bump less changeover facility to second sensor in case first sensor fails. This changeover is to be alarmed.
3. Composite accuracy is to be calculated as summation of all applicable accuracies of temperature transmitter for converting sensor input to output (e.g., basic accuracy, digital accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of temperature elements specified. All such accuracy/ temperature effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures. All temperature transmitters shall be interchangeable (i.e. can be used for either RTD or thermocouple) and composite accuracy shall be met for each type of input as specified above.
4. Above mentioned parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only.
5. Dual input temperature transmitters can also be accepted in place of single input TT.

SUB-SECTION-III-C8

ELECTRIC ACTUATOR

1.00.00 GENERAL:

1.01.00 Actuators shall be designed for valve operation to ensure proper function in accordance with specifications given below and complying to EN15714-2or equivalent. All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions.

1.02.00 This sub-section of specification is applicable for following types of electric actuators:

1.02.01 **Modulating duty electric actuators:**

These shall be provided as per standard practice of OEM of equipment,meeting other requirements of specifications. For specifications of Blade pitch actuators, refer clause no. 5.00.00 of this chapter.

1.02.02 **Electric actuators for valves/ dampers/ gates (other than covered in 1.02.01):**

These actuators shall be Non-Intrusive type electric actuators. The interface of these actuators with DDCMIS shall be of two types viz. with Hardwired interface and with Fieldbus interface. The common requirements of both these type of actuators are specified at clause 2.00.00, specificrequirements of Non-Intrusive hardwired actuators are specified at clause 3.00.00 and specific requirements of Non-Intrusive fieldbus actuators are specified at clause 4.00.00. The applications where these two types of actuators are to be provided is specified in Part-A of Technical Specifications.

2.00.00 COMMON REQUIREMENTS FOR NON INTRUSIVE ELECTRIC ACTUATORS

2.01.00 TYPE:

2.01.01 The actuators shall have integral starters with built in SPP(Single Phasing Preventer).415 V, 3 phase 3 wire power supply shall be given to the actuator from switch board as applicable through a switch fuse unit. Control voltage of the motor starter shall be 110 V AC / 24 V DC, derived suitably from 415V power supply.

2.01.02 The actuators shall be Non- Intrusive electric actuator. All actuator settings including torque, limit shall be possible without opening the actuator cover and LCD indication shall be available integral to actuator body.

2.02.00 RATING:

(a) Supply Voltage & frequency: 415V +/- 10%, 3 Phase, 3 Wire &50HZ +/-5%.

(b) Sizing:

Open/Close at rated speed against designed differential pressure at 90% of rated voltage.

For ON/OFF type: Three successive open-close operations or 15 minutes, whichever is higher.

For inching type:150 starts per hour or required cycles, whichever is higher.

2.03.00 CONSTRUCTION:

(a) Enclosure:

Totally enclosed weatherproof, minimum IP-68 degree of protection.

(b) Manual Wheel:

Shall disengage automatically during motor operation.

2.04.00 **MOTOR:**

(a) Type :

Squirrel cage induction motor suitable for Direct On Line (DOL)starting.

(b) Enclosure:

Totally enclosed, self-ventilated.

(c) Insulation

Class F. Temperature rise 70 Deg C. over 50 Deg C ambient.

(d) Bearings:

Double shielded, grease lubricated antifriction.

(e) Earth Terminals:

Two

(f) Protection:

Single Phasing Protection, Over heating protection through Thermostat (as applicable) and wrong phase sequence protection shall be provided over and above other protection features standard to bidder's design. Suitable means shall be provided to diagnose the type of fault locally.

2.05.00 **POSITION/TORQUE TRANSMITTER:**

The Position/ Limit measurement shall be done using absolute encoders which will give information of position/ limit in both the directions. Electronic measurement of torque shall be provided.

2.06.00 **LOCAL OPERATION:**

It shall be possible to operate the actuator locally also. Lockable local/remote selection shall be provided on the actuator.

2.07.00 **LCD DISPLAY:**

A local LCD display shall be provided to give information regarding actuator alarms, status and valve position indications as a minimum in local.

2.08.00 **WIRING:**

Suitable voltage grade copper wire.

2.09.00 **TERMINAL BLOCK:**

For power cables,the grade of TBs shall be minimum 650V.

2.10.00 **ACCESSORIES:**

All required accessories (if applicable) for calibration/ settings/ configuration of various parameters of actuator shall be provided. For quantities, please refer Part A of technical specifications.

2.11.00 **SIL CERTIFICATION:**
All actuators shall be certified for SIL 2 or better.

3.00.00 **SPECIFIC REQUREMENTS FOR NON INTRUSIVE HARDWIRED ACTUATORS**

3.01.00 **INTERFACES:**

For ON-OFF and INCHING typeactuators interface with the control system shall be through hardwired signal only.

(a) Open/Close command, open/ close statusand disturbance monitoring signal (common contact for Overload, Thermostat, control supply failure, L/R selector switch at local & other protections operated) shall be provided hardwired.

(b) The actuator shall be able to accept open/close command at 24V DC with max. 2.5VA load from control system.Accordingly suitable isolated interface in the actuator shall be provided.

(c) Open/close command termination logic shall be suitably built inside actuator.

(d) For typical wiring diagram Refer Tender Drawing No. 0000-999-POI-A-063 (Except plug & socket connector, if not applicable)

(e For INCHING type actuators, hard-wired analog position signal (4-20mA) derived from absolute encoder to be provided for actuator position.

3.02.00 **TERMINAL BOX:**

Suitable terminals/ connectors, integral to actuator, for terminating instrumentation & power cables shall be provided. Necessary glands for power cables and instrumentation cables shall be provided.

3.03.00 **TRAINING:**

Contractor shall provide training on Non-Intrusive hardwired Electric Actuator for Employer's personnel. The duration of the training shall be as elaborated in Part-C, Section-VI of technical specifications.

4.00.00 **SPECIFIC REQUIREMENTS FOR NON INTRUSIVE FIELDBUS ACTUATORS**

4.01.00 **INTERFACES:**

For ON-OFF and INCHING typeactuators interface with the control system shall be through fieldbus network.

(a) Open/ close commands, open/ close feedback status,disturbance signal etc. shall be available to the Control System through the fieldbus network along with diagnostics.The detailed diagnostics including the actuator operating data shall be available to the DDCMIS through the fieldbus network.

(b) All actuators shall be Foundation Fieldbus/ Profibus compatible. However the exact protocol shall be based on finalized protocol of DDCMIS. If Profibus DP protocol is envisaged then actuator shall have two (redundant) Profibus DP ports for connecting the redundant Profibus DP cables. That is if one profibus cable is cut or not working/ not available, then complete actuator functionality shall be available through the second redundant cable without any manual intervention.Also, for Profibus DP cable connection, suitable connector integral to the actuator, or external devices/ accessories (mounted inside minimum IP65 protection class enclosure) shall be provided so that the actuator can be isolated online from the profibus network without disturbing the Profibus communication of other actuators of the segment.

(c) Open/close command termination logic shall be suitably built inside actuator.

(d) For all actuators GSD and DTM files are to be provided which shall be configured/ tested with DCS for proper interfacing and diagnostics.

4.02.00 **TERMINAL BOX:**

Suitable terminals/ connectors, integral to actuator, for terminating fieldbus cables and power cables shall be provided. Necessary glands for power cables and armored fieldbus cables shall be provided.

4.03.00 **TRAINING:**

Contractor shall provide training on Non-Intrusive Fieldbus Electric Actuator along with detail training on Foundation Fieldbus/ Profibusinterface used in actuator for Employer's personnel. The duration of the training shall be as elaborated in Part-C, Section-VI of technical specifications.

5.00.00 **SPECIFIC REQUIREMENTS FOR BLADE PITCH ACTUATORS**

Sl No.	Description	Requirement
1.	Duty	Continuous duty / Modulation,
2.	Operating Ambient Temperature	-20 to +60 Deg C or better
3.	Enclosure Protection	IP 68
4.	Resolution/ Precision	0.1%- 0.2% or better of total travel
5.	Supply Voltage & frequency	415V +/- 10%, 3 Phase, 50HZ +/-5% or 230V +/- 10%, Single Phase, 50Hz +/- 5%
6.	Motor Suitable for	Continuous Duty
7.	Motor insulation Class	F
8.	Analog Control	4-20mA, (24VDC)
9.	Position Transmitter	4-20mA (24VDC)
10.	Integral Starter	Yes
11.	Terminal Block	For power cables,the grade of TBs shall be minimum 600V
12.	Accessories (if applicable)	for calibration/ settings/ configuration of various parameters of actuator shall be provided
13.	Hand wheel	Yes
14.	Standard Compliance	EN 15714-2 Class D or equivalent

SUB-SECTION-III-C7

CONTROL VALVES, ACTUATORS & ACCESSORIES

CONTROL VALVES, ACTUATORS & ACCESSORIES

1.00.00 **CONTROL VALVES & ACCESSORIES**

1.01.00 General Requirements

1.01.01 The control valves and accessories equipment furnished by the Bidder shall be designed, constructed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, the ASME Boiler & pressure vessel code, Indian Boiler Regulation (IBR), ISA, and other standards specified elsewhere as well as in accordance with all applicable requirements of the "Federal Occupational Safety and Health Standards, USA" or acceptable equal standards. All the Control Valves, their actuators and accessories to be furnished under this Sub-section will be fully suitable and compatible with the modulating loops covered under the Specification.

1.01.02 All the control valves and accessories offered by the Bidder, shall be from reputed, experienced manufacturers of specified type and range of valves.

1.02.00 **CONTROL VALVE SIZING & CONSTRUCTION**

1.02.01 The design of all valve bodies shall meet the specification requirements and shall conform to the requirements of ANSI (USA) for dimensions, material thickness and material specification for their respective pressure classes.

1.02.02 The valve sizing shall be suitable for obtaining maximum flow conditions with valve opening at approximately 80% of total valve stem travel and minimum flow conditions with valve stem travel not less than 10% of total valve stem travel. All the valves shall be capable of handling at least 120% of the required maximum flow. Further, the valve stem travel range from minimum flow condition to maximum flow condition shall not be less than 50% of the total valve stem travel. The sizing shall be in accordance with the latest edition of ISA handbook on control valves. While deciding the size of valves, Bidder shall ensure that valves trim exit outlet velocity as defined in ISA handbook does not exceed 8 m/sec for liquid services, 150 m/sec. for steam services and 50% of sonic velocity for flashing services. Bidder shall furnish the sizing calculations clearly indicating the outlet velocity achieved with the valve size selected by him as well as noise calculations, which will be subject to Employer's approval during detailed engineering.

1.02.03 Control valves for steam and water applications shall be designed to prevent cavitation, wire drawing, flashing on the downstream side of valve and down stream piping. Thus for cavitation/flashing service, only valve with anti cavitation trim shall be provided. Detailed calculations to establish whether cavitation will occur or not for any given application shall be furnished.

1.02.04 Control valves shall have leakage rate as per leakage Class-IV.

1.02.05	The control valve induced noise shall be limited to 85 dBA at 1 meter from the valve surface under actual operating conditions. The noise abatement shall be achieved by valve body and trim design and not by use of silencers.
2.00.00	**VALVE CONSTRUCTION**
2.01.00	All valves shall be of globe /Butterfly body design & straightaway pattern with single or double port, unless other wise specified or recommended by the manufacturer to be of angle body type. Rotary valve may alternatively be offered when pressure and pressure drops permit.
2.02.00	Valves with high lift cage guided plugs & quick-change trims shall be supplied.
2.03.00	Cast Iron valves are not acceptable.
2.04.00	Bonnet joints for all control valves shall be of the flanged and bolted type or other construction acceptable to the Employer. Bonnet joints of the internal threaded or union type will not be acceptable.
2.05.00	Plug shall be of one-piece construction cast, forged or machined from solid bar stock. Plug shall be screwed and pinned to valve stems or shall be integral with the valve stems.
2.06.00	All valves connected to vacuum on down stream side shall be provided with packing suitable for vacuum applications (e.g. double vee type chevron packing)
2.07.00	Valve characteristic shall match with the process characteristics.
2.08.00	Extension bonnets shall be provided when the maximum temperature of flowing fluid is greater than 280 deg. C.
2.09.00	Flanged valves shall be rated at no less then ANSI press class of 300 lbs.
3.00.00	**VALVE MATERIALS**
	Refer mechanical sections for body and trim materials. The exact body and trim materials shall be finalised during detailed engineering depending on the service applications. However, Bidder may offer valves with body and trim materials better than specified materials and in such cases Bidder shall furnish the comparison of properties including cavitation resistance, hardness, tensile strength, strain energy, corrosion resistance and erosion resistance etc. of the offered material vis-a-vis the specified material for Employer's consideration and approval.

4.00.00 **END PREPARATION**

Valve body ends shall be either butt welded/socket welded, flanged (Rubber lined for condensate service) or screwed as finalised during detailed engineering and as per Employer's approval. The welded ends wherever required shall be butt welded type as per ANSI B 16.25 for control valves of sizes 65 mm and above. For valves size 50 mm and below welded ends shall be socket welded as per ANSI B 16.11. Flanged ends wherever required shall be of ANSI pressure-temperature class equal to or greater than that of the control valve body.

5.00.00 **VALVE ACTUATORS**

All Control Valves shall be furnished with Pneumatic Actuators. The Bidder shall be responsible for proper selection and sizing of valve actuators in accordance with the pressure drop and maximum shut off pressure and leakage class requirements. The valve actuators shall be capable of operating at 60 deg.C continuously.

Valve actuators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance for stem force, at least 0.15 Kg/sq.cm. per linear millimeter of seating surface, shall be provided in the selection of the actuator to ensure tight seating unless otherwise specified.

The travel time of the pneumatic actuators shall not exceed 10 seconds.

6.00.00 **CONTROL VALVE ACCESSORY DEVICES**

6.01.00 All pneumatic**ally** actuated control valve accessories such as air locks, hand wheels/hand-jacks, limit switches, Microprocessor based Positioner, diffusers, external volume chambers, position transmitters (capacitance or resistance type only), reversible pilot for Positioner, tubing and air sets, solenoid valves and junction boxes etc. shall be provided as per the requirements.

7.00.00 **SPECIFICATIONS FOR MICROPROCESSOR BASED POSITIONERS**

1	Electrical	a) Input signal	4-20 mA
		b) Power Supply	Loop powered from the output card of control system.
		c) Hart Protocol	Compatibility for remote calibration & diagnostics (Super-imposed Hart signal on input signal (4-20 mA)
		d) Valve position sensing	Non contact type position sensing **with** 4-20 mA output signal

2	Environment	a) Operating Temp	(-)30 To 80 Deg. C
		b) Humidity	0-95 %
		c) Protection Class	IP-65 Minimum
4	Test reports/ certificates	Factory Valve Signature Tests reports (Pr vs Valve travel and Travel vs I/P signal) are to be provided.	
		Test certificates as per Manufacture Standard/Relevant Standard are To Be Submitted	
5	Configuration/ calibration	Universal hand held HART Calibrator to be provided.	
6	Operating	Operating Range	Full range & split range signal.
7	Modes	Valve Action	Direct & Reverse valve action(selectable)
		Flow Characterization	Possible to fit valve characteristic curve - Linear & Equal Percentage.
8.	Fail Safe/Fail Freeze	Fail safe/Fail freeze feature is to be provided. (In case, the fail freeze feature is not intrinsic to the positioner, Bidder shall achieve the same externally through solenoid valve connected in the pneumatic circuit).	
9	Pneumatic	Air capacity	Sufficient to handle the valves selected/ boosters to be supplied if required.
		Air supply pressure	To suit air supply pressure/quality available.
		Process connection	1/4 inch NPT
10	Electrical Cable Entry	1/2-NPT, side or bottom entry to avoid water ingress.	
11	Performance	Characteristic Deviation	<=0.5 % Of Span

		Ambient Temp Effect	<=0.01 %/Deg C Or Better
12	EMC & CE Compliance	Required To International Standard Like EN/IEC.	En50081-2& En50082 Or Equivalent
13	Accessories	In-built operator panel	Display with push buttons for configuration and display on the Positioner itself (password protected/hardware lock).
		Press gauge block	For supply & output pressure.
		Mounting assembly	On as required basis.

8.00.00 **TEST AND EXAMINATION**

All valves shall be tested in accordance with the quality assurance programme agreed between the Employer and Contractor, which shall meet the requirements of IBR and other applicable codes mentioned elsewhere in the specifications. The tests shall include but not be limited to the following:

8.01.00 Non Destructive Test as per ANSI B-16.34.

8.02.00 Hydrostatic shell test in accordance with ANSI B 16.34 prior to seat leakage test.

8.03.00 Valve closure test and seat leakage test in accordance with ANSI-B 16.34 and as per the leakage class indicated above.

8.04.00 Functional Test: The fully assembled valves including actuators control devices and accessories shall be functionally tested to demonstrate times from open to close position.

8.05.00 **CV Test**: Refer **Cl.no 3.00.00 (8) Subsection IIIC-06 (Type test requirements)**

9.00.00 **CONTROL VALVE QUANTITIES**

Bidder shall furnish all the control valves under this package as finalised during detailed engineering stage without any price repercussions whatsoever depending on the process requirements. All the control valves provided by the Bidder for this project shall meet the specifications requirements specified herein. Specification for control valves in this Sub-section has to be read in conjunction with other relevant Sub-sections of this specification.

SUB-SECTION-II-E19

VFD

VFD

1.00.00 **GENERAL**

The Design, manufacture, erection, testing and performance of items and services provided under this specification shall comply with the latest edition including all applicable official amendments and revisions as on date of award of the following standards. In case of conflict between this specification and code (IS Code, standards, etc.) referred herein, the former shall prevail. All work shall be carried out as per the following codes and standards.

2.00.00 **CODES AND STANDARDS**

HT breaker	IEC:60056
DC reactor	IEC 60289
Transformers	IS:2026, IEC: 60076 IEC 61378
Bushing	IS: 2099, IEC 60137
Adjustable Speed Electrical Power Drive Systems	IEC 61800
Semiconductor converters–General requirements	IEC 60146
IEEE Recommended practices and requirements for harmonic control in electrical power systems	IEEE 519
Degrees of protection provided by enclosures (IP Code)	IEC 60529
Electrostatic immunity test	IEC1000-4-2
Fast transient immunity test	IEC1000-4-4
Surge immunity test	IEC1000-4-5

High-voltage switchgear and controlgear; Pt.102: Alternating current disconnectors and earthing switches	IEC 62271-102
High-voltage switchgear and controlgear; Pt.200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 KV	IS/IEC: 62271-200
AC electricity meters	IS: 722
Metal oxide surge arrestor without gap for AC system	IEC: 60099-4
Terminal blocks for copper conductors	IEC: 60947-7-1
Dry transformer	IS: 11171
Motor	IEC 60034-18-41 &42, IEC60034 / NEMA 30 & 31,
Contactor/Switches/Fuses etc.	IEC:60947, IS: 13947
Harmonics & EM compatibility	IEEE:519/IEC: 61000
VFD	IEC: 60034/ IEC: 61800

Equipment complying with other internationally accepted standards will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision amendments and revision in force as on date of opening of bid and shall clearly bring out the salient features for comparison.

3.00.00 **OPERATING CONDITIONS**

3.01.00 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and also relative humidity of 95% at 40 deg. Celsius shall be considered.

3.02.00 All equipment shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.

3.03.00 The auxiliary AC voltage supply arrangement shall have 11/6.6/3.3kV and 415V systems (as applicable). It shall be designed to limit voltage variations as given below under worst operating condition:

1. 11kV/ 3.3 kV/ 6.6 KV : +/- 6%
2. 415V : +/- 10%

Note: The Voltage level mentioned above is the Nominal Voltage available at the input of the VFD System from the MCC/ Switchgear/transformer, based on the system requirement/Availability.

The voltage level for the VFD output to be fed to motor shall be as follows:-

1. Upto 400 kW : 415V/690V, Low Voltage, Three Phase AC
2. Above 400kW and upto 700 KW : 690V, Low Voltage, Three Phase AC
3. Above 700KW : Medium Voltage

From here onwards in the specifications all the VFD Systems consisting of either 415 V or 690 V may be termed as LV VFD while the higher rated VFD System shall be termed as MV VFD. If nothing is mentioned than the Clause is applicable for both the LV and the MV VFD until deliberated otherwise.

4.00.00 **SYSTEM DESCRIPTION**

Type of drive	3-Phase Diode / Thyristor / Multi Stage IGBT / IGCT / SGCT/ IEGT
Type of Cooling of VFD	Naturally air cooled/forced air cooled/Liquid cooled
Converter Type	Full wave diode rectifier/active front end type
Inverter Type	Thyristor/IGBT/IGCT/SGCT/IEGT

5.00.00 **GENERAL REQUIREMENTS**

5.01.00	**Medium Voltage VFD**: The Variable frequency drive (VFD) system shall be of a modern proven design for similar applications in power plants/industry. The system shall be either Current Source Inverter (CSI) or Voltage Source Inverter (VSI) type with minimum eighteen (18) pulse design.
5.02.00	**415 V/690 V LV VFD:** The Variable frequency drive (VFD) system shall be of a modern proven design for similar applications in power plants/industry. The system shall be either Current Source Inverter (CSI) or Voltage Source Inverter (VSI) type with minimum Twelve (12) pulse design. For drives less than 100 KW Six (6) pulse can be offered meeting all other requirements.
5.03.00	The system shall be fully digital, PLC/Microprocessor based, energy efficient, and shall provide very high reliability, high power factor, low harmonic distortion and low vibration and wear and noise. It shall be easy to install in minimum time and expense and no special tools shall be required for routine maintenance.
5.04.00	The offered equipment shall be with state of art technology and proven field track record. No prototype equipment shall be offered.
5.05.00	The VFD manufacturer shall ensure the proper coordination of their VFD with the Driven Motor and the supply system. All the Motors which are to be driven by VFDs will be of Inverter duty type. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable. The VFD operation shall have no inherent detrimental impact on the Motors/ cables & supply system.
6.00.00	**TECHNICAL AND OPERATIONAL REQUIREMENTS**
6.01.00	The system shall be designed to deliver the motor input current and torque for the complete speed torque characteristics of the driven equipment, with worst input supply voltage and frequency variation. The system shall be suitable for the load characteristics and the operational duty of the driven equipment.
6.02.00	The overload capacity of the controller shall be 150% of the rated current of the motor for one minute for constant torque applications and 110% of rated current for one minute for variable torque applications at rated voltage. If the motor load exceeds the limit, the drive shall automatically reduce the frequency and voltage to the motor to guard against overload.
6.03.00	The drive system shall be designed to operate in one or more of the following operating modes as to suit characteristics of the driven equipment or specified by the load: a. Variable torque changing as a function of speed. b. Constant torque over a specific speed range. c. Constant power over a specific speed range. d. Any other as specified in data-sheet

6.04.00	VFDs shall comply with the latest edition of IEEE 519 & IEC 61000 for both individual as well as total harmonic voltage and current distortion limits. The Voltage and Current limits shall be applicable at the Point of Common Coupling (PCC), which shall be the MCC/ Switchgear/ from which the VFD system is fed.
6.05.00	The above compliance shall be verified by the field measurements of harmonics at the PCC with and without VFDs operation.
6.06.00	VFD shall be capable of withstanding the thermal and dynamic stresses and the transient mechanical torque, resulting from short circuit. Any damage resulting from such a short circuit or internal fault shall be limited to the component concerned.
6.07.00	The system shall be suitable to maintain speed variation within range 10-110% or as per the requirement of driven equipment with speed set accuracy of +1% of rated maximum speed and steady state regulation of +0.5% of rated speed as per system requirement.
6.08.00	The VFD System shall maintain a power factor of 0.95 (minimum) (for LV VFD system) and 0.9 (minimum) (for MV VFD system) in the entire operating range.
6.09.00	Maximum allowable audible noise from the VFD system will be 85 dB (A) at a distance of one meter under rated loaded with all cooling fan operating conditions.
6.10.00	All the circuit components shall be suitably protected against over voltages, surges, lightning etc.
6.11.00	The panels shall be designed to provide easy access to hardware, to facilitate replacement of cards in case of any failure.
6.12.00	All the VFDs for particular application shall be of same design so as to ensure 100 % interchangeability of components.
6.13.00	For each programmed warning and fault protection function, the VFD shall display a message in complete English words or Standard English abbreviations. At least 30 time tagged fault messages shall be stored in the drive's fault history.
6.14.00	The VFD cubicles shall be placed in air conditioned environment. However if VFDs of less than 100 kW are designed to operate in non-air condition environment the same shall also be acceptable.
6.15.00	The 3-Phase Thyristor/IGCT/SGCT/ multistage IGBT/IEGT based VFD system shall have minimum number of components to ensure very high reliability. The input side converter shall have 3-Phase Diode/Thyristor bridge configuration modular type and inverter shall be of 3-Phase Thyristor/IGCT/SGCT/multi stage IGBT/IEGT type, using Pulse Width Modulation or better technique for generating near sine wave output to motor.
6.16.00	Fiber optic cable connection shall be provided preferably to ensure high network reliability.
7.00.00	**VFD COMPATIBILITY WITH THE MOTOR**

7.01.00	MV VFD output current waveform, as measured at the motor, shall be inherently sinusoidal at nominal loads, with a total harmonic current and voltage distortion within acceptable/standard limits. VFD with transformers on output side are not acceptable.
7.02.00	The system design shall not have any inherent output harmonic resonance in the operating speed range.
7.03.00	VFD shall provide stable operation of motor from high-voltage dv/dt stress, regardless of cable length to motor. The vendor shall clearly state the limitations in the motor cable distance in his proposal. However, due to system requirements & constraints if the cable length becomes critical, filters/ chokes etc. shall be provided by the VFD manufacturers as an integral part of the VFD to mitigate the reflected wave effect of harmonics.
8.00.00	**BYPASS ARRANGEMENT (OPTIONAL, IF SPECIFIED)**
8.01.00	The VFD System shall have an optional feature to run the motor under bypass arrangement for operation of Motor with VFD bypassed. During starting (under rated conditions) the motor will be switched on in VFD Mode to limit the starting current and after gaining speed, the load would be switched over to bypass mode.
8.02.00	Comprehensive motor protection scheme for protection and control for operation VFD during bypass mode shall be finalized during detailed engineering.
9.00.00	**STANDBY VFD ARRANGEMENT (OPTIONAL, IF SPECIFIED)**
9.01.00	A Common standby arrangement with auto/manual switchover shall be provided in case of failure of any VFD in a group of drives. Complete protection, interlocks & control required shall be provided in the changeover module.
10.00.00	**EFFICIENCY**
10.01.00	Efficiency (Drive only) shall be minimum 98% for both MV VFD and LV VFD. Overall efficiency shall be minimum 96.5% for LV VFD and minimum 94 % for MV VFD at rated load and speed. Overall Efficiency evaluation shall include input transformer, harmonic filters and power factor correction (if applicable), VFD converters, cooling fans and output filter, as applicable in the system. Auxiliary controls, such as internal VFD control boards, cooling fans/pumps.
10.02.00	In absence of valid test report, a factory test shall be performed at the VFD manufacturer's facility verifying the efficiencies. Manufactures who are supplying Drive and transformer from different locations, efficiency test will be conducted separately for Drive and transformer.
11.00.00	**COOLING SYSTEM**
11.01.00	The VFD shall be designed to operate indoor under temperature range of 0 deg C to 50 deg C and relative humidity of 95 %(at 40 deg C).

11.02.00	VFD manufacturer to primarily offer Air cooled Design. However in case of large ratings, liquid cooled drives may be accepted subject to employer's approval. In case of liquid cooled system, there shall be no necessity of continuous water supply system (Closed Loop System).
11.03.00	In case of Air cooled design, the VFD Cooling system shall be such that it puts minimum heat load inside the room and preferably throw the hot air outside the room with ventilation ducts. The Cooling system shall be designed in such a way that the Air Conditioning & Ventilation Air requirements are kept to minimum. The VFD Manufacturer shall furnish the data regarding heat load, air flow requirements during the detailed engineering.
11.04.00	Air cooled VFDs shall be provided with cooling fans mounted integral to the VFD/ enclosure. The VFD shall include air-flow pressure switches and temperature detectors to monitor proper operation of the air cooling system. If the fan fails, the system must generate the alarm/trip for the fan failure.
12.00.00	**TRANSFORMER:**
12.01.00	Type: Outdoor Mineral oil filled ONAN type or Indoor air-cooled Dry type, Three phase unit, rectifier/converter duty type transformer.
12.02.00	All other components, technical parameters shall be as per applicable IEC/IS.
12.03.00	Enclosure for Dry Type Transformer (as applicable) Enclosure shall be of a tested quality sheet steel of minimum thickness 2 mm & shall also accommodate cable terminations. The housing door shall be interlocked such that it should be possible to open the door only when transformer is off. The enclosure shall be provided with lifting lugs and other hardware for floor mounting.
12.04.00	Core — Shall be High grade non-ageing cold rolled grain oriented silicon steel Laminations.
12.05.00	Winding conductor — Shall be electrolytic grade copper. Windings shall be of class F insulation or better.
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12.06.00	Winding temperature Indicator (WTI) — Shall be Platinum resistance type temperature detector in each limb.
12.07.00	Thermistors — Shall be embedded in each limb with alarm and trip contacts for remote annunciation.
12.08.00	Temperature rise: Winding temperature rise shall be as per applicable IEC.

13.00.00	**POWER CONVERTER:**
13.01.00	The static power converter shall consist of a line side converter for operation as a rectifier and a load side power converter for operation as a fully controller inverter. Power converter shall be fast switching, most efficient and low loss type.
13.02.00	The converter shall be coordinated with the transformers. The converter shall be able to withstand a three phase short circuit current until interrupted by normal breaker operation.
13.03.00	Adequate short circuit and over voltage protection shall be provided for the converter and inverter system.
13.04.00	All power converter devices shall include protective devices, snubber networks and dv/dt networks as required.
13.05.00	The current rating of the converter's semi-conductor components shall not be less than 120% of the nominal current flowing through the elements at full load of the VFD through the whole speed range. If the parallel connection of semiconductor is applied, the above current rating shall not be less than 140% of the above values.
13.06.00	All power diodes shall be of silicon type with minimum VBO rating at 2.5 times the rated operating voltage.
13.07.00	The power converter circuit shall be designed so that motor can be powered at its full nameplate rating continuously without exceeding its rated temperature rise nor reducing its service factor due to harmonic currents generated by the inverter operation. The conversion devices and associated heat sinks shall be assembled such that individual devices can be replaced without requiring the use of any special precautions / tools.
13.08.00	The cooling system of the electronic components, if provided, shall be monitored and necessary alarms shall be provided to prevent any consequential damage to the power control devices.
14.00.00	**OUTPUT FILTER (AS APPLICABLE):**
14.01.00	Output/ dv/dt filter shall be provided, if required. It shall be an integral part of the VFD system and included within the VFD enclosure. It shall inherently protect motor from high voltage dv/dt stress.
15.00.00	**DC LINK CAPACITOR (AS APPLICABLE):**
15.01.00	Capacitor shall be of self-healing film or electrolytic type having high life time. The capacitor shall be an integral part of VFD system. DC link Capacitors shall have

discharge resistors which shall be capable of reducing the residual charges to zero just after the capacitor is disconnected from the supply source. The capacitor shall be suitable for high ripple currents.

16.00.00 AC/**DC Reactor (As applicable)**

1) Type: Dry type, air cored, self cooled, indoor type. Suitable for withstanding earth fault continuously.
2) Insulation: Thermal Class 155(F), temperature rise is limited to thermal class 130 (B).
3) Noise level shall not exceed value specified in NEMA TR-1.

17.00.00 **VFD PANEL REQUIREMENTS**

17.01.00 Enclosure frames and load bearing members shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness 1.6 mm. Stiffeners shall be provided wherever necessary. The gland plate thickness shall be 3.0 mm for hot / cold-rolled sheet steel and 4.0 mm for non-magnetic material. In case dry type transformer is provided inside VFD panels, the enclosure and in its frame thickness shall be same as indicated in this para.

17.02.00 The cable entry shall be from the bottom of the panel and a removable bolted un-drilled gland plate.

17.03.00 All Panels shall be of dust-proof and vermin-proof construction and shall be provided with a degree of protection of IP: 3X or better for MV VFD and IP: 4X or better for LV VFD as per IS/IEC 60947

17.04.00 Enclosures must be designed to avoid harmonic and inductive heating effects and to shield any outside equipment from interference, enclosing and shielding the complete to eliminate any radio frequency interference. The construction of the panel shall provide effective protection against electromagnetic emissions.

17.05.00 Each panel shall be provided with illuminating lamp, space heater with switch fuse and variable setting thermostat.

17.06.00 Proper ventilation using air filters and fans/pumps shall be provided in the panels to ensure that maximum temperature inside the cubicle is within permissible limits for reliable and continuous operation of the system.

18.00.00 **PAINTING**

Paint shade shall be as follows

a) VFD transformer reactor enclosure : RAL 5012 (Blue), legend in black letter
b) Motors : RAL 5012 (Blue)

	c) VFD Panels : Front and rear panels in Grey (RAL9002). End panel sides in blue (RAL 5012)
19.00.00	**HT SWITCHGEAR**
19.01.00	The technical requirements of HT switchgear shall be as per chapter of HT switchgear in Part-B of Technical specifications.
20.00.00	**MOTORS**
20.01.00	VFD shall be used to drive three (3) phase squirrel cage inverter duty Induction motor with VPI insulation (Resin poor) suitable for VFD application. These motors shall be provided with insulated bearing on at least one side for motor frame size above 250 frame. However, contractor's proven practice with respect to use of insulated bearing in VFD driven motor may be accepted subject to Employer's approval.
20.02.00	Motors shall also meet the requirements mentioned in subsection for motors, relevant portions of the specifications for driven equipment and relevant IS/IEC.
20.03.00	Motor shall be suitable for operation with a solid state power supply consisting of an adjustable frequency inverter for speed control & shall be suitable for the current waveforms produced by the power supply including the harmonics generated by the drive.
20.04.00	Motor insulation shall be designed to accept the applied voltage waveform, within the Vpeak and dv/dt limits as per IEC-61800.
20.05.00	Drive manufacturer shall coordinate with the motor manufacturer for proper selection of the motor for the given load application and the output characteristics of the drive.
20.06.00	Other requirements of motor shall be as stipulated in technical chapter of Motors and driven equipment in Part-B of technical specifications.
21.00.00	**LT & HT CABLES**
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21.01.00	Contractor's scope shall also include LT and HT cables suitable for VFD system and Motors.
22.00.00	**CONTROL AND PERFORMANCE REQUIREMENTS**
22.01.00	The VFD to provide an automatic current limiting feature to control motor currents during startup and provide a "soft start" torque profile for the motor load combination. Current and torque limit adjustments shall be provided to limit the maximum VFD output current and the maximum torque produced by the motor.

22.02.00	It shall be possible to vary the speed of the drive and control it in either Local or Remote mode. Local / Remote selection shall be done from VFD panel unless otherwise specified.
22.03.00	Provision shall be kept for exchange of information between different VFD control system parameters thru PLC/DDCMIS. Man machine interface for (MV) VFD shall have one flat TFT monitor with keyboard (password protected) in the VFD room and a color laser printer for system alarm and monitoring located in control room. Parameter Monitoring: -Input and output voltage of Drive - Input and output current of Drive - Motor speed - Input and output power frequency of Drive - Torque -Input and Output power of Drive system (covering transformer if applicable) - Output kWhr of Drive - Transformer (if applicable) temperature for alarm & trip. - Ambient temperature - Run/stop and local/remote status displayed
22.04.00	Drive shall be equipped with a front mounted operator console panel consisting of a backlit alphanumeric display and a keypad with keys for parameterization and adjusting parameter. Control panel shall be operable with password for changing the protection setting, safety interlock etc.
22.05.00	Operator console/Main Control Card shall have facility / port to connect external hardware such as Lap-Top etc. Console shall have facility for upload and download of all parameter settings from one drive to another drive for start up and operation.
22.06.00	User-friendly licensed software for operation and fault diagnostic shall be loaded in the drive system panel before commissioning.
23.00.00	**PROTECTION FEATURES**
23.01.00	The system offered shall incorporate adequate protection features as per IEC 61800-4: 2002 Table-8, properly coordinated for the drive control and for motor including following: i) Converter transformer: short circuit, over current, earth fault & winding temperature high protection. ii) Incoming and outgoing line surge protection. iii) Under / over voltage protection iv) Phase loss, phase reversal, overload, negative phase sequence, locked rotor protection. v) Instantaneous Over current & Earth fault protection

	vi) Converter/Inverter module failure indication. vii) Over frequency/speed protection. viii) Ventilation failure indication & alarm. ix) Over temperature of VFD x) Bearing temperature protection. xi) System earth fault protection. xii) Speed reference loss protection.
23.02.00	Under VFD Bypass Mode (if applicable) all the electrical protections related to the Motor shall remain applicable.
24.00.00	**CONTROL FEATURES**
24.01.00	Following controls shall be provided as a part of the Operator Control Panel or through separate switches on the front panel door. i) Start / stop (in local/remote mode) ii) Speed control (Raise / lower) iii) Acknowledge/Accept/ Test Push Button for annunciation iv) Auto / Manual / Test Mode select v) Emergency stop vi) Trip-Remote Breaker
25.00.00	**DIAGNOSTIC FEATURES**
25.01.00	The VFD shall include a microprocessor/PLC based digital diagnostic system which monitors its own control functions and displays faults and operating conditions.
25.02.00	Fault diagnostic shall be built into the system to supervise the operation and failure of the system. The information regarding failure of any of the system including shut down of the system shall be available. It shall be possible to retrieve the record of events prior to tripping of the system or de-energization. Auxiliary supply to the system components or to the electronics (firmware) for the diagnostics / display shall be taken care of by the manufacturer for this purpose.
26.00.00	**SERVICEABILITY / MAINTAINABILITY**

26.01.00	Power Component Accessibility: All power components in the converter sections shall be designed for rack-out accessibility for ease of maintenance and to minimize repair downtime.
26.02.00	Marking / Labeling: Sleeve type wire marker tags or other acceptable means of permanent identification shall be applied to power and control wiring. Individual labels shall be provided for all major components of the VFD system.
27.00.00	**STORAGE AND PRESERVATION**
27.01.00	The Contractor shall be responsible for the storage and preservation of all the equipments to be supplied under the VFD System, till the time of successful installation and commissioning. The equipment should be suitable for storage for long periods before installation. Contractor should take adequate measures to ensure that no damage happens to the VFD System due to storage and preservation.
28.00.00	**TESTS**
28.01.00	**ROUTINE TESTS** All acceptance and routine tests as envisaged in QA section shall be carried out. Charges for these shall be deemed to be included in the equipment price.
28.02.00	**TYPE TESTS**
28.02.01	The Contractor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately in the relevant schedule and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the employer's engineer.
28.02.02	The type tests shall be carried out in presence of the employer's representative, for which minimum 15 days' notice shall be given by the Contractor. The Contractor shall obtain the employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set–up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.
28.02.03	In case the Contractor has conducted such specified type test(s) within last ten years as on the date of bid opening, he may submit during detailed engineering the type test reports to the Employer for waival of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Employer reserves the right to waive conducting of any or all the specified type

	test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the Contractor.
28.02.04	Further the Contractor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED" and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the Contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.
28.03.00	**LIST OF TYPE TESTS TO BE CONDUCTED** The following type tests shall be conducted under this contract for MV VFD i) Overall efficiency determination of VFD system including transformer/ Harmonic filters etc at motor full load ii) Temperature rise test iii) Noise level iv) Harmonics of No load current.(Input/Output)
28.04.00	**LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED** The following type test reports shall be submitted for VFD Panels' **1) VFD panels (For LV VFD used with load >= 50 KW)** i. Rated Current/ Output ii. Temperature rise test iii. Noise level test iv. Power Loss Determination Test v. Power factor measurement. vi. Degree of Protection Test vii. EMC Test

viii. The Fast transient SWC tests as per ANSI / IEEE C37.901-2002 / IEC 60255-22-04-2008 / IEC 61800

2) VFD panels (For MV VFD)

i. Rated Current/ Output

ii. Current Sharing

iii. Voltage Division

iv. Power Loss Determination Test

v. Power factor measurement.

vi. Degree of Protection Test

vii. The Fast transient SWC tests as per ANSI / IEEE C37.901-2002 / IEC 60255-22-04-2008 / IEC 61800

3) AC/DC Reactor

i. Lightning impulse test(If applicable)

ii. Heat run test

iii. Short time current test(If applicable)

iv. Noise level test

4) Transformers (In case of non integrated type)

i. As per requirements mentioned in subsection for Transformer chapter in technical specifications.

SUB-SECTION-III-C9

CONTROL DESK, PANEL AND FURNITURE

1.00.00	**CONTROL DESK & PANELS**
1.01.00	**GENERAL**
1.01.01	All control desk, panels, LVS panel etc. shall be furnished fully wired with necessary provision for convenience outlets, internal lighting, grounding, ventilation, space heating, anti-vibration pads, internal piping & accessories as required for completeness of the system.
1.01.02	All panels, desks, cabinets shall be free standing type & have bottom / top entry for cables to be finalised application wise during detailed engineering stage. The bottom of desk & cabinets shall be sealed with bottom plate, compression cable glands (double for field and single for inside rooms) and fire proof sealing material to prevent ingress of dust and propagation of fire. Sufficient number of power receptacles with disconnect switches shall be installed within all panels/desk.
1.01.03	Exterior steel surface shall be sand blasted, ground smooth, filled, primed, sanded and smooth enamel painted to give a good finish subject to minimum paint thickness of 65-75 microns for sheet thickness of 3 mm and 50 microns for sheet thickness of 2mm. The exact color shall be finalised during detailed engineering.
1.01.04	The design shall conform to the EN ISO 11064 (Ergonomical design of control room), Part-1,2 and 3.
2.00.00	**CONTROL DESK & PANEL**
2.01.00	**GENERAL**
2.01.01	The exact dimensions, material, construction details, grounding, general arrangement etc. of Control Desk etc. shall be as per the actual requirement and shall be finalised during detailed engineering and subjected to Employer's Approval.
2.01.02	For control desk mounted instruments/ devices etc., which are to be powered from UPS, all required conversion of interface equipments / accessories to make such devices compatible with UPS supply shall be provided. All necessary hardware like Input switches/ fuse unit for each feeder as well as switch fuse unit for each instrument/ device on the power supply line shall be provided. From UPS, redundant feeders shall be provided with suitably rated MCB and provision of fast auto changeover of UPS feeders.
2.02.00	**Control Desk (CD)**
2.02.01	Control desk shall be Modular, non-welded construction free standing table top type with front & back cover constructed of 1.6 mm thick CRCA steel plates. The tabletop of the control desk shall be arc-shaped for mounting TFT monitors & mice. The work surface of control desk shall be 30mm thick with the top 12mm of Acrylic Solid Surface (ASS) and the remaining 18mm of laminated medium density fiber board. Work surface shall be made of two different colors at same level and seamlessly joined in each section. The structure frame shall consist of extruded aluminum top and bottom horizontal beams and vertical support tensioned together to form an integrated, finished curvilinear shaped frame. Vertical & Horizontal supports, minimum 2.5mm and 2mm thick respectively, have to be provided for the structure frame. Extreme side legs shall be illuminated type and should complete the

overall form and aesthetics of the desk. It shall have concealed cable & wire way management system. Telephone sets shall be mounted on the control desk. Sliding keyboard trays shall be provided on the CD. The exact profile of the desk, dimension and the radius of curvature shall be finalised during detailed engineering stage.

2.02.02 All operator monitors & mice shall be mounted on this CD.

2.02.03 The cabling / wiring between OWS & CPU's, power supply cables etc. shall be aesthetically routed and concealed from view.

2.03.00 Internal Panel/Desk Items

Equipment and devices mounted within the panels/desk shall be mounted on suitable racks/brackets and shall be arranged for convenient access for adjustment and maintenance work.

2.04.00 Furniture

Bidder shall provide following industrial grade furniture items as a minimum from reputed manufacturers/suppliers meeting International Standards. The furniture shall be modular and latest with ease of operational features. The furniture shall be modern, aesthetically designed, modular, flexible, space saving and future safe. Each module shall have transparent cover and adjustable partition. It shall have locking provision for security. The components shall be suitable for integration/fabrication without any welding technology.

1. Work Station furniture

   Modular work station furniture, suitable for mounting servers & historians, programmer stations, PC based systems, printers (inkjet or A4 laser) etc. is to be provided..

2. Server Rack

   Server rack shall be provided to mount programmer stations, PC based systems (of rack type and tower type), Matrix KVM switcher, Mini UPS etc. Suitable arrangement for Ventillation and cooling shall be built in.

3. PC rack

   PC rack shall be provided to mount CPUs of work stations/PCs of OWS/LVS etc in Control Room.

4. Chairs

   Industry standard revolving chairs with wheels and with provision for adjustment of height (hydraulically/gas lift) shall be provided for the operators & other personnel in control room area. These shall be designed for sitting for long duration such that these are comfortable for the back.

5. Tables

a Industry standard computer tables shall be provided & shall be as approved by Employer during detailed Engineering.

6. Almirahs

Steel Almirahs shall be provided for keeping documents in the documentation room.

7. Keypad

Keypads shall be provided for the storing of keys of relevant areas in the respective control rooms

8. Lockers

Suitable lockers shall be provided in the room adjacent to the control room for storing of personal articles of control room personnel & also for documents.

1.0 SCOPE

This specification covers the Design, Manufacture, Inspection and Testing at the manufacturer's works, proper packing for transportation and delivery to site, supervision, erection, and commissioning at site of Local Panels required for control and monitoring of the Auxiliary Plant & Equipment.

2.0 CODES AND STANDARDS

2.1 All the equipments specified herein shall comply with the requirements of the latest issue of the relevant National and International standards.

2.2 As a minimum requirement, the following standards shall be complied with:

a) IS-6005 : 1998 : Code of practice for phosphating of iron and steel.
b) IS-5 : 2007 : Colors for ready mixed paints and enamels.
c) IS-1248:2003 : Direct Acting Indicating Analog Elec Measuring Instruments.
d) IS/IEC 60947:Part 1:2004 : Low Voltage switchgear & control gear: Part-I (General Rules)
e) IS-8828:1996 : Circuit breaker for household and similar installations.
f) IS-13947 (Part-I):1993 : Low Voltage switchgear & control gear : Part-I (General Rules)
g) ISA-18.1:1979 : Annunciator Sequences and Specification
h) NFPA-496:2003 : Purged & Pressurised Enclosure for Electrical Equipment in Hazardous Locations.

3.0 TECHNICAL REQUIREMENTS

3.1 Panel Construction

3.1.1 The local panels shall house the secondary instruments, annunciation system, Single loop controller, Control switches / push buttons, indicating lamps/LED cluster, relays, timers and other devices required for operation and monitoring of the equipment locally.

3.1.2 The panels shall be of free standing type either welded construction on angle iron (minimum section of 50 x 50 x 4 mm) structure or folded construction by sheet metal formation depending upon the equipments to be mounted on it. The panels shall be robustly built and stiffeners as necessary shall be provided.

3.1.3 The panel shall be suitably reinforced to ensure adequate support for all instruments mounted thereon. All welds on exposed panel surfaces shall be ground smooth.

3.1.4 The salient features of construction shall be:

Sheet material: Cold rolled sheet steel
Frame thickness: Not less than 3.0mm
Enclosure thickness: Not less than 2.5 mm for load bearing sections (Mounted with instruments)
1.6 mm for doors and Not less than 2.0 mm for others
Panel Height: Not less than 2365 mm (Refer data sheet-A (No. PES-145A-DS1-0)
Gland plate thickness: 3.0mm
Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

3.1.5 The panel shall be provided with rear doors with integral lockable handle. The door when locked shall be held at minimum three places. The door width shall not be more than 550mm.The doors shall be provided with suitable stiffeners to prevent buckling. The handle shall be on the right side of the door. The door shall be removable type with concealed hinges to facilitate maintenance work. Suitable pocket inside the door shall be provided for keeping the drawings / documents. Double door shall be provided with suitable glass windows, as per the requirement.

3.1.6 Suitable neoprene gasket shall be provided on all doors and removable covers. Suitable ventilation system along with louvers shall be provided at bottom and top of the doors covered with removable wire mesh.

3.1.7 The class of protection shall be in accordance with IP-42 unless otherwise specified in the data sheet – A (No. PES-145-54A-DS1-0).

3.1.8 All steel surfaces shall be cleaned by sand / pellet blasting, treated for pickling, degreasing and phosphating etc. by seven tank method. The panel shall have a high quality finish and appearance. The panel shall be painted with two coats of primer followed by two coats of epoxy / synthetic enamel based final paint of color shade and finish as given in data sheet-A (No. PES-145A-DS1-0). Minimum thickness of the paint shall be 85 microns for external paint and 70 microns for internal paint.

3.1.9 The cable glands of the required size and type as given in data sheet-A (No. PES-145A-DS1-0) shall be supplied alongwith the Panel.

3.1.10 All operable and indicating devices shall be mounted on the front of the panel while aux. Relays / timers MCBs etc. required for realization of control logics shall be mounted on a mounting plate inside the panel. Auxiliary relays and timers etc. shall be grouped according to the control function.
No operable or indicating devices shall be mounted below 750 mm and above 1800 mm (w.r.t. finished ground level). The devices shall be located in such a way so as to ensure easy access for operation / maintenance.

3.1.11 Single / dual control power supply feeders of voltage class as specified in data sheet-A (No. PES-145A-DS1-0) shall be provided by the purchaser. In case redundant power supply feeders are provided then auto changeover unit shall be mounted on the panel are in the panel supplier's scope. Where DC control power supply is specified an additional 240V, 50 Hz AC supply feeder for powering of space heater and lighting shall be provided by the purchaser. Suitable arrangement shall be provided inside the panel to receive and terminate the power supply feeder(s). For this purpose MCBs of suitable current rating shall be provided by the vendor. A supervisory relay along with a pilot lamp to indicate control supply 'ON' shall be provided on the panel. Any other power supply required for the operation of the devices mounted in the panel shall be arranged by the vendor.

3.1.12 The internal wiring shall be carried out with 1100 volt grade PVC insulated copper multi strand wire / flexible of 1.5mm2 size. AC & DC wires shall be kept separate from each other. Separate coloured wires to be used for AC and DC circuits. All wires shall be properly numbered and identified with ferrules as per the Control scheme / wiring diagram. Wires shall be routed and run through PVC troughs.

3.1.13 Terminal blocks shall be clip on type, 1100 volts grade. Separate terminal blocks shall be used for AC & DC circuits. The terminals shall be suitable for terminating 0.5 mm2 to 2.5mm2 external cables. The TB points in terminal block shall be cage clamp type / screw type. The terminal for ammeters shall be provided with removable links for shorting CTs. Each terminal strip shall be provided with identification strip. The terminal shall not be mounted below 250 mm height from finished floor. The panel shall have ten (20) percent spare terminal.

3.1.14 The interior of each panel shall be suitably illuminated through fluorescent lamps / tube lights with shrouded cover of minimum 15W operable on 240V 50 Hz AC power supply through panel door switch. A 15 Amp. 3-pin Power receptacle shall be provided.

3.1.15 Suitable space heaters operable on 240 Volts 50 Hz AC power system shall be provided at the panel bottom. These shall be designed to maintain the panel temperature five (5) deg. C above the ambient temperature during maintenance shutdown. Suitable isolating and control devices comprising of MCB, thermostat etc. shall be provided for the space heater.

3.1.16 The panel shall be provided with a copper earth bus of 25 x 6 mm size running throughout the width of the panel. It shall be terminated internally with 10 mm bolts at extreme ends for connection to; main station earth. The panel mounted equipments / devices shall be connected to earth bus through green coloured PVC insulated stranded copper conductor of 2.5 mm2 size.

3.1.17 Local Panel shall be provided with main name plate of 150 mm x 40 mm size having inscription of 20 mm height. The individual devices on the panels shall be as provided with separate name plate with inscription of 3 mm height. The instrument / devices shall be provided with stick on label plates inside the panel. The material of the main and individual labels shall be three (3) ply 3 mm thick Traffolyte

Sheet / 2 mm Anodised Aluminium Plate. The inscription shall be with white letters on black background on traffolyte sheet. The labels shall be fixed by self tapping non-rusting screws.

3.1.18 Vendor shall furnish electric load and heat load list (in case panel is to be placed in ac environment) of each panel.

3.2 Hazardous Area Panel Requirement

3.2.1 The Local Panel located in hazardous area shall be pressurized as per NFPA-496 requirements to render it non-hazardous. Alarms shall be provided for local and remote annunciation when pressurisation falls below 2.5 mm of water column. Protection shall be of type Z of NFPA-496. It shall not be possible to switch ON the power of purged section unless it is purged as per the recommendation of NFPA-496. Vendor must provide a protective device on the panel to protect the panel from over pressurisation.

3.2.2 Vendor shall supply pressurisation kit consisting of valves, restriction orifices, dual filter regulation, pressure gauges, pressure switches, rotameter etc. Pressurisation kit shall be surface mounting on a metal board and located outside the local panel. Pressurisation kit shall further consist of solenoid valve flow switch, timer blow off safety device etc., so as to make purging fully automatic. However final start shall be manual. Panel protection against over pressure to be provided as per NFPA-496.

3.2.3 Pressurised local control panel pressurization kit assembly design shall provide minimum leakage flow through the Local Control Panel. Panel venting shall be as per NFPA-496.

3.2.4 All components in the local panel like indicating instruments, push buttons switches, lamps etc., which are required to be energized without panel pressurization or before completion of purge cycle shall be explosion proof as per NEMA-7 & suitable for area classification.

3.2.5 All push buttons etc. requiring frequent operation during machine running shall have good positive sealing. Weatherproof housing or cover to be provided wherever necessary. Vendor shall provide pressurisation bypass switch outside explosion proof enclosure of pressurized panel with lamp indication. This shall be used only during maintenance. All hinges, screws, other non-painted metallic parts shall be of stainless steel material.

3.2.6 Provision to switch off manually all types of power shall be provided in the panel. In addition, it shall also be possible to switch off power circuits / components which are powered from motor control centre or control room manually in case of pressurization failure. All such cables from MCC and main control room shall be terminated in explosion proof boxes (NEMA-7).

3.3 Control & Monitoring devices

3.3.1 Instruments like Indicators, recorders, single loop controllers etc. as applicable and specified elsewhere for the plant / equipment shall be supplied and mounted on the panel.

3.3.2 Alarm Annunciator System

It shall be solid state discrete facia type having a sequence of ISA-S18.1A or as specified, opaque facia windows of 70 mm x 50 mm size, having two (2) lamps per window, and hooter of 10W, and provision for repeat group alarm at remote. The annunciator shall be provided with ten (10) percent spare windows or minimum two (2) windows along with electronics.

3.3.3 Relays

The relays shall be electromagnetic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable. There shall be ten (10) percent spare contacts.

3.3.4 Timers

The timers shall be electronic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However, minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable.

3.3.5 Control / Selector Switches

Switches shall be Rotary Cam type with minimum of 5 Amps AC & 2 Amp DC continuous current rating. Selector switches shall be stay put type while control switches shall be spring-return-to-neutral type. Contact configuration and rating shall be as per the control function requirement. The switches shall be lockable type wherever specified. Each switch shall be provided with engraved plates indicating the switch position / functions.

3.3.6 Push Buttons / Indicating Lights

The push buttons shall be momentary action self-resetting type, however stop P.B. for unidirectional drives shall be provided with manual reset facility. Its contact configuration & rating shall be as required for the control function but minimum 2 NO + 2 NC of 5 Amp. AC rating. It shall have round coloured projecting tab and engraved escutcheon plate / inscription plate. Colour coding of push buttons shall be as under:

RED	Motor OFF / Valve CLOSE	YELLOW	Alarm acknowledge	Left Hand Side
GREEN	Motor ON / Valve OPEN	BLACK	Lamp test	Right Hand Side

Indicating lights shall be suitable for direct connections across specified power supplies. It shall be fitted with built in resistance to prevent circuit tripping on shorting of lamp filament. It shall be fitted with LED cluster type lamp replaceable from front.

GREEN	Motor OFF / Valve CLOSED condition	AMBER	Motor tripped	Left Hand Side
RED	Motor ON / Valve OPEN condition	WHITE	Normal / healthy	Right Hand Side

3.3.7 Ammeters

Ammeter shall be 96 x 96 mm size, 90 deg. deflection, 1.5% accuracy, 1 Amp. CT operated or with 4-20mA input and Flush mounting type as called for in the data sheet-A (No. PES-145-54A-DS1-0). Ammeters for motors shall have six (6) times folded scale at upper end to enable motor starting current indication

3.3.8 Miniature Circuit Breaker (MCB)

These shall be instantaneous magnetic trip type for short circuit in addition to current time inverse delayed thermal trip feature for over current protection. The housing of MCB shall be made of non-ignitable, high impact material. It shall have minimum short circuit rating of 9 KA for AC Voltages and 4 KA for DC Voltages.

3.3.9 Makes of various instruments / devices shall be as given below

1.	Alarm Annunciators	:	Procon / IIC
2.	Ammeters	:	AEP / IMP
3.	Control / Selector Switches	:	Alsthom / Kaycee / Siemens / L&T
4.	Push Buttons / Indicating Lamps	:	Siemens / L&T / Teknic / Alsthom
5.	Auxiliary Relays	:	Jyoti / Siemens / L&T / OEN
6.	Timers	:	L&T / Alsthom / Bhartiya Cutler Hammer
7.	MCBs	:	S&S Power Engg. / Indo Asian / MDS
8.	Terminal Blocks	:	Jyoti / Elmex

4.0 TESTING AND INSPECTION

4.1 The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.

4.2 BHEL's standard Quality Plan for LCP is enclosed with the specification. The bidder shall furnish his acceptance to BHEL's QP and submit the signed and stamped copy of QP along with the offer.

4.3 The vendor shall conduct the following tests as a minimum requirement:

4.3.1 Routine Tests

1. High Voltage (H.V.)
2. Insulation Resistance (I.R.)
3. Functional

4.3.2 Type Tests

1. Enclosure Class Test

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

The bidder shall supply all commissioning spares and consumables 'as required' during Start-up, as part of the main equipment supply.

5.2. Mandatory Spares

The bidder shall offer alongwith main offer, the Mandatory Spares as specified elsewhere in the specification. The Mandatory Spares offered shall be of the same make and type as the main equipment.

5.3. Recommended Spares

The bidder shall furnish a list of Recommended Spares indicating the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation alongwith unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

6.0 DRAWINGS AND DOCUMENTS

6.1 The bidder shall furnish the following documents in required number of copies along with the bid :

1. Data Sheet no. PES-145A-DS1-0
2. General Arrangement Drawing.
3. Catalogue and technical information for instruments and devices.
4. Quality Plan.

6.2 The vendor shall furnish the following documents in required number as agreed after the award of contract:

1. Data Shee No. PES-145A-DS2-0
2. GA Drawing indicating layout of instruments, construction details, foundation details, cable gland plate alongwith cable glands and all details mentioned in this specification.
3. Control Schematic Diagram along with grouping of different terminals for various functions.
4. Catalogue and technical information for instruments and devices with selected options clearly marked.
5. O&M Manuals.
6. "As Built" Drawing.
7. CDs.

7.0 MARKING AND PACKING

7.1 Panel with all instruments / devices mounted on it shall be suitably packed & protected for the entire period of despatch, storage and erection against impact, abrasion, corrossion, incidental damage due to vermin, sunlight, high temperature, rain moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in Transit and storage in open.

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Local Panels : Data sheet no. PES-145A-DS1-0
- Data sheet C for Local Panels : Data sheet no. PES-145A-DS2-0

FORM NO. PEM-6666-0

	DATA SHEET FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS-999-145-054A
		VOLUME
		SECTION
		REV. NO. 02 / DATE: 16.09.2013
		SHEET 1 OF 3

TAG No. ..... Qty.....

Data Sheet No.: **PES-145A-DS1-0**

Data Sheet A & B

			DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL	MANUFACTURER			
	CONSTRUCTION		☐ FOLDED ☐ WELDED (As per requirement EDN)	
	ENCLOSURE SHEET THICKNESS	FRONT	☐2.0 mm	
		OTHER	☐ 2.0 mm	
		DOOR	☐ 1.6 mm	
		HEIGHT	☐ 2365 mm for stand alone panels. ☐ Other	
		OTHER	☐ Load bearing sheet front shall have 3mm thickness	
TECHNICAL	INPUT POWER SUPPLY * (ANY OTHER POWER REQUIREMENT TO BE DERIVED FROM THIS SUPPLY ONLY)		☐ 240V 50 Hz AC ☐ 220V DC ☐ 415V 3 PHASE 3W ☐ 415V 3 PHASE 4W	
	NO. OF FEEDERS		☐ ONE ☐ TWO	
	STARTER WITH MCC (CHECK WITH MAUX/ELEC)		☐ REQUIRED ☐ NOT REQUIRED	
	IPR POSITION		☐ MCC ☐ RELAY PANEL	
	CONTACT RATING OF RELAY		☐ 5 Amp, 230 V AC ☐ 0.25 Amp, 220V DC	
	CONTROL SUPPLY		☐ 110V AC ☐ 220V AC ☐ 220V DC ☐ Other. (As per requirement)	
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		_____NOS. (AS REQUIRED)	
	TEMP SCANNER (IF REQUIRED –NO. OF CHANNELS TO BE SPECIFIED UNDER SEC-C)		☐ REQUIRED ☐ NOT REQUIRED	
	PAINT TYPE		☐ EPOXY ENAMEL ☐ EPOXY POWDER COATED	
	MIMIC (TYPE OF MIMIC- MATERAIL, THICKNESS TO BE SPECIFIED DURING DETAILED ENGG.)		☐ REQUIRED ☐ NOT REQUIRED	
	PANEL COLOUR (EXTERNAL)		☐ LIGHT GREY (Shade 631 IS-5) ☐ OPALINE GREEN (Shade 275)	
	FINISH (EXTERNAL)		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	PANEL COLOUR (INTERNAL)		☐ WHITE ☐ CREAM ☐ OFF WHITE	
	FINISH (INTERNAL)		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	CLASS OF PROTECTION		☐ IP-42 (FOR INDOOR SERVICE) ☐ IP-55 (FOR OUTDOOR SERVICE) ☐ ANY OTHER	
	CONTROL HARDWARE		☐ RELAY BASED	

FORM NO. PEM-6666-0

	DATA SHEET FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS-999-145-054A
		VOLUME
		SECTION
		REV. NO. 02 DATE: 16.09.2013
		SHEET 2 OF 3

TAG No. ..... Qty.....

Data Sheet No.: **PES-145A-DS1-0**

Data Sheet A & B

	DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	FOUNDATION ARRANGEMENT	☐ FOUNDATION BOLTS ☐ ANCHOR FASTENERS	
	WEIGHT OF PANEL (Kg.)	.....(Vendor to specify)	
	PANEL TYPE	☐ PRESSURISED ☐ UNPRESSURISED As per Requirement	
	CABLE GLAND	☐ DOUBLE COMPRESSION	
	AMMETER (TYPE OF INPUT) *	☐ 1 Amp CT ☐ 4-20 mA	
	SCOPE OF SUPERVISION FOR ERECTION & COMMISSIONING	☐ APPLICABLE ☐ NA	
	* TO BE CO-ORDINATED WITH PEM ELECTRICAL		

	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL
NAME	AANCHAL CHOUDHARY	SACHIN SRIVASTAVA	MA MANSOORI	NAME:
DESIGNATION	SR.ENGR	DY.MNGR	D. GM	
SIGNATURE	16.09.13	16/09/13		SIGNATURE:
DATE	16.09.2013	16.09.2013	16.09.2013	DATE:

FORM NO. PEM-6666-0

	DATA SHEET FOR LOCAL PANELS	SPECIFICATION NO: PE-SS-999-145-054A
		VOLUME
		SECTION
		REV. NO. 02 DATE: 16.09.2013
		SHEET 3 OF 3

TAG No. ..... Qty..... Data Sheet No.: **PES-145A-DS1-0**

Data Sheet C

DATA SHEET-C FOR LOCAL PANEL
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

GENERAL	MANUFACTURER			
	CONSTRUCTION		☐ FOLDED ☐ WELDED (As per requirement EDN)	
	ENCLOSURE SHEET THICKNESS	FRONT		
		OTHER		
		DOOR		
		HEIGHT		
		OTHER		
TECHNICAL	INPUT POWER SUPPLY			
	NO. OF FEEDERS			
	CONTACT RATING OF RELAY			
	TEMP SCANNER			
	CONTROL SUPPLY			
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)			
	PAINT TYPE			
	PANEL COLOUR (EXTERNAL)			
	FINISH (EXTERNAL)			
	TYPE OF MIMIC MATERIAL OF MIMC THICKNESS OF MIMIC			
	PANEL COLOUR (INTERNAL)			
	FINISH (INTERNAL)			
	CLASS OF PROTECTION			
	CONTROL HARDWARE			
	FOUNDATION ARRANGEMENT			
	WEIGHT OF PANEL (Kg.)			

FORM NO. PEM-6666-0

	DATA SHEET FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS-999-145-054A
		VOLUME
		SECTION
		REV. NO. 02 / DATE: 16.09.2013
		SHEET 3 OF 3

TAG No. ..... Qty.....

Data Sheet No.: **PES-145A-DS1-0**

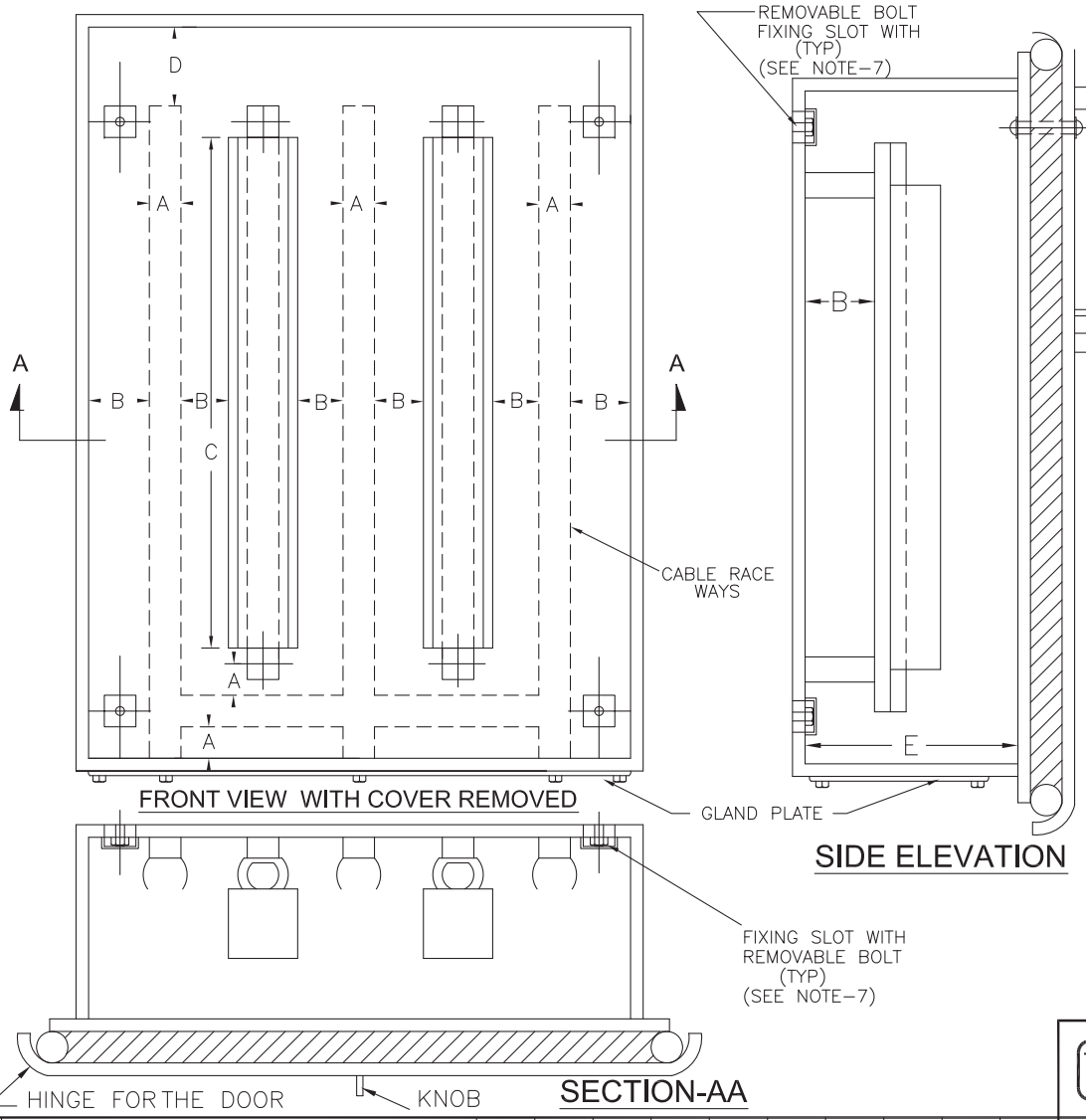
Data Sheet C

DATA SHEET-C FOR LOCAL PANEL
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

PANEL TYPE		
CABLE GLAND		
AMMETER (TYPE OF INPUT)		
SCOPE OF SUPERVISION		

	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL
NAME	AANCHAL CHOUDHARY	SACHIN SRIVASTYAVA	MA MANSOORI	NAME:
SIGNATURE	16-09-13	16/9/13		SIGNATURE:
DATE	16.09.2013	16.09.2013	16.09.2013	DATE:

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A – 75 mm

B – 25 mm

C – SEE NOTE–4

D – 100 mm

E – 150 mm

NOTES:–

1. JUNCTION BOXES SHALL HAVE GLAND PLATES AT THE BOTTOM OF THE BOX ONLY.
2. TUBULAR TYPE GASKETS WILL BE USED.
3. FRP JUNCTION BOXES, SHALL BE PROVIDED WITH POLYEUTHERENE COATING. ALSO REFER SUB SECTION INST CABLE, PART–B SECTION–VI FOR DETAILES.
4. DIMENSION OF 'C' SHALL BE BASED ON NO. OF TERMINAL BLOCKS.
5. THE EXACT TYPE & DIMENSION OF JUNCTION BOXES TO BE USED FOR A PARTICULAR APPLICATION SHALL BE AS DECIDED DURING DETAIL ENGG. STAGE AND SHALL BE SUBJECT TO EMPLOYER's APPROVAL WITHOUT ANY PRICE REPERCUSSION.
6. THE KNOB FOR ALL THE JUNCTION BOXES SHALL BE IDENTICAL.
7. ANY TYPE OF SEALED FIXING ARRANGEMENT AS PER MANUFACTURER's STANDARD CAN ALSO BE PROVIDED SUBJECT TO EMPLOYER's APPROVAL.

FOR TENDER PURPOSE ONLY

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N T P C LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
D	GENERALLY REVISED		JM	KS							21.08.12
C	GENERALLY REVISED		JM	KS							04.08.06
B	GENERALLY REVISED	S.K.	A.R	PS							
A	FIRST ISSUE	S.K.	A.R	PS							04.05.05
					CLEARED BY						

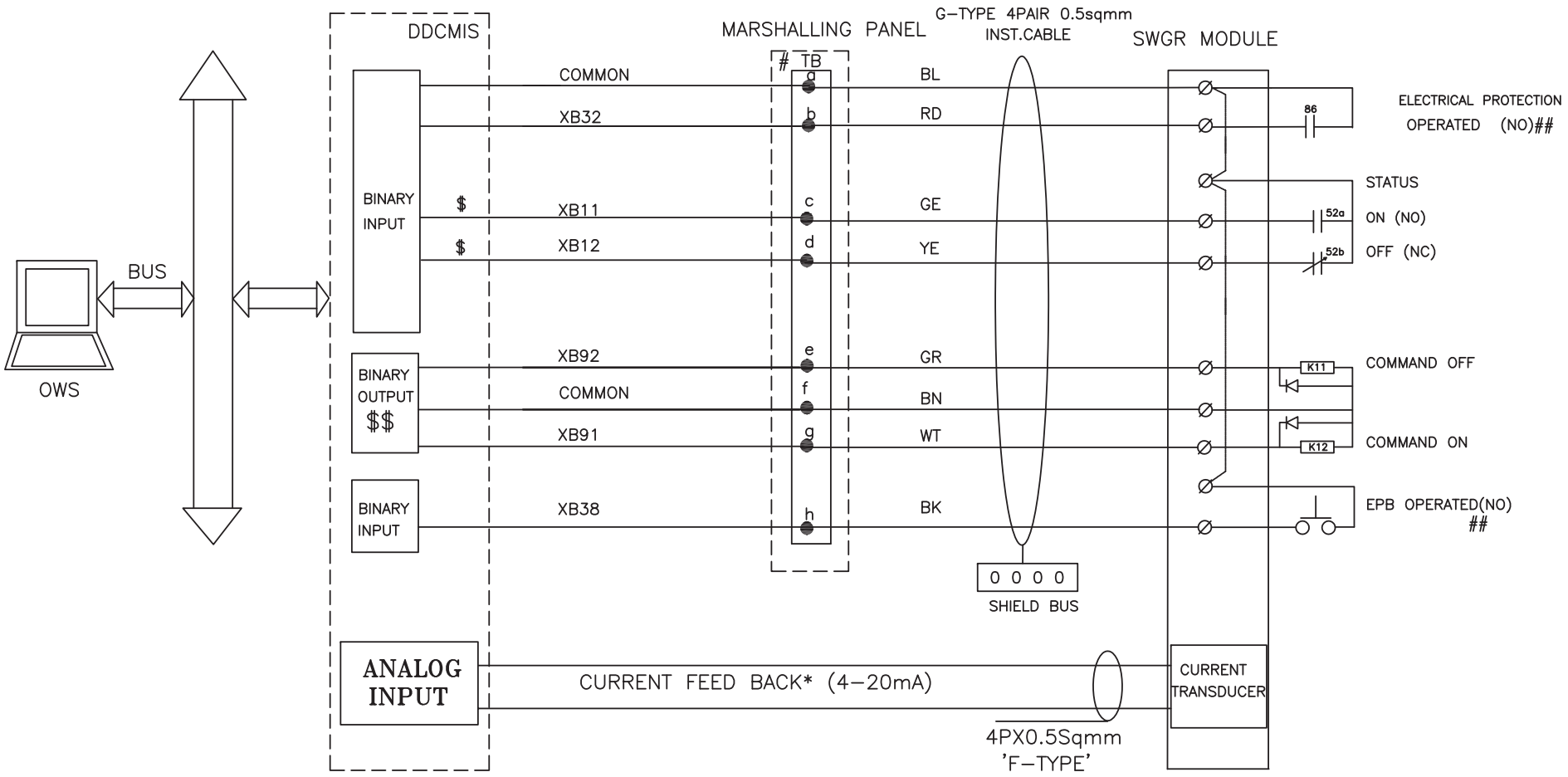
PROJECT: TYPICAL THERMAL POWER PLANT

TITLE: G.A. OF JUNCTION BOX

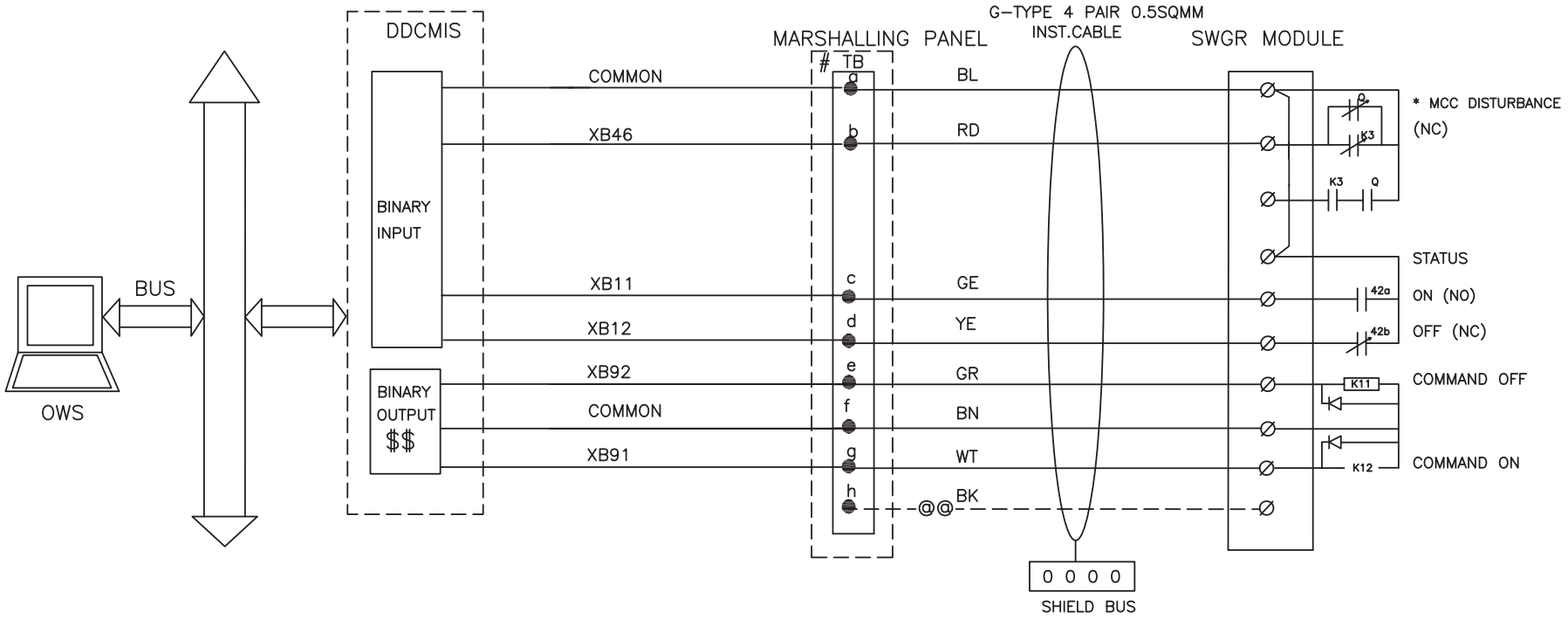
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A4	N.T.S.	0000-999-POI-A-017	D

SIGNAL EXCHANGE BETWEEN DRIVES & DCS

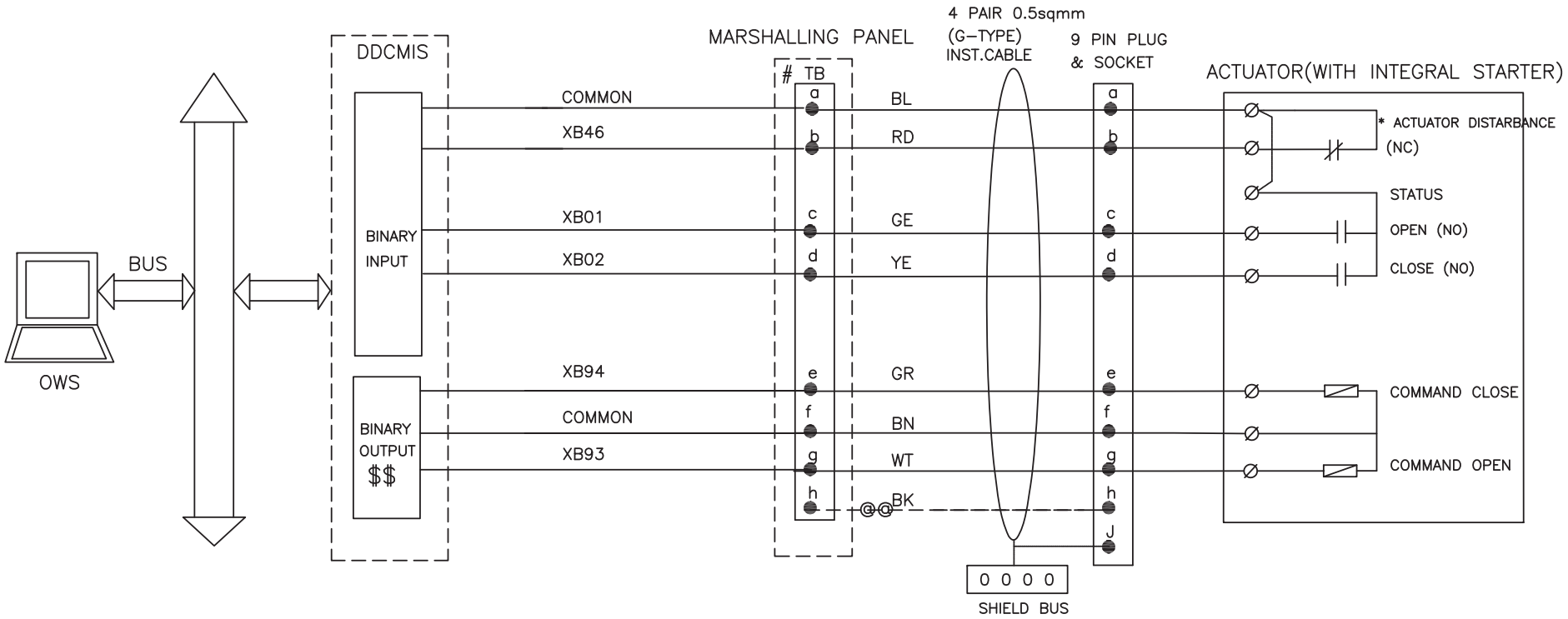
DDCMIS INTERFACE WITH HT SWITCH GEAR (HT)



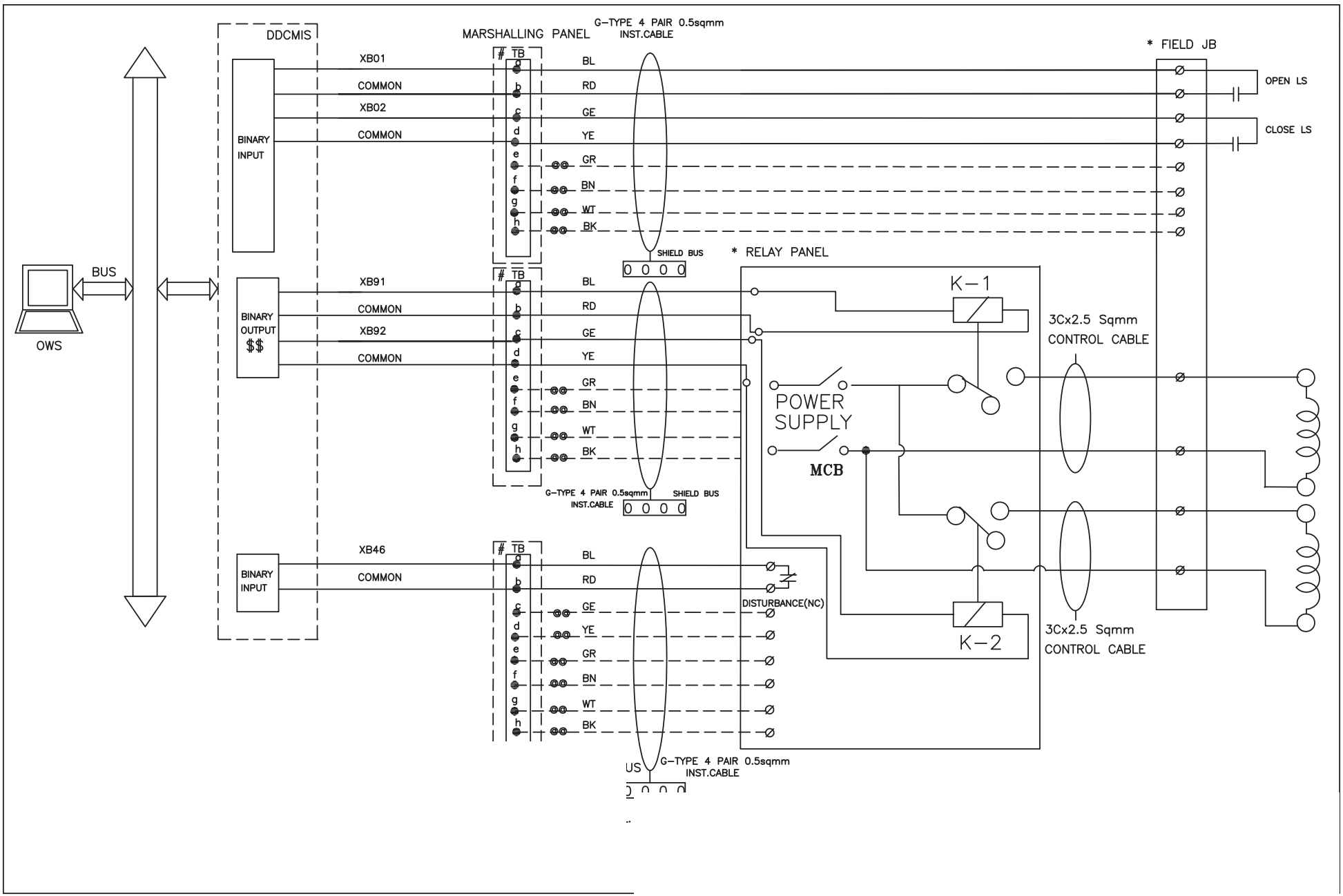
DDCMIS INTERFACE WITH LT MCC (LT)



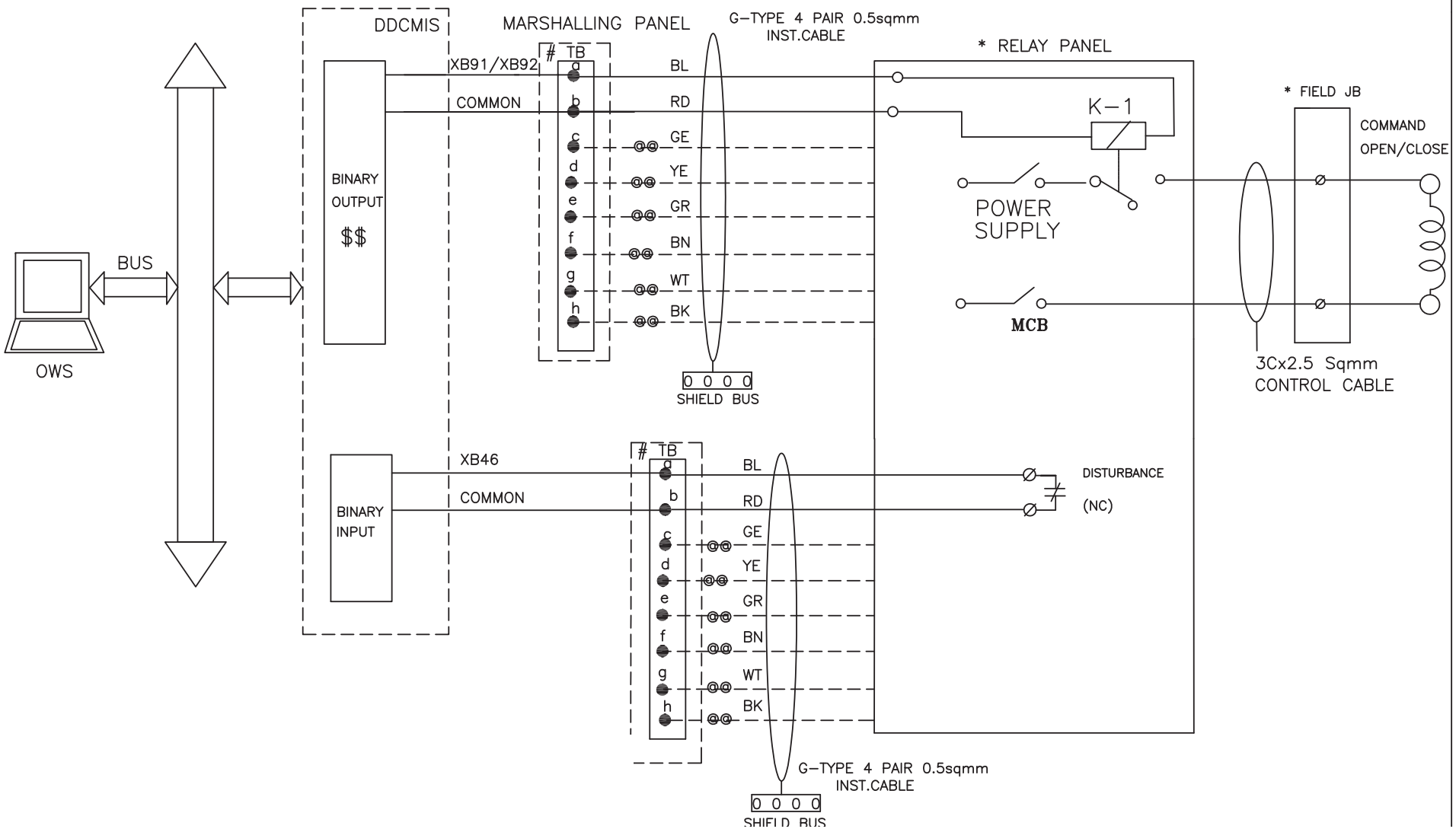
DDCMIS INTERFACE WITH BID



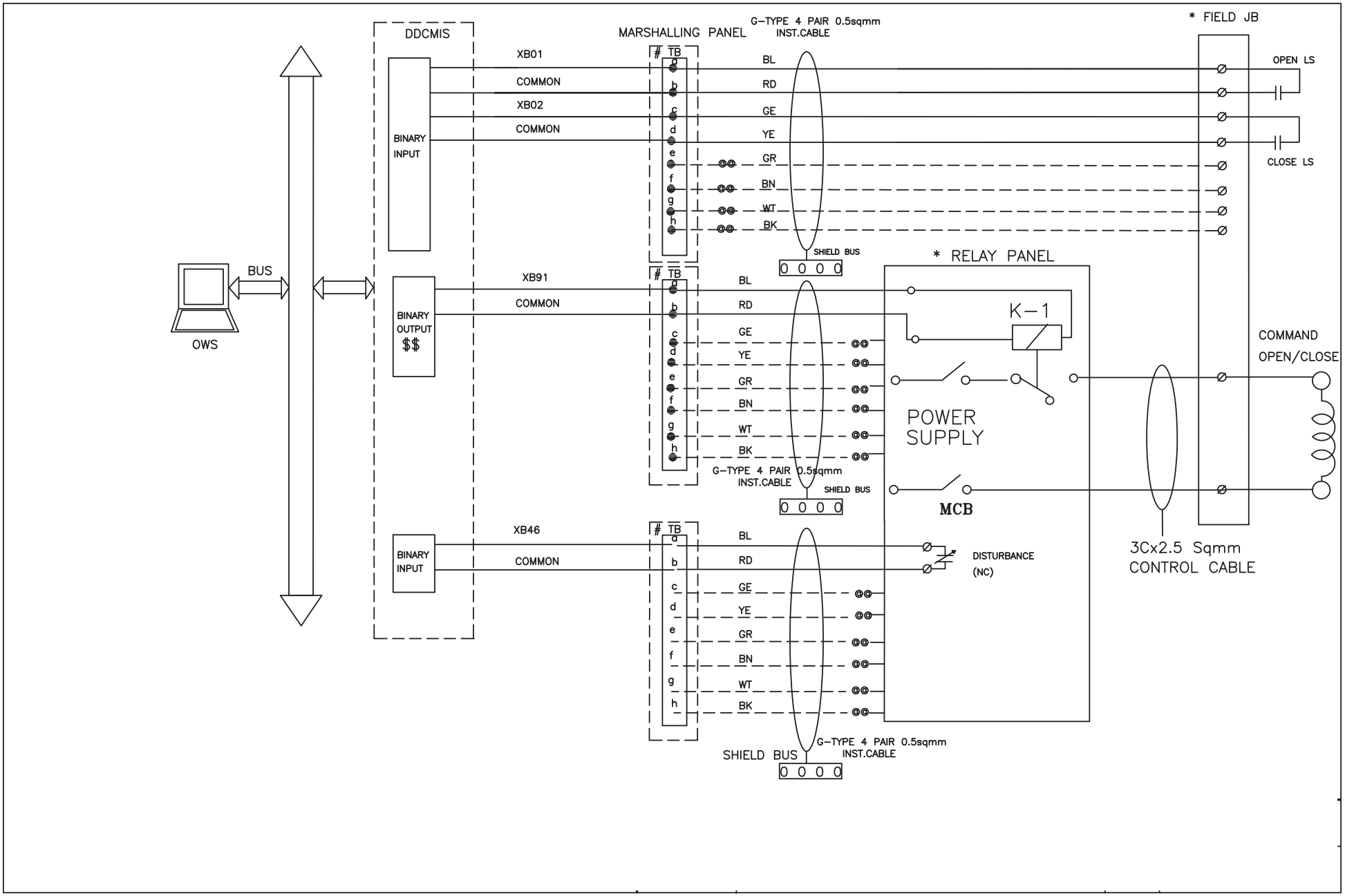
DDCMIS INTERFACE WITH DUAL COIL SOLENOID (DSOV/L)



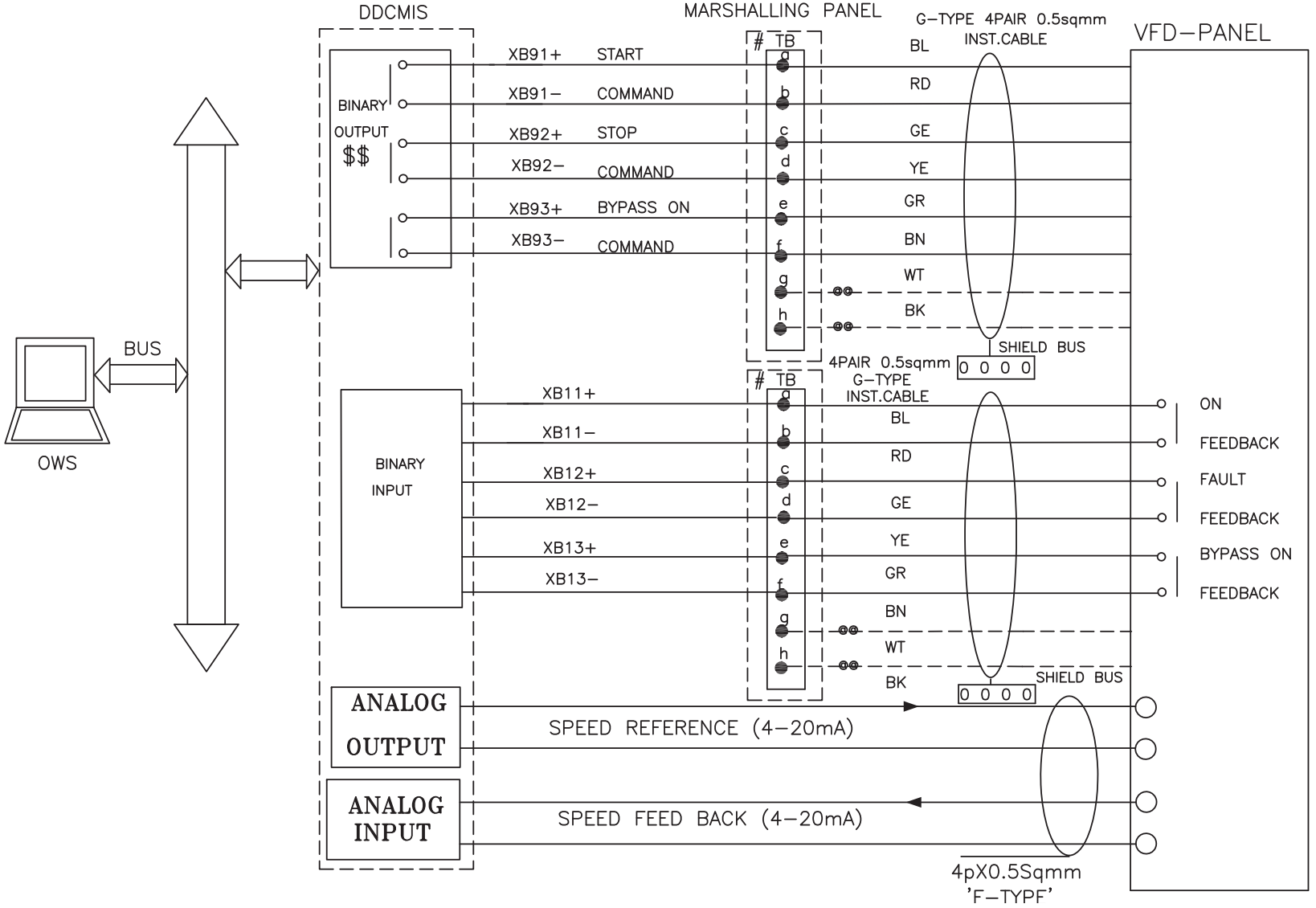
DDCMIS INTERFACE WITH SOV/O/SOV/C(WITH OUT FEEDBACKS)



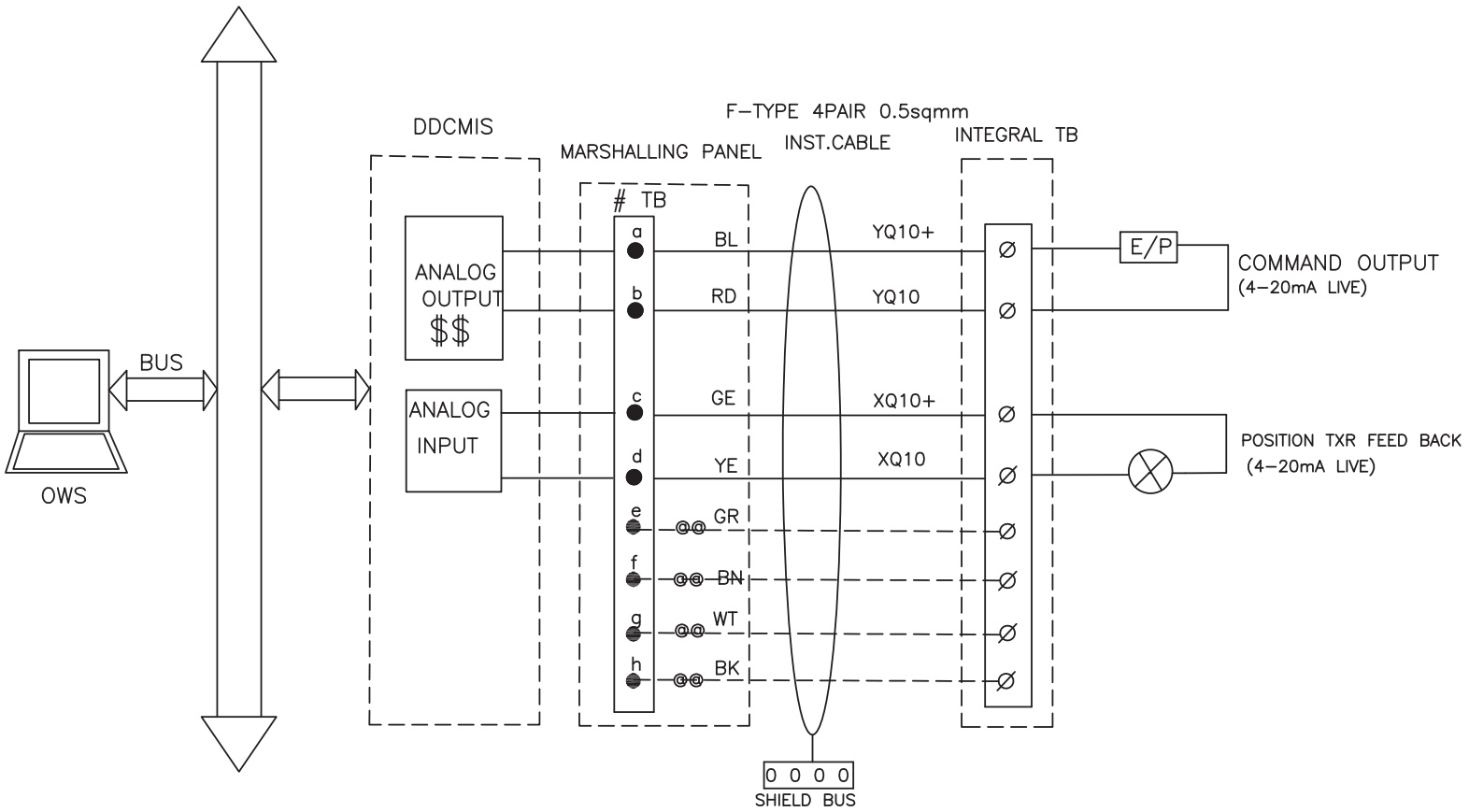
DDCMIS INTERFACE WITH SOV/O/L(WITH FEED BACKS)



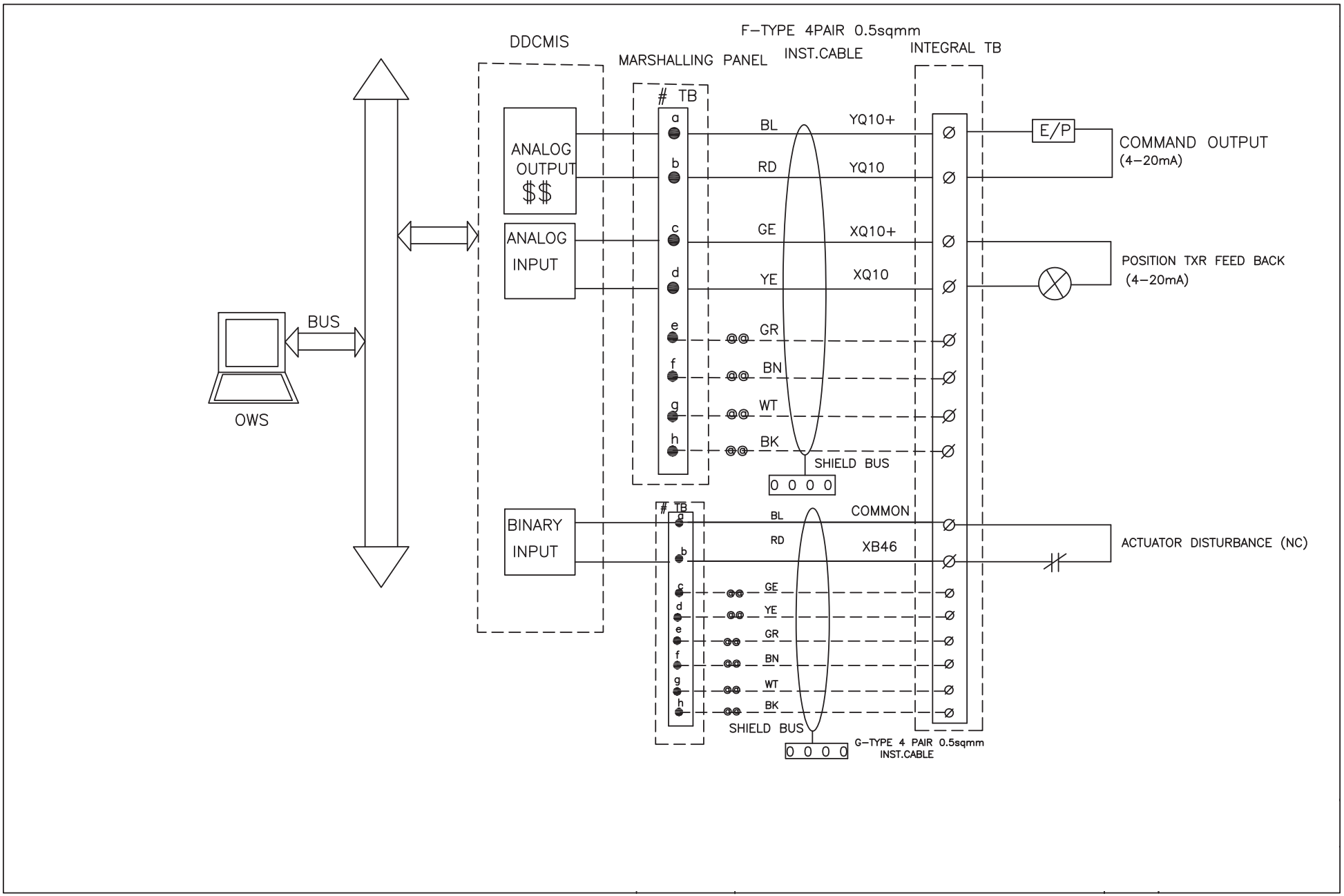
DDCMIS INTERFACE WITH VFD



INTERFACE FOR MODULATING DRIVES – CLCS



INTERFACE FOR MODULATING DRIVES – CLCS–M



SUB-SECTION-III-C3

PROCESS CONNECTION AND PIPING

1.00.00 **PROCESS CONNECTION PIPING**

1.01.00 The Contractor shall provide, install and test all required material for completeness of Impulse Piping System and Air Piping System as per the requirements of this Sub-Section on as required basis for the connection of all instruments and control equipments of entire plant.

1.01.01 **IMPULSE PIPING, TUBING, FITTINGS, VALVES AND VALVE MANIFOLDS**

1.01.02 All impulse pipes shall be of seamless type conforming to ANSI B36.10 for schedule numbers. The size of impulse pipe shall be ½" for Steam & Water Application and ¾" for Air & Flue Gas applications. The rating of material of impulse pipes, tubes, fittings, valves and their installation thereof shall conform to the latest edition of standards as per following table:

Impulse Pipes, Tubes (Material, Rating)	ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70
Valves (Material, Pr. Class, Size)	ASTM A182/ASTM A105 as per ASME 16.34
Fittings (Size, Rating, Material)	ANSI B31.1, ANSI B31.1a, ASME B16.11-2009
Installation Schemes	BS 6739-2009, ANSI/ISA 77.70

Stainless steel tube shall be provided inside enclosures & racks from tee connection to valve manifold and then to instrument. The source shut-off (primary process root valve) and blow down valve shall be of 1/2 inch size globe valve type for all applications except for air and flue gas service wherein no source shut-off valves are to be provided. Two root valves are to be used wherever pressure is more than 40 Kg/cm^2 or Temp>280 ^oC. The end connections of valves shall be of socket welded type. Typical installation scheme of DP Transmitter (inside LIE/LIR) mounted below instrument source point is indicated in Drg. No. 0000-999-POI-A-036. Same scheme with necessary changes shall be applied for other instruments.

1.01.03 The valve manifolds of 316 SS with pressure rating suitable for intended application shall be provided as given below:

Manifold	Application/Measurement
2 Valve	Pressure measurements using pressure transmitters/pressure switches
3 Valve	Pressure measurements using differential pressure transmitter/ switches
5 Valve	Differential Pressure, Flow and Level Measurements

For Pr./D.P gauges, two-way globe/gate valve shall be provided on each impulse line to the instrument in Fluid/Air & Flue Gas applications respectively .

2.00.00 **AIR SUPPLY PIPING**

2.01.01 All pneumatic piping, fittings, valves, air filter cum regulator, purge rotameter and other accessories required for instrument air for the various pneumatic devices/ instruments shall be provided. This will include as a minimum air supply to pneumatically operated control valves, actuators, instruments, continuous and intermittent purging requirements etc.

2.02.00 Instrument air and Service air supply shall be provided for continuous and intermittent purging respectively for all transmitters of mill, dirty air and flue gas applications. Purging Scheme shall be as per Drg. No. 0000-999-POI-A-036.

2.03.00 The Contractor shall also provide SS Tubing and associated fittings (screwed type) of suitable sizes for all pneumatic equipments/actuators (including supply air, signal air and output to actuators) conforming to ANSI 31.1 and 31.3 standard. All other air supply lines shall be of mild steel hot dipped galvanized inside and outside as per IS-

1239, heavy duty with threaded ends. Fittings for air supply line shall be of forged carbon steel A234 Gr. WPB galvanized inside and outside, screwed as per ASA B2.1. Dimensions of fittings shall be as per ASA B16.11 of rating 3000 lbs. Air supply piping shall be adequately sloped to prevent accumulation of condensed water within the pipe. The air supply headers, sub-headers and branch pipes shall be supported properly by clamps or supports.

2.04.00 The instrument/service air supply to each equipment/devices requiring air supply shall be provided by a well designed air distribution scheme comprising of 2" GI Pipe Header feeding 1" GI Pipe sub-header feeding ½" pipe at each equipment/device. Instrument air filters cum regulator set with mounting accessories shall be provided for each pneumatic device requiring air supply except for Ash Handling System wherein it shall be provided on instrument air header at each location.

2.05.00 All the isolation valves in the air supply line shall be gate valves as per ASTM B62 inside screw rising stem, screwed female ends as per ASA B2.1. Valve bonnet shall be union type & trim material shall be stainless steel, body rating 150 pounds ASA. The valve sizes shall be ½ inch to 2 inch.

2.06.00 Instrument air filters cum regulator set with mounting accessories shall be provided for pneumatic device requiring air supply. The filter regulators shall be suitable for 10-kg/ sq.cm max. Inlet pressure. The filter shall be of size 5 microns and of material sintered bronze. The air set shall have 2-inch size pressure gauge and built in filter housing blowdown valve. The end connection shall be as per the requirement to be finalized during detailed engineering.

3.00.00 INSTALLATION AND ROUTING

3.01.01 All instrument piping, tubing and its accessories shall be supported in a safe manner to prevent excessive vibrations and anchored sufficiently to prevent undue strain on connected equipment. Impulse piping shall be supported at an interval not exceeding 1.5 meters. The slope of the impulse pipe form the process connection to the instrument shall be as per ANSI/ISA 77.70 latest edition and BS 6739-2009. All impulse piping shall be installed to permit free movement due to thermal expansion. Wherever required expansion loops shall be provided.

Condensate pots shall be provided for all level measurements in steam and water services, all flow measurement in steam services and for flow measurements in water services above 120 Deg. C. Colour coding of all impulse pipes shall be done by the Contractor in line with the colour coding being followed for the parent pipes.

4.00.00 SHOP AND SITE TESTS

4.01.01 The equipment and work performed as per this Sub-section shall be subject to shop and site test as per requirements of Sub-section-IIIE-04 (Quality Assurance & Inspection) other applicable clauses of this Sub-section and Employer approved quality assurance plan.

4.01.02 Hydrostatic and Pneumatic leakage tests shall be performed on all pipes, tubing and systems and shall conform to ANSI B31.1.

5.00.00 LOCAL INSTRUMENT ENCLOSURE AND RACKS

All transmitters, switches etc. for FGD system and other system being provided under the contract shall be suitably grouped together and mounted inside (i) local instruments enclosures in case of open areas of the plant and (ii) In local instrument racks in case of covered areas. The GA of LIE with purging indicated in the Drg. No. 0000-999-POI-A-036 is to be followed by contractor. The GA of LIR shall be similar to LIE except for front/rear doors and side panels.
The internal layout shall be such that the impulse piping/ blow down lines are accessible from back side of the enclosure / rack and the transmitters etc. are accessible from front

side for easy maintenance. Bulkheads, especially designed to provide isolation from process line vibration shall be installed on instrument enclosures/racks to meet the process sensing line connection requirement. Vibration dampeners shall be installed for each enclosure / rack. The Degree of Protection of LIE and JB of LIE/LIR shall be IP-55.

The enclosures shall be constructed of 3 mm sheet plate and shall be of modular construction with one or more modules and two end assemblies bolted together to form an enclosure. Double inter locking doors shall be provided. The doors shall be the three-point locking type constructed of not less than 1.6 mm thick steel. Doors shall have concealed quick removal type pinned hinges and locking handles. Door locks shall accept the same key.

The instrument racks shall be free standing type constructed of suitable 5 mm thick channel frame of steel and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel, and extended beyond the ends of the rack.

Enclosures/Racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein. Centre posts or any member which would reduce access shall not be provided.

Contractor shall provide not more than three variants for LIE/LIR with respect to max. no. transmitters mounted in each LIE/LIR.

5.01.00 ENCLOSURE / RACKS FOR DUAL I/P TEMPERATURE TRANSMITTERS

All Dual Input temperature transmitters for FGD system and other system being provided under the contract shall be suitably grouped together and mounted inside (i) Enclosures in case of open areas of the plant and (ii) Racks in case of covered areas. Integral JB shall be provided with each Enclosure and Rack.

The internal layout shall be such that the transmitters are accessible from both front and back side of the enclosure / rack for easy maintenance.

Enclosure/ Racks shall be of robust and rugged design. Vibration dampeners shall be installed for each enclosure / rack. The Degree of Protection of Enclosure and JB shall be IP-55.

Enclosure and Racks shall be free standing type.

Enclosures/Racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein.

Contractor shall provide not more than five variants for Enclosure/ Rack with respect to max. no. transmitters mounted in each Enclosure/ Rack. However, the maximum number of Transmitters that can be grouped in one Enclosure/ Rack shall be decided during detail Engineering.

6.00.00 INSTALLATION OF OTHER INSTRUMENTS:

For installation and routing of other field mounted instruments which are not covered in Cl. No. 5.00.00, please refer Cl. No 52.04.00(J) of Section-VI, Part-D, Erection Conditions of Contract (ECC) of Technical Specifications.

7.00.00 For Sea Water Applications following to be provided

System/Line Description	Sea Water Applications
Piping Class	S
Impulse Pipe Material	ASTM-A 213 TP 316L
Schedule (Size)	80(1/2 inch)
Materials for Fitting/Valve Body	ASTM-A 182 316L

Valve Stem Material	-do-
Rating of Piping/ Fittings	3000lb
Pr. Class of Valve	800

TABLE A: CABLE TERMINATION TO BE FOLLOWED

Application		Type Of Termination		Type Of Cable
FROM (A)	**TO (B)**	**END A**	**END B**	
Valves/dampers drives (Integral Junction box)	Marshalling / Marshalling – cum Termination Cubicle / local group JB	Plug in connector	Post mount cage clamp type.	G
Transmitters, Process Actuated switches mounted in LIE/LIR	Integral Junction box of LIE/LIR	Plug in connector	Cage clamp (Rail mount) type.	F,G
RTD heads	Local junction box	Plug in connector	Cage clamp (Rail mount) type.	F
Thermocouple	Local junction box / CJC box (if applicable)	Plug in connector	Cage clamp (Rail mount) type.	A, B, C*
Other Field mounted Instrument	Local JB / Group JB	Plug in connector	Cage clamp (Rail mount) type.	F,G
RTD	Temperature transmitter	Plug in connector	Screwed, Cage clamp type	F
Thermocouple	Temperature transmitter	Plug in connector	Screwed, Cage clamp type	A, B, C*
Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/ MCC/SWGR	Group JB	Cage clamp (Rail mount) type.	Cage clamp (Rail mount) type.	F,G
Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/ Group JB / MCC/SWGR	Marshalling / Marshalling – cum Termination Cubicle	Cage clamp (Rail mount) type.	Cage clamp (Post mounted) type.	F,G
Marshalling cubicle/ Termination Cabinet	Electronic system cabinet	Cage clamp (Post mounted) type.	Plug-in connector / other system as per Mfr.'s Standard	Internal wiring

Application		Type Of Termination		Type Of Cable
FROM (A)	TO (B)	END A	END B	
Marshalling/ Termination System Cabinets	UCD mounted equipments	Cage clamp (Post mounted) type.	Plug in connector / Cage clamp type (rail mounted).	F,G (with plug-in connect or at one end)
DDCMIS/PLC cabinets	PC, Printers etc.	Plug in connector	Plug in connector	Mfr.'s Standar d

Notes

1 Normally 10% spare cores shall be provided when the numbers of pairs of cables are more than four pairs, except for pre-fabricated cables which shall be as per manufacturer's standard.

2 For analog signals, individual pair shielding & overall shielding & for Binary signals, only overall shielding of instrumentation cables shall be provided.

3 * For high temperature applications only.

4 . For connection between field/JB and DDCMIS marshalling cabinet

Minimum 4 pair instrumentation cable shall be used.

5 All the spare cores of instrumentation cable have to be terminated in Marshalling cabinets/ DCS panel end.

6 Not used.

6.00.00 TERMINAL BLOCKS

6.01.00 All terminal blocks shall be rail mounted/post mounted, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 deg. C. The terminal blocks in field mounted junction boxes, temperature transmitters, instrument enclosures/racks, etc., shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room logic/termination/marshalling cubicles shall be suitable for post mounted cage clamp connection at the field input end. The exact type of terminal blocks to be provided by the Bidder and the technical details of the same including width etc. shall be subject to Employer's approval.

6.02.00 All the terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, partitions, small partitions, transparent covers, support brackets, distance sleeves, warning label, marking, etc.

6.03.00 The marking on terminal strips shall correspond to the terminal numbering on wiring diagrams. At least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures, termination/marshalling cabinets, etc. All terminal blocks shall be numbered for identification and grouped according to the function. Engraved labels shall be provided on the terminal blocks.

6.04.00	For terminating each process actuated switches, drive actuators, control valves, Thermocouple, RTD, etc. in Local Junction Boxes, etc, refer Drg no. 0000-999-POI-A-065.
6.05.00	The terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks and between terminal blocks and junction box walls.
7.00.00	**INTERNAL PANELS/ SYSTEM CABINETS WIRING**
7.01.00	Internal panel/cabinet wiring shall be of multi-stranded copper conductor with FRLS PVC insulation without shield and outer sheath meeting the requirements of VDE 0815.
7.02.00	All internal wires shall be provided with tag and identification nos. etched on tightly fitted ferules at both ends. All wires directly connected to trip devices shall be distinguished by one additional red colour ferrule.
7.03.00	All external connection shall be made with one wire per termination point. Wires shall not be tapped or spliced between terminal points.
7.04.00	All floor slots of desk/panels/cabinets used for cable entrance shall be provided with removable gasketed gland plates and sealing material. Split type grommets shall be used for prefabricated cables.
7.05.00	All the special tools as may be required for solder less connections shall be provided by Bidder.
7.06.00	Wire sizes to be utilised for internal wiring. (i) Current (4-20 mA), low voltage signals (48V); Ammeter/Voltmeter circuit, control switches etc. for electrical system. — 0.5 Sq.mm. (ii) Power supply and internal illumination. — 2.5Sq.mm. minimum (shall be as per load requirement.)
8.00.00	**INSTRUMENTATION CABLE INSTALLATION AND ROUTING**
8.01.00	All cables assigned to a particular duct/conduit shall be grouped and pulled in simultaneously using cable grips and suitable lubricants. Cables removed from one duct/conduit shall not be reused without approval of Employer.
8.02.00	Cables shall be segregated as per IEEE Std.-422. In vertically stacked trays, the higher voltage cable shall be in higher position and instrumentation cable shall be in bottom tier of the tray stack. The distance between instrumentation cables and those of other system shall be as follows: From 11 kV/6.6 kV/3.3 kV tray system - 914 mm From 415V tray system - 610 mm From control cable tray system - 305 mm
8.03.00	Cables shall terminate in the enclosure through cable glands. All cable glands shall be properly gasketed. Sealing (to prevent ingress of dust entry and propagation of fire) shall be provided for all floor slots used for cable entrance. Compression cable glands (double for armoured and single for other cables) shall be provided.

8.04.00 Not in use

8.05.00 The cables emanating from redundant equipment/devices shall be routed through different paths. The above segregation of cables & wiring for redundant equipments/devices shall be in accordance with IEEE-Std-422.

9.00.00 CABLE LAYING AND ACCESSORIES

9.01.00 CABLE LAYING

1 Cables shall be laid strictly in line with cable schedule.

2 Identification tags for cables.

Indelible tags to be provided at all terminations, on both sides of wall or floor crossing, on each conduit/duct/pipe entry/exit, and at every 20 m in cable trench/tray.

3 Cable tray numbering and marking.

To be provided at every 10m and at each end of cable way & branch connection.

4 No jointing is permissible for Instrumentation cables. For other cables Jointing for more than 250 Meters run of cable shall be permitted.

5 Buried cable protection

With concrete slabs; Route markers at every 20 Meters along the route & at every bend.

6 Road Crossings

Cables to pass through buried high density PE pipes encased in PCC. At least 300 mm clearance shall be provided between

- HT power & LT power cables,
- LT power & LT control/instrumentation cables,

Spacing between cables of same voltage grade shall be in accordance with the derating criteria adopted for cable sizing.

7 Segregation (physical isolation to prevent fire jumping)

a All cable associated with the unit shall be segregated from cables of other Units.

b Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire.

8 Cable clamping

All cables laid on trays shall be neatly dressed up & suitably clamped/tied to the tray. For cables in trefoil formation, trefoil clamps shall be provided.

9 Optical fiber cables (OFCs) :

Outside Building Area - to be laid necessarily inside GI conduit with support from cable tray/Trestle structure

Inside Building Area – to be laid on separate cable sub-trays

While buried- in separate burried trench approx.1.0 meter depth, to be laid in 2" rodent proof HDPE conduits covered with sand, brick, laid breadth-wise and soil along the pipe line route by contractor;

While crossing roads - to be laid in GI/ rodent proof HDPE conduits with sand filling at bottom and sand, soil filling at top with cement concrete;

While crossing canals/river- to be laid in rodent proof HDPE conduits within hume pipe.

10 **Laying of Network Cable (UTP/STP) :**

Out side Building Area- to be laid necessarily inside GI conduits with support from cable tray / Trestle structure.

Inside Building Area- to be laid necessarily inside GI conduits on separate cable sub-trays.

9.02.00 Bidder shall supply and install all cable accessories and fittings like Light Interface Units, Surge suppressors, Opto isolators, Interface Converters, Fibre Optic Card Cage, Fibre Optic Line Driver, Repeater / Modem (for Optical Fibre Cables), cable glands, grommets, lugs, termination kits etc. on as required basis.

9.03.00 Cables, which terminate in cabinets of draw out sections shall have sufficient cable coiled in the bottom of the cabinet to permit full withdrawal of draw out sections without disconnecting the cables. When prefabricated cables with factory connectors on both ends are longer than required, the excess cable shall be coiled in the bottom of one or both termination cabinets.

9.04.00 The Bidder shall be responsible for proper grounding of all equipment under this package. Further, proper termination of cable shields shall be verified and the grounding of the same shall be coordinated so as to achieve grounding of all instrumentation cable shields at same potential. This shall be completed prior to system tests.

9.05.00 The Contractor shall take full care while laying / installing cables as recommended by cable manufacturers regarding pulling tensions and cable bends. Cables damaged in any way during installation shall be replaced at the expense of the Contractor.

10.00.00 FIELD MOUNTED LOCAL JUNCTION BOXES

(i)	No. of ways	12/24/36/48/64/72/96/128 with 20% spares terminals.
(ii)	Material and Thickness	4mm thick Fiberglass Reinforced Polyester (FRP).
(iii)	Type	Screwed at all four corners for door. Door gasket shall be of synthetic rubber.
(iv)	Mounting clamps and accessories	Suitable for mounting on walls, columns, structures etc. The brackets, bolts, nuts, screws, glands required for erection shall

			be of SS, included in Bidders scope of supply.
	(v)	Type of terminal blocks	Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm^2. A M6 earthing stud shall be provided.
	(vi)	Protection Class	IP: 55 minimum for indoor & IP-65 minimum for outdoor applications.
	(vii)	Grounding	To be provided.
	(viii)	Color	RAL 7035

11.00.00 CONDUITS

11.01.00 Conduits shall be generally used for interconnecting cables from field instruments to Local JB's. All rigid conduits, couplings and elbows shall be hot dipped galvanised rigid mild steel in accordance with IS: 9537 Part-I (1980) and Part-II (1981). The conduit interior and exterior surfaces shall have continuous zinc coating with an overcoat of transparent enamel lacker or zinc chromate. Flexible conduit shall be heat resistant **terne coated steel** with , water leak, fire and rust proof protected *for the areas of* Mills,Drum, Main Steam, RH steam Air Heaters and Furnace, BFPDT's .

And for remaining applications, water leak, fire and rust proof flexible GI conduits shall be provided. The temperature rating of flexible conduit shall be suitable for actual application.

11.02.00 All rigid conduit fittings shall conform to the requirements of IS: 2667, 1976. Galvanized steel fitting shall be used with steel conduit. All flexible conduit fittings shall be liquid tight, galvanized steel. The end fittings shall be compatible with the flexible conduit supplied.

11.03.00 Conduit sealing, explosion proof, dust proof and other types of special fittings shall be provided as required by these specifications and shall be consistent with the area and equipment with which they are installed. Fittings installed outdoors and in damp locations shall be sealed and gasketed. Hazardous area fittings and conduits sealing shall conform with NEC requirements for the area classification.

11.04.00 Contractor shall provide double locknuts on all conduit terminations not provided with threaded hubs and couplings. Water tight conduit unions and rain tight conduit hubs shall be utilised for all the application which shall be exposed to weather. Moisture pockets shall be eliminated from conduits.

11.05.00 Conduits shall be securely fastened to all boxes and cabinets.

12.00.00 CABLE SUB-TRAY & SUPPORT

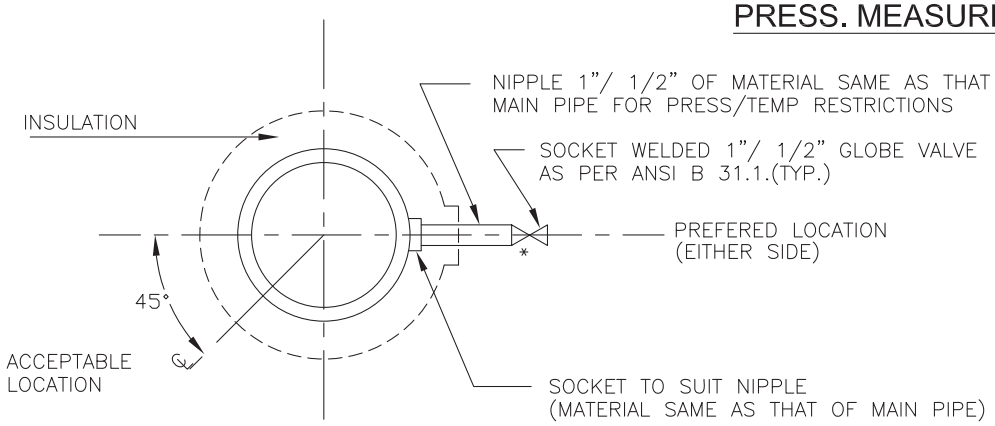
12.01.00 The cable sub-trays and the supporting system, to be generally used between Local/Group JBs and the main cable trays and the same shall be furnished and installed by the Contractor. It is the assembly of sections and associated fittings forming a rigid structural system used to support the cable from the equipment or instrument enclosure upto the main cable trays (trunk route).

12.02.00 The covers on the cable sub-trays shall be used for protection of cables in areas where damage may occur from falling objects, welding spark, corrosive environment, etc. & shall be electrically continuous and solidly grounded.

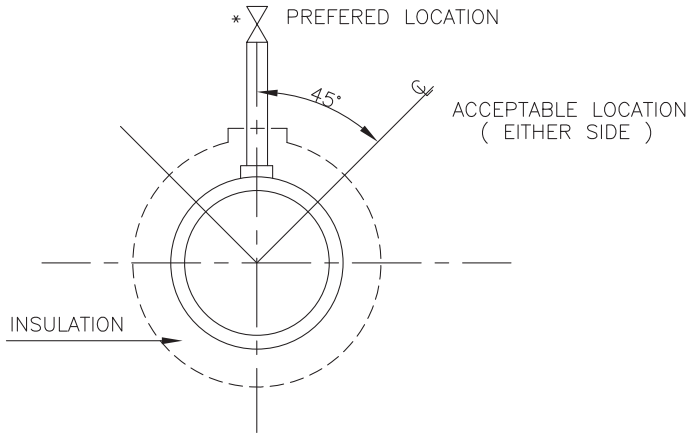
INSTRUMENT STUB DETAILS

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PRESS. MEASUREMENT

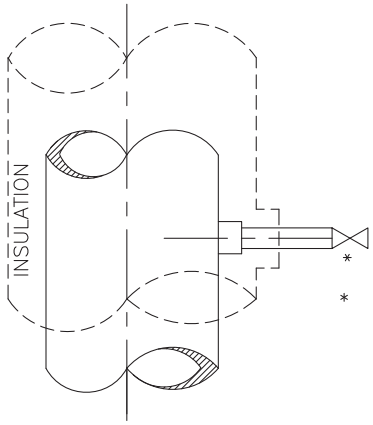


ELEVATION
LIQUID SERVICE



ELEVATION
STEAM SERVICE

PRESSURE CONNECTION ON HORIZONTAL PIPE



* USE DOUBLE ISOLATION VALVES FOR PRESSURE EQUAL TO OR EXCEEDING 40 Kg/Cm2.

ELEVATION
LIQUID OR STEAM SERVICE

PRESSURE CONNECTIONS ON VERTICAL PIPES

FOR TENDER PURPOSE ONLY

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N T P C LIMITED
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ENGINEERING DIVISION

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	T.G. C&I	ARCH.	APPD.	DATE
A	FIRST ISSUE										21.08.12

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PROJECT: TYPICALTHERMAL POWER PROJECT

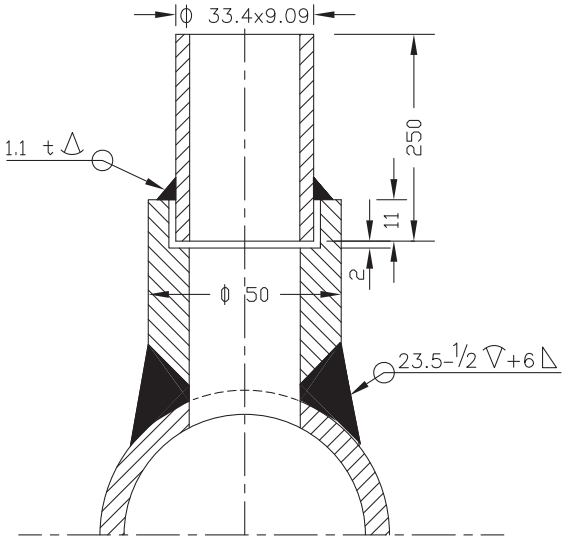
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SIZE	SCALE	DRG. NO.	REV. NO.
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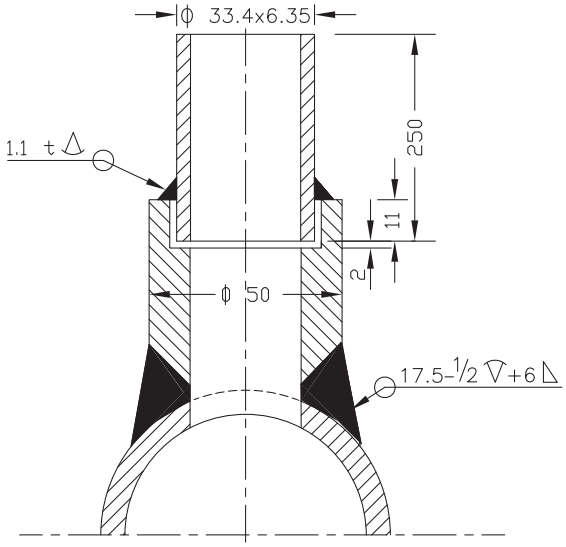
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PRESSURE MEASUREMENT

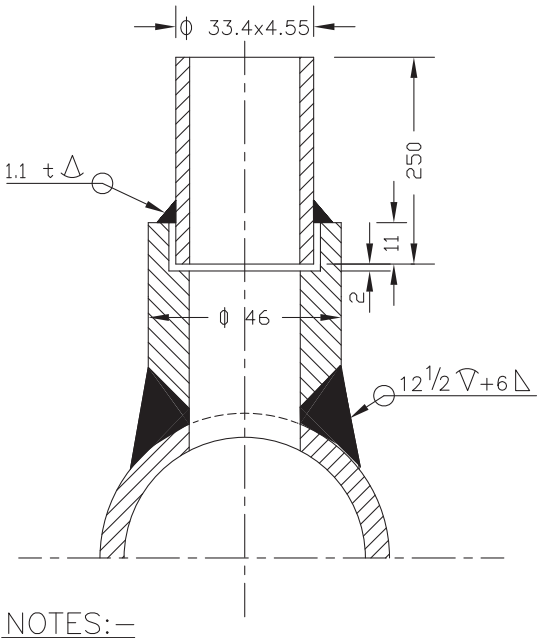
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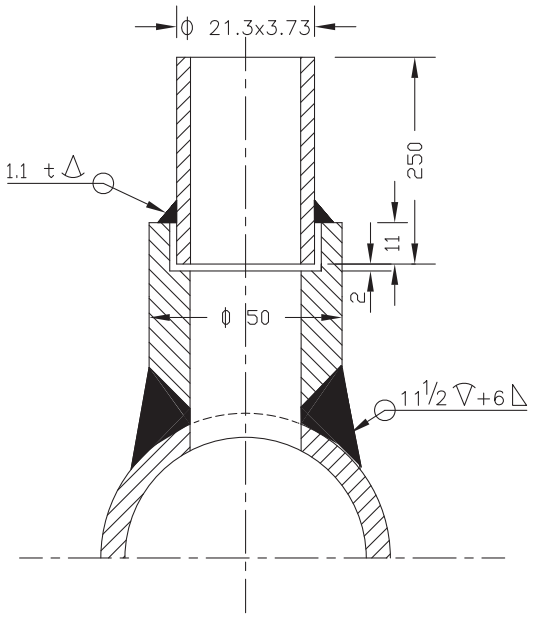
(SYSTEM PR.>40Kg/Sq Cm CL 6000)



(SYSTEM PR. <40Kg/Sq cm Nb 25 CL 3000)



(SYSTEM PR. <40Kg/Sq cm Nb 15 CL 3000)



NOTES:–

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFIRM TO ANSI B 16.11.
2. THE LENGTH OF THE NIPPLE SHOULD BE 250mm.
3. THE OTHER END OF THE NIPPLE SHALL BE SOCKET WELDED WITH 1" GLOBE VALVE OF MATERIAL AS PER ANSI B 16.1.
4. TWO ISOLATED VALVES ARE TO BE USED FOR PRESSURE = >40 Kg/Cm2.
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES.
6. ORIENTATION OF TAP WILL BE VARY WITH TYPE OF PROCESS FLUID AND NATURE OF RUN OF THE PIPE.
7. ACTIVITIES TO BE COMPLETED AT THE SHOP, WELD THE COUPLING (OR BOSS) ON THE PIPE AND DRILL PRESSURE CONNECTION HOLE (SAME AS I D OF NIPPLE) IN THE PIPE IN ALLIGNMENT WITH HOLE IN THE COUPLING.
8. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.

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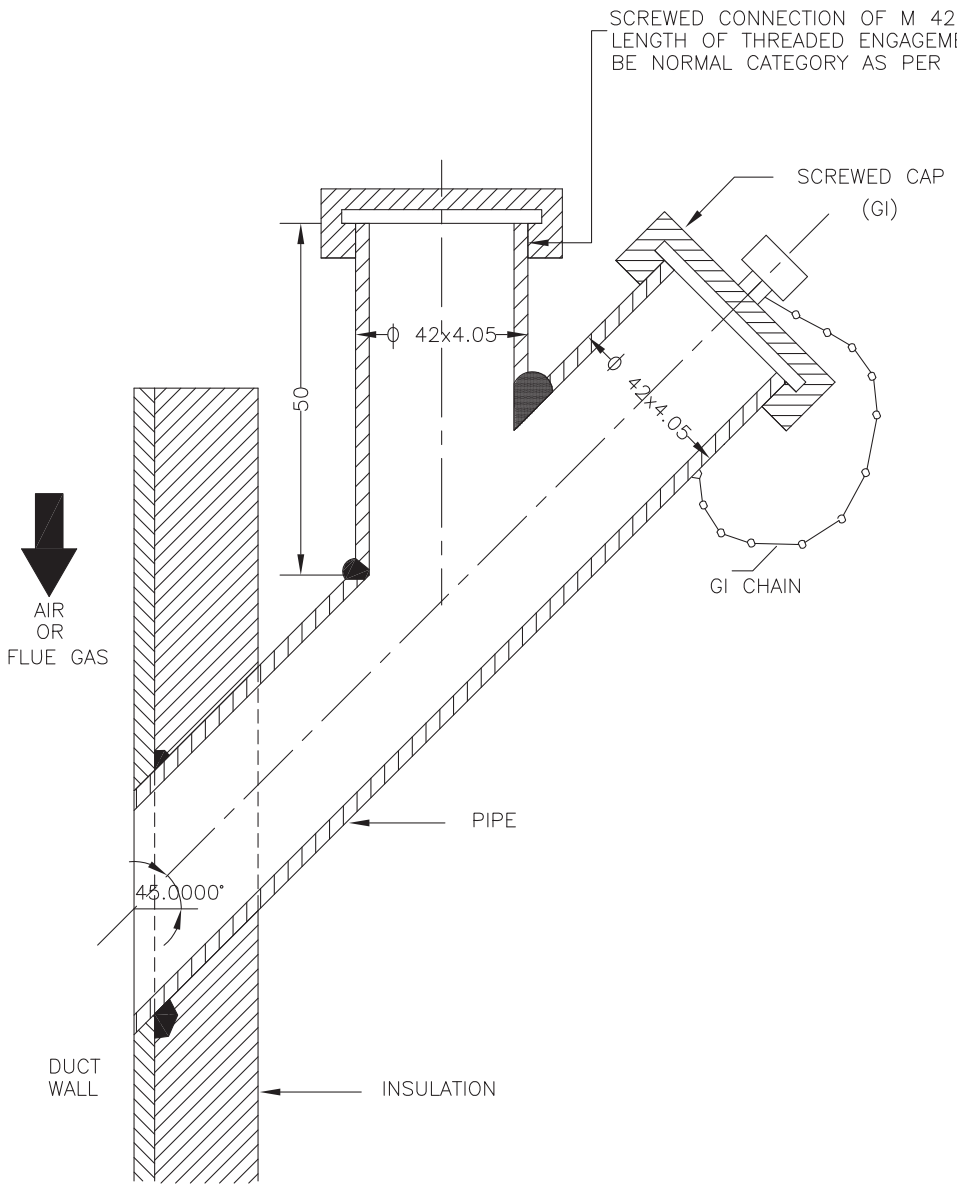
PROJECT: TYPICALTHERMAL POWER PROJECT

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
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PRESS. MEASUREMENT



NOTES:–

1. THIS TYPE OF PRESSURE CONNECTON SHALL BE PROVIDED FOR PRESSURE MEASUREMENTS IN AIR AND FLUE GAS DUCT/FURNACE.
2. DIMENSIONS ARE INDICATIVE ONLY.

FOR TENDER PURPOSE ONLY

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	T.G. C&I	ARCH.	APPD.	DATE
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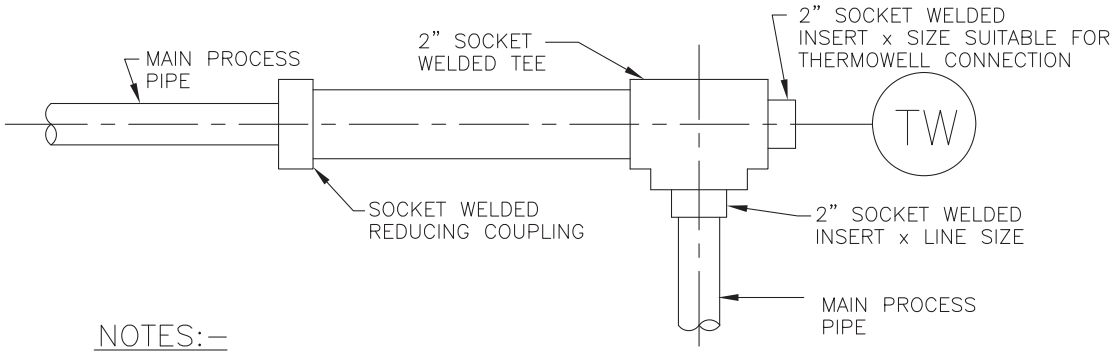
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PROJECT: TYPICALTHERMAL POWER PROJECT

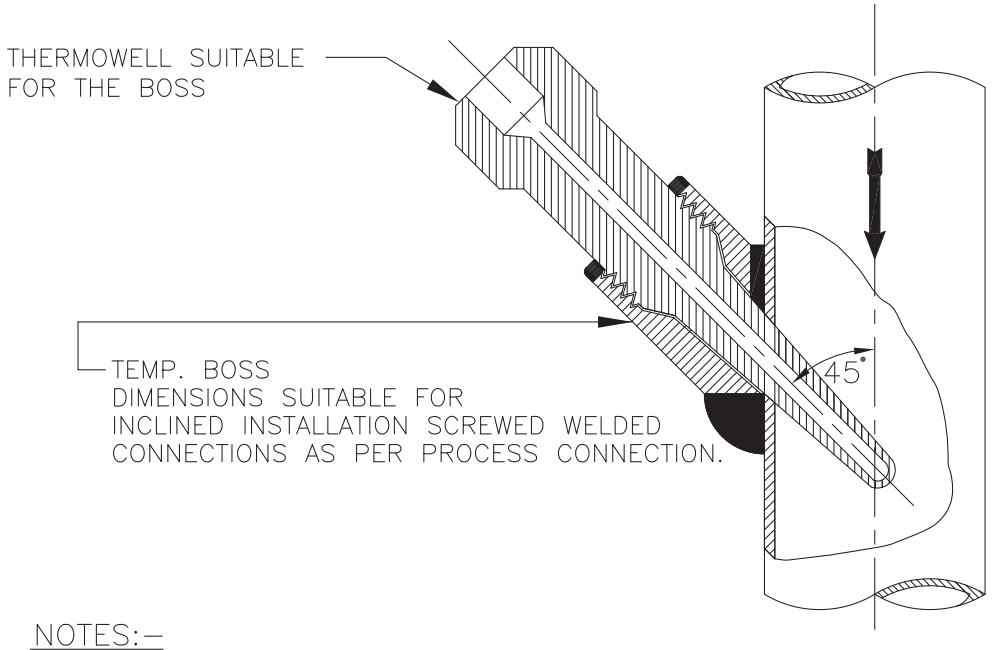
TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
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NOTES:–

1. THIS TYPE OF THERMOWELL INSTALLATION IS SUITABLE FOR THE PROCESS PIPE OF 2" NPS AND SMALLER.
2. FOR STEAM SERVICE THIS TYPE OF THERMOWELL INSTALLATION 90° BEND MAY BE USED ONLY IN VERTICAL PLANE.
3. THE LENGTH OF THE LARGER PIPE SECTION SHALL BE MINIMUM 150mm (IT MUST BE GREATER THAN THERMOWELL LENGTH).



NOTES:–

1. INCLINED INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MIN. 3" LINE SIZE.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF MIN. 3" SIZE OF MAIN PIPING SPECIFICATION SHALL BE USED.
3. THIS TYPE OF INSTALLATION IS APPLICABLE FOR HORIZONTAL AND VERTICAL PIPE SECTION.
4. FOR STEAM SERVICES EXPANDER SECTION MAY BE USED ONLY IN VERTICAL RUN.
5. THE EXPANDER SECTION SHALL BE OF ADEQUATE LENGTH (ATLEAST 3–4 TIMES DIA OF THE MAIN PROCESS PIPE AT BOTH SIDE OF THE INSTALLED THERMOWELL).

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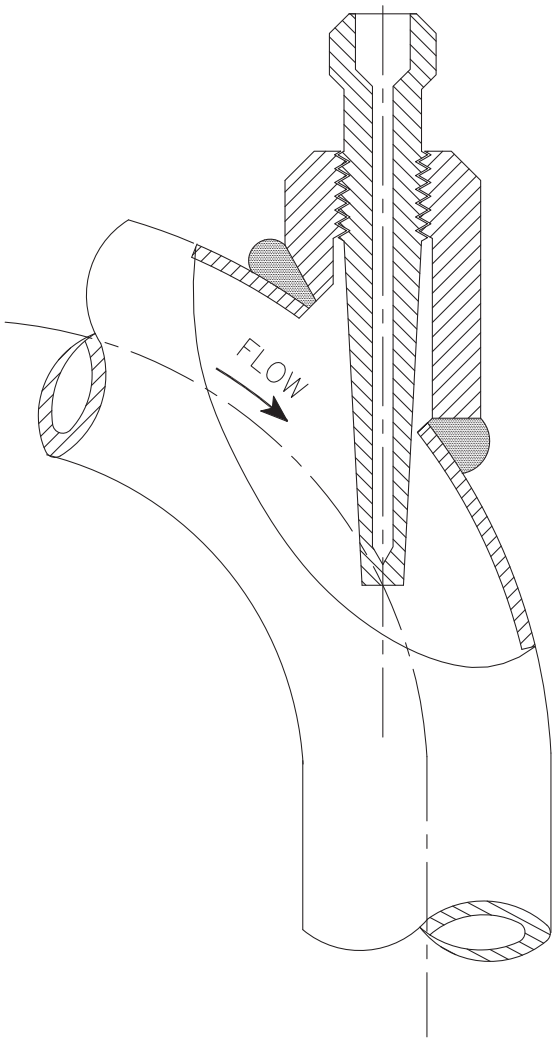
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TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

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TEMP. MEASUREMENT



NOTES:–

1. FLOW INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MINIMUM 3" LINE SIZE.

2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF ELBOW FORM (AS SHOWN) OF MINIMUM 3" SIZE SHALL BE USED.

3. ELBOW EXPANDER SECTION IN HORIZONTAL PLANE MAY BE USED FOR LIQUID SERVICES. ONLY STEAM SERVICES EXPANDER SECTION MAY BE USED IN VERTICAL PLAN.

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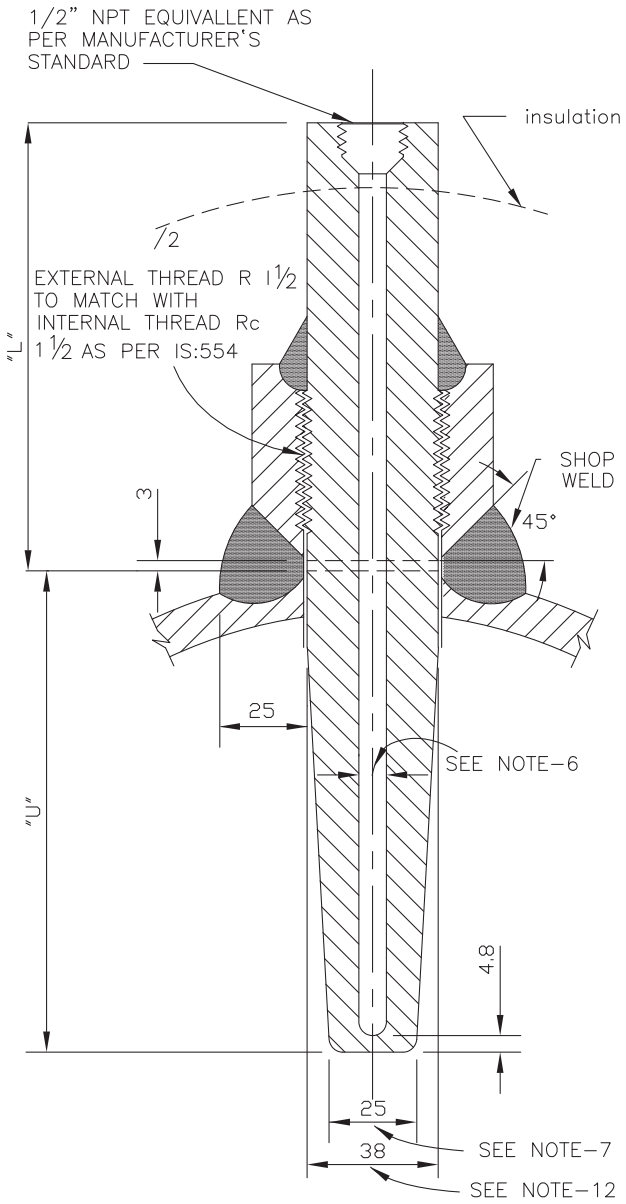
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PROJECT: TYPICALTHERMAL POWER PROJECT

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

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NOTES:-

1. THIS TYPE OF TEMPERATURE BOSS SHALL BE USED FOR THE PROCESS PRESS EQUAL/ABOVE 40 Kg/Cm2(g).
2. THE MATERIAL OF THE BOSS SHOULD BE SIMILAR TO THAT OF PIPING MATERIAL OF SPECIFICATION.
3. ALL WELD TO BE TESTED IN ACCORDANCE WITH APPLICABLE CODES BY MANUFACTURER.
4. MATERIAL OF THE THERMOWELL SHALL BE OF 316SS.
5. THERMOWELL SHALL BE DRILLED BARSTOCK TYPE.
6. INTERNAL BORE OF THE THERMOWELL SHOULD BE SELECTED BASED ON THE NORMAL SIZE OF THE SENSING ELEMENT AS PER ASME,PTC-19.3.
7. THE BOTTOM DIAMETER OF THE THERMOWELL TYPICALLY SHOWN HERE SHALL BE SUBJECT TO VARIATION BASED ON THE INTERNAL BORE OF THERMOWELL AND THICKNESS OF THERMOWELL MATERIAL TO WITHSTAND THE PROCESS PRESS.AND TEMP.,AS PER ASME,PTC-19.3.
8. THE TYPE OF TAPERED THERMOWELL SHALL BE USED FOR LIQUID VELO-CITIES UP TO 92M.P.S.(300F.T.P.S.).
9. THERMOWELL WITH THE INSULATION LAG EXTENSIONS SHALL BE USED WHEREVER APPLICABLE.
10. ACTIVITIES TO BE COMPLETED AT THE SHOP. WELD THE BOSS ON THE PIPE AND DRILL THE HOLE IN THE PIPE IN ALLIGNMENT WITH HOLE IN THE BOSS. PROVIDE INTERNAL THREAD AS PER IS:554 TO MATCH WITH THE THERMO-WELL EXTERNAL THREAD.
11. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
12. WIILL BE SUITABLE TO MATCH THE STUB DIMENSIONS AS PER RC 1 1/2
13. THE "U" & "L" DIMENSIONS SHALL BE BE SELECTED BASED ON PARTICULAR APPLICATION AND THE SAME SHALL BE SUBJECT TO OWNER'S APPROVAL DURING DETAILED ENGINEERING.
14. ALL DIMENSIONS ARE INDICATIVE ONLY.

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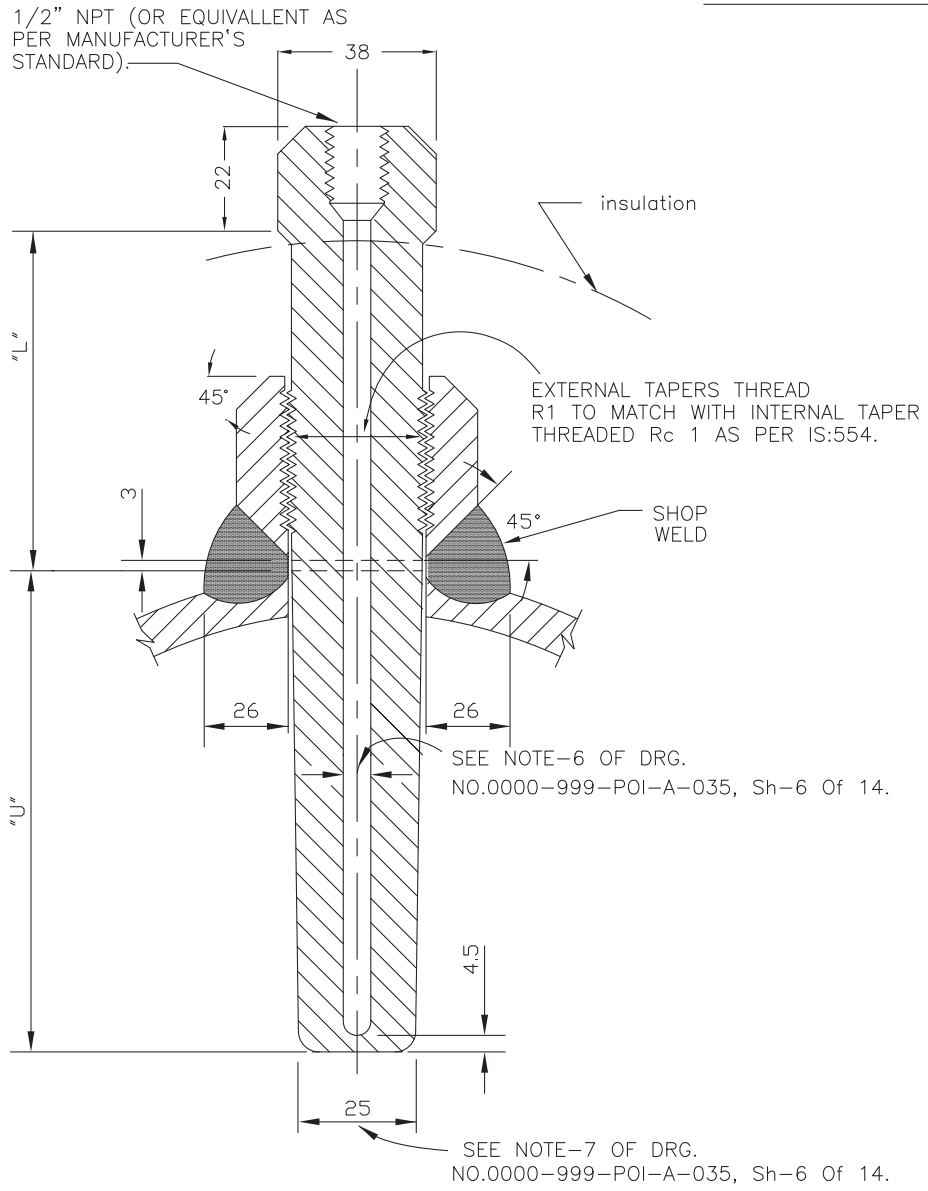
PROJECT: TYPICALTHERMAL POWER PROJECT

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TEMP. MEASUREMENT



NOTES:–

1. THIS TYPE OF TEMPERATURE BOSS IS APPLICABLE FOR THE PROCESS PRESSURE/TEMPERATURE BELOW 40 Kg/Cm2(g)/400°C
2. FOR PRESSURE TIGHT JOINTS THE BOSS SHOULD HAVE INTERNAL TAPERED PIPE THREAD Rc 1 AS PER IS:554. THE LENGTH OF THREAD ENGAGEMENT SHOULD BE AS PER ABOVE STANDARD.
3. PIPES HAVING PROBABILITY OF PROLONGED VIBRATION SEAL WELDING MAY BE DONE ALL AROUND AFTER TIGHTENING THERMOWELL WITHIN THE BOSS.
4. SEE NOTES–2 TO 14 OF DRG. NO. 0000–999–POI–A–035, Sh–6 Of 14.

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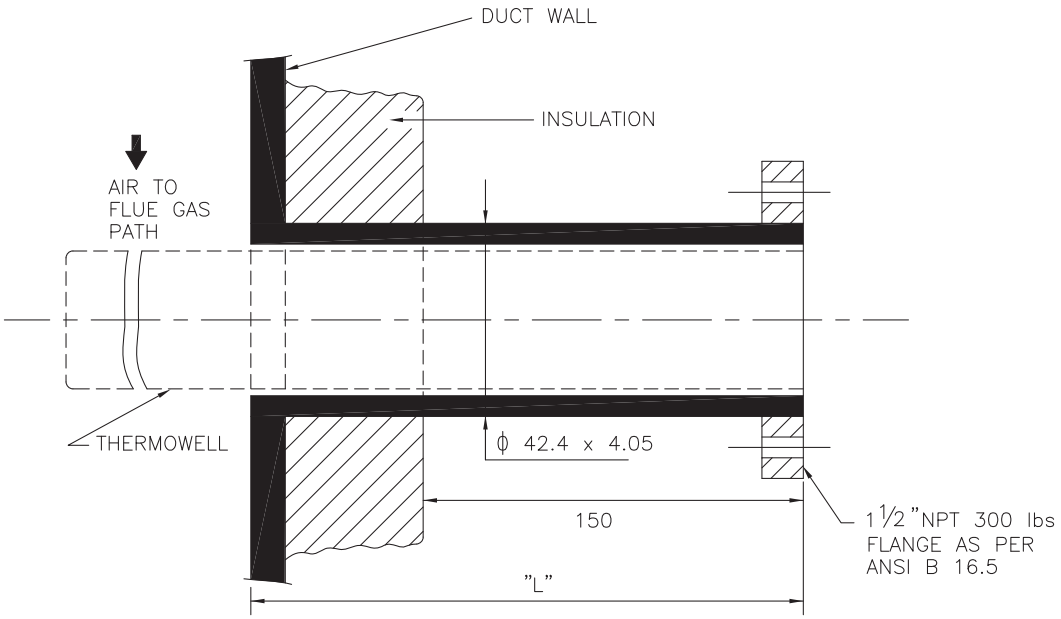
PROJECT: TYPICALTHERMAL POWER PROJECT

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TEMP. MEASUREMENT



NOTES:–

1. THIS TYPE OF TEMPERATURE CONNECTIONS SHALL BE PROVIDED FOR TEMPERATURE MEASUREMENT IN AIR AND FLUE GAS DUCT.
2. MATERIAL OF THERMOWELL SHALL BE OF 316SS.
3. EXTERNAL CONNECTION SHALL BE OF SLIP ON FLANGED TYPE AND THERMOWELL DESIGN SHALL BE AS PER ASME.PTC–19.3 (REFER NOTES 9&10 OF DRG.NO. 0000–999–POI–A–035, Sh–6 Of 14).
4. BIDDER TO SUPPLY AND INSTALL THE COUNTER FLANGED AND THERMOWELL (ALONG WITH TEMP. ELEMENT).
5. ALL DIMENSIONS ARE INDICATIVE ONLY.

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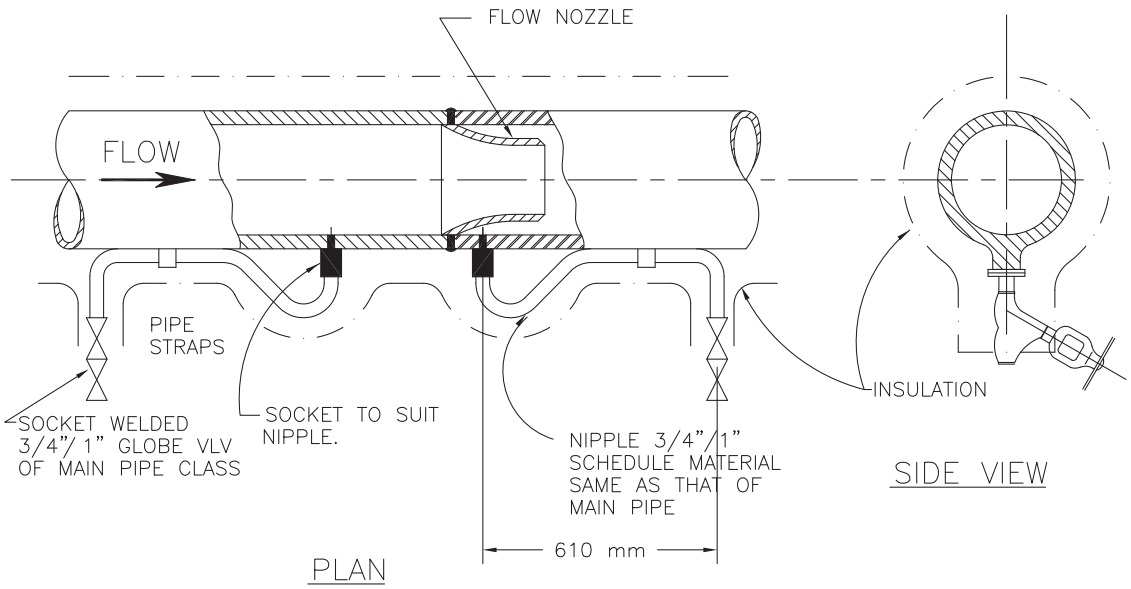
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NOTES:–

1. THIS METHOD OF CONNECTING NIPPLES AND VALVES ON THE HORIZONTAL PIPE IS APPLICABLE FOR MEASUREMENT OF STEAM AT TEMP. ABOVE 455°C .
2. FOR STEAM SERVICE IN HORIZONTAL PIPE THE PRESSURE HOLES AND CONNECTING NIPPLES SHOULD BE IN THE HORIZONTAL PLANE OF THE PIPE CENTRE LINE.
3. THE ENTIRE LENGTH OF THESE NIPPLES AS WELL AS SHUT OFF VALVES SHOULD BE LAGGED IN WITH STEAM LINE AS SHOWN IN THE DRAWING.
4. FLOW ELEMENTS SHALL BE PROVIDED WITH 3 PAIRS OF TAPPING POINTS.

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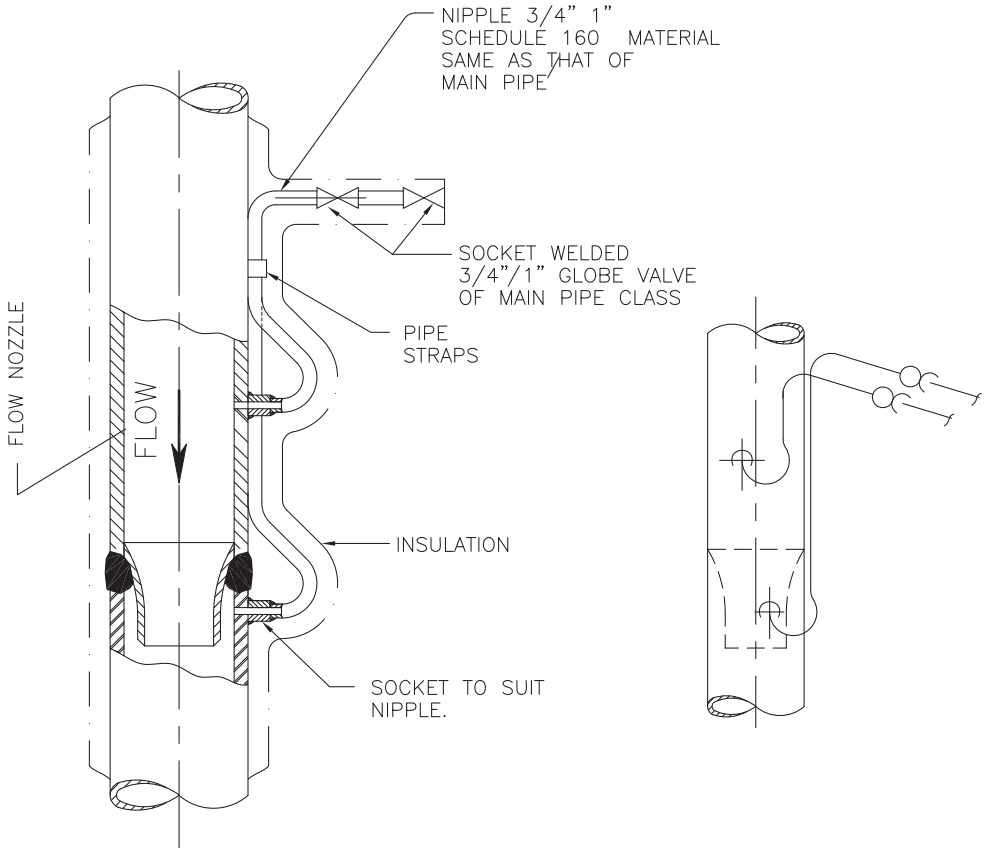
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FLOW MEASUREMENT



ELEVATION

NOTES:–

1. THIS METHOD OF CONNECTING NIPPLES AND VALVES ON THE VERTICAL STEAM PIPE IS APPLICABLE FOR MEASUREMENT OF STEAM AT TEMP. ABOVE 455°C
2. THE ENTIRE LENGTH OF THESE NIPPLES AS WELL AS SHUT OFF VALVES SHOULD BE LAGGED IN WITH STEAM LINE AS SHOWN IN THE DRAWING.
3. ON VERTICAL STEAM PIPE BOTH HIGH TEMPERATURE (SPECIAL VENTS) NIPPLES WILL BE LONG ENOUGH SO THAT HIGH AND LOW PRESSURE CONNECTION NIPPLES WILL BE AT SAME LEVEL.
4. UP STREAM AND DOWN STREAM PRESSURE CONNECTIONS MUST BE INSTALLED IN DIFFERENT PLANES PASSING THROUGH THE CENTRE OF THE PIPE.
5. FLOW ELEMENTS SHALL BE PROVIDED WITH 3 PAIRS OF TAPPING POINTS.

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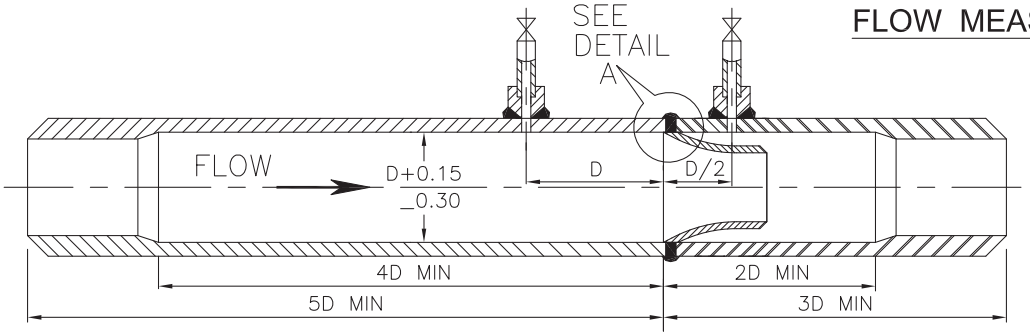
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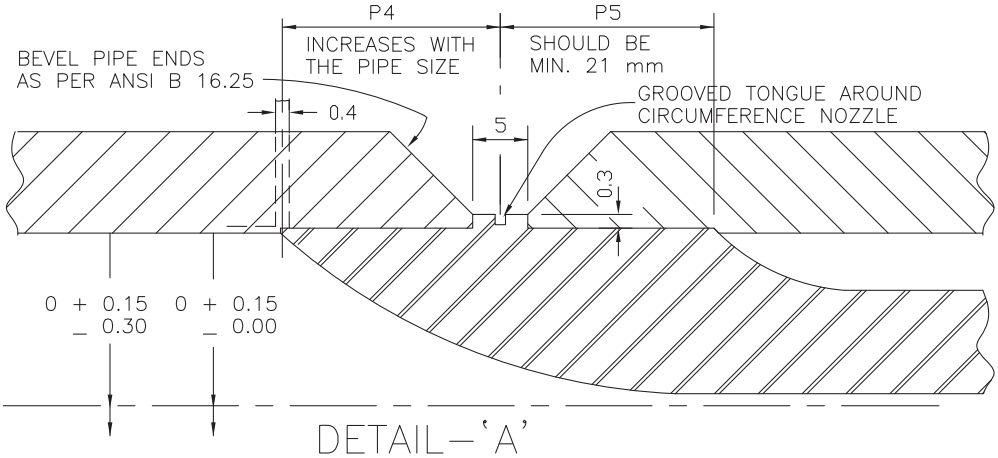
PROJECT: TYPICALTHERMAL POWER PROJECT

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FLOW MEASUREMENT





DETAIL – 'A'

NOTES:–

1. COMPLETE FLOW NOZZLE BRANCH ASSEMBLY ALONG WITH NIPPLES AND SOURCE ISOLATION VALVES SHALL BE SUPPLIED BY THE BIDDER. THE BIDDER ALSO TO INSTALL FLOW NOZZLE WITHIN THE MACHINED BRANCH, PRESSURE STUBS ON THE BRANCH PIPE (FOR ORIENTATION OF PRESSURE TAP REF. NOTE–3) ALONG WITH NIPPLE AND SOURCE ISOLATION VALVES.
2. THE MACHINING OF BRANCH PIPE SHOULD BE DONE AFTER PRESSURE CONNECTIONS HAVE BEEN WELDED TO PIPE AND ALSO EXTEND FOR ATLEAST 4D IN THE INLET SECTION, 2D IN THE OUTLET SECTION, MEASURED FROM THE INLET FACE OF FLOW NOZZLE. TOTAL BRANCH PIPE ASSEMBLY SHOULD BE ATLEAST A LENGTH OF 8D/5D IN THE INLET SECTION AND 3D IN THE OUTLET SECTION, MEASURED FROM THE INLET FACE OF THE FLOW NOZZLE AS SHOWN ABOVE.
3. ON HORIZONTAL PIPE RUN PRESSURE CONNECTIONS ARE TO BE LOCATED ON SIDES OF THE PIPE FOR LIQUID AND STEAM SERVICE AND ON THE TOP FOR DRY GAS SERVICE FOR PROCESS LIQUIDS, INSTALLATION OF PRESS. TAPS MAY BE ALLOWED WITHIN AN ANGLE OF 45° ELBOW HORIZONTAL FOR SPECIAL CASES BUT NO BOTTOM CONNECTIONS ARE ALLOWED.
4. THE LOCATION OF PRESSURE TAPS MUST BE WITHIN 1.5 mm(1/16") OF DISTANCE SPECIFIED AND NUMBER OF PAIRS OF PRESSURE TAPS TO BE PROVIDED WILL BE AS PER FLOW MEASUREMENT DATA SHEET.
5. PRESSURE TAPS SHOULD BE DRILLED RADIALLY WITH RESPECT TO PIPE AND THIS DRILLING SHOULD BE DONE AFTER ANY COUPLING FOR ATTACHING THE PRESSURE TUBING HAS BEEN WELDED TO THE PIPE. THE HOLE WHERE IT BREAKS THROUGH THE INNER SURFACE OF THE PIPE MUST BE FREE OF BURRS OR WIRE EDGE AND CORNER OF EDGE HOLE LEFT ROUNDED VERY SLIGHTLY (1/64" RADIOUS).
6. RECOMMENDED MAXIMUM DIAMETERS OF PRESSURE TAP HOLES IN THE BRANCH PIPES WILL BE AS PER EN ISO 5167:2003. THE DIAMETER FOR HOLE SHOULD REMAIN SAME FOR DISTANCE NOT LESS THAN 2.5 TIME OF DIA FROM THE INNER SURFACE OF THE PIPE.
7. FLOW NOZZLE SHALL BE CENTRED IN THE PIPE WITHIN 0.8 mm (1/32") OF THE PIPE AXIS. INSIDE DIAMETER MEASURED AT FOUR POINTS AT ANY CROSS SECTION SHALL NOT DIFFER BY MORE THAN 1%.
8. BRANCH PIPE SHALL BE AS PER MAIN PIPING MATERIAL SPECIFICATION. INTERNAL SURFACE OF BORED SECTIONS MUST BE SMOOTH AND STRAIGHT, FREE FROM SCALES, PITS, BURRS OR ANY IRREGULARTIES.
9. FLOW NOZZLE MATERIAL SHALL BE 316 SS AND THE DESIGN AS PER ASME.
10. MAXIMUM UPSTREAM AND DOWN STREAM STRAIGHT LENGTH REQUIRED FROM INLET FACE OF FLOW NOZZLE SHALL BE AS PER EN ISO 5167:2003.

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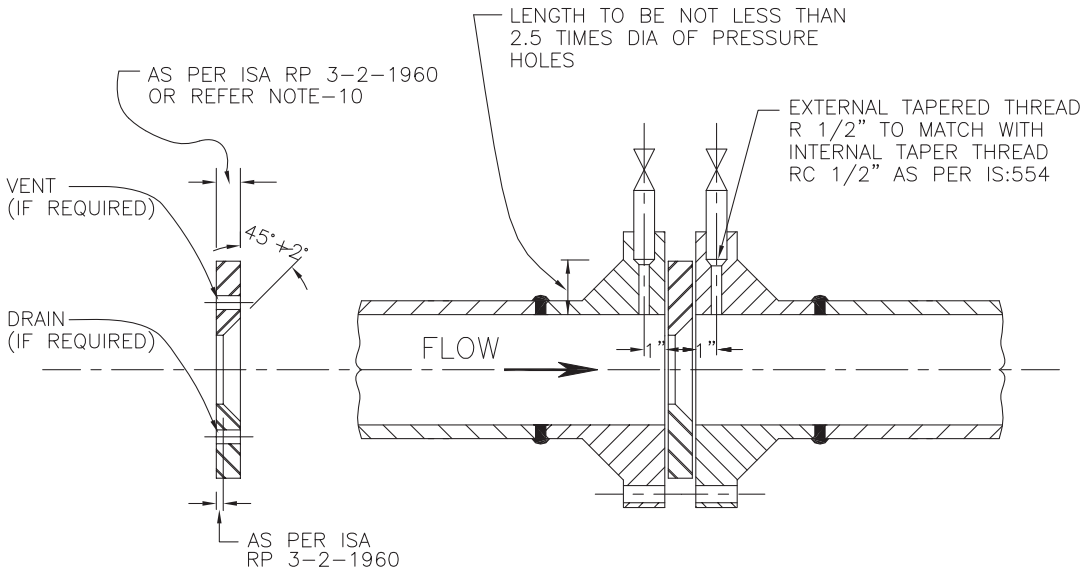
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TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

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FLOW MEASUREMENT



NOTES:-

1. ORIFICE PLATE MOUNTED BETWEEN FLANGES WITH FLANGE TAPPING (AS SHOWN ABOVE) SHOULD BE LIMITED TO PIPE SIZES OF 2" OR LARGER.
2. ORIFICE PLATE SHALL BE MOUNTED BETWEEN PIPING FLANGES WITH THE SHARP EDGE FACING UPSTREAM SUCH THAT CENTRE OF THE CONCENTRIC ORIFICE SHOULD BE WITHIN 0.79 mm (1/32") OF THE AXIS OF THE PIPE.
3. TWO GASKETS SHALL BE INSERTED BETWEEN THE PLATE AND THE FLANGES AND INSIDE DIAMETER OF THE GASKETS SHOULD BE ATLEAST 1.5 mm (1/16") GREATER THAN THE INSIDE DIAMETER OF THE PIPE SO THAT THEY DO NOT PROTRUDE INTO THE PIPE.
4. PIPING FLANGES SHALL BE ANSI WELD NECK, RAISED FACE TYPE. THE FLANGE IS TO BE ALIGNED WITH THE FACE PERPENDICULAR TO THE FLOW AXIS.
5. BIDDER TO SUPPLY ORIFICE PLATE SPECIAL TYPE (HAVING PRESS. CONNECTIONS) OF FLANGES ALONG WITH GASKETS, NIPPLES AND SOURCE VALVES.
6. ON HORIZONTAL PIPE RUN PRESSURE CONNECTIONS ARE TO BE TAKEN FROM SIDES FOR LIQUID AND STEAM SERVICE AND FROM TOP FOR DRY GAS SERVICE. FOR PROCESS LIQUIDS INSTALLATION OF PRESSURE TAPS MAY BE ALLOWED WITHIN AN ANGLE OF 45° ELBOW THE HORIZONTAL IN SPECIAL CASES BUT NO BOTTOM CONNECTIONS ARE ALLOWED.
7. THE LOCATION OF PRESSURE TAPS MUST BE WITHIN 1.5 mm (1/16") OF THE DISTANCE SPECIFIED.
8. MAXIMUM DIAMETER OF PRESS. CONNECTION HOLES SHALL BE AS PER RECOMMENDATIONS OF ASME PTC 19.5. THE DIAMETER OF THE HOLE SHOULD REMAIN THE SAME FOR A DISTANCE NOT LESS THAN 2.5 TIMES OF THE DIAMETER BEFORE EXPANDING INTO THE PRESSURE PIPE.
9. THERE MUST BE NO BURRS WIRE EDGES OR OTHER IRREGULARTIES ALONG THE EDGE OF THE HOLE AND IT MUST BE SQUARE AND ROUNDED SLIGHTLY (1/64" RADIUS).
10. ORIFICE PLATE SHOULD BE FLAT WITHIN 0.02 mm (0.001") AND THE SURFACE ROUGHNESS SHOULD NOT EXCEED 20 MICRO INCH. THE THICKNESS OF THE ORIFICE PLATE SHOULD BE AS PER EN ISO 5167:2003.
11. FOR HORIZONTAL PIPE RUN DRAIN HOLES IN ORIFICE PLATES ARE AT THE BOTTOM (APPROX. TANGENT TO INSIDE DIA OF PIPE) FOR STEAM OR GAS SERVICE. VENT HOLES SHOULD BE LOCATED ON UPPER SIDE FOR INCOMPRESSIBLE FLUID.
12. ORIFICE PLATE SHOULD BE OF 316 SS (ASTM A167-54 GRADE-II).
13. RECOMMENDED MINIMUM LENGTHS OF STRAIGHT PIPE PRECEDING AND FOLLOWING ORIFICES SHALL BE AS PER EN ISO 5167:2003.
14. THREE PAIRS OF PRESSURE TAPS SHALL BE PROVIDED WITH NIPPLES OF REQUIRED LENGTH AND SOURCE VALVES AND THE UN-USED TAPS ARE PLUGGED.
15. THE INTERNAL TAPERED CONNECTION WITHIN THE FLANGE FOR PRESSURE TAPS SHOULD BE RC 1/2" AND THE NIPPLE SHOULD ALSO OF EXTERNAL THREADED R 1/2" AS PER IS:554. THE LENGTH OF THREADED ENGAGEMENT SHALL BE AS PER ABOVE STANDARD.

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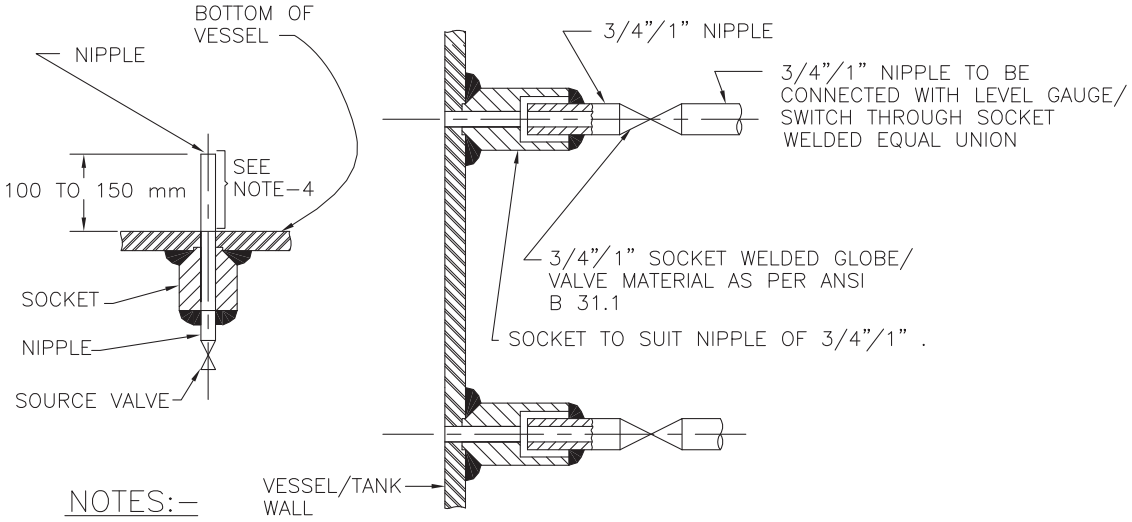
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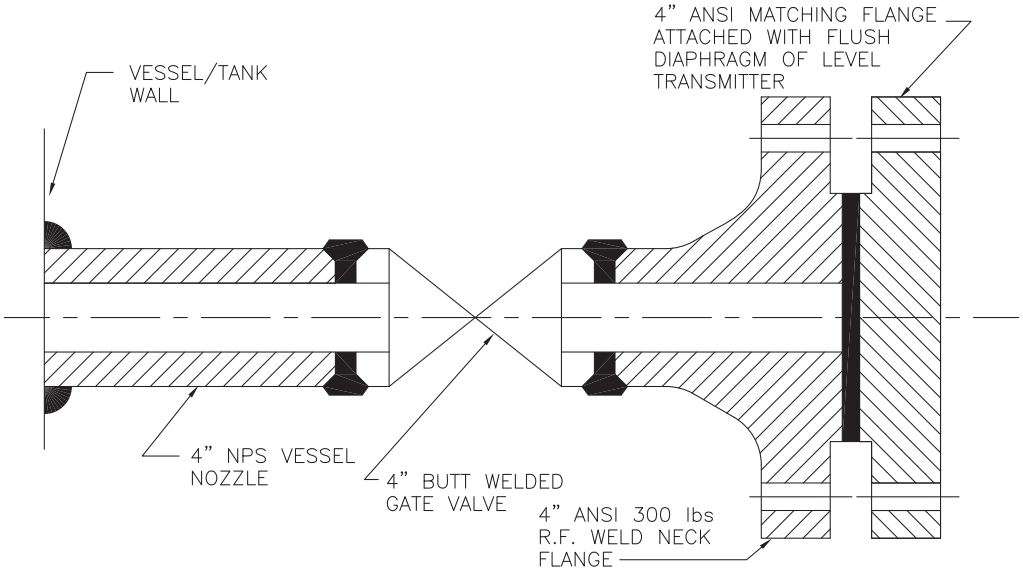
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LEVEL MEASUREMENT



NOTES:-

1. THIS TYPE OF PROCESS CONNECTION SHALL BE USED FOR LEVEL GAUGE AND EXTERNAL CAGE TYPE FLOAT OR DISPLACER OPERATED LEVEL SWITCH.
2. FOR GAUGES 3/4" NIPPLE ALONG WITH 3/4" SW SOURCE VALVE AND FOR SWITCHES 1" NIPPLE ALONG WITH 1" SW SOURCE VALVE SHALL BE PROVIDED AS PROCESS CONNECTION.
3. SOURCE CONNECTION ON VESSEL SHOULD NOT BE LOCATED AT PLACES SUBJECTED TO INTERFACE AND TURBULENCE FROM INLETS AND OUTLETS.
4. IF LOWER CONNECTION IS TAKEN FROM BOTTOM OF THE VESSEL THEN THE NIPPLE MUST BE 100 mm TO 150 mm ABOVE THE BOTTOM OF THE VESSEL.



NOTES:-

1. THIS TYPE OF PROCESS CONNECTION SHALL BE PROVIDED FOR TANK LEVEL MEASUREMENT OF VISCOUS OR CORROSIVE LIQUID USING FLUSH DIAPHRAGM/WAFER TYPE LEVEL TRANSMITTER.
2. WELDING OF MATCHING FLANGE TO GATE VALVE SHALL BE DONE BY BIDDER.

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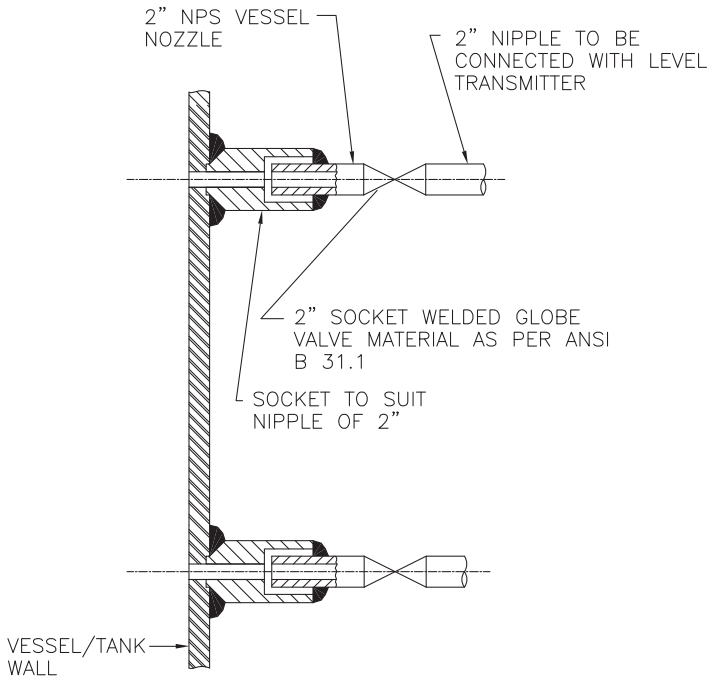
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PROJECT: TYPICALTHERMAL POWER PROJECT

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh-13 Of 14	A

LEVEL MEASUREMENT



NOTES:–

1. THIS TYPE OF PROCESS CONNECTION SHALL BE USED FOR DISPLACER TYPE LEVEL TRANSMITTER.
2. SOURCE CONNECTION ON VESSEL SHOULD NOT BE LOCATED AT PLACES SUBJECTED TO INTERFACE AND TURBULENCE FROM INLETS AND OUTLETS.
3. IF LOWER CONNECTION IS TAKEN FROM BOTTOM OF THE VESSEL THEN THE NIPPLE MUST BE 100 mm TO 150 mm ABOVE THE BOTTOM OF THE VESSEL.

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REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	T.G. C&I	ARCH.	APPD.	DATE
A	FIRST ISSUE							T.G.			21.08.12

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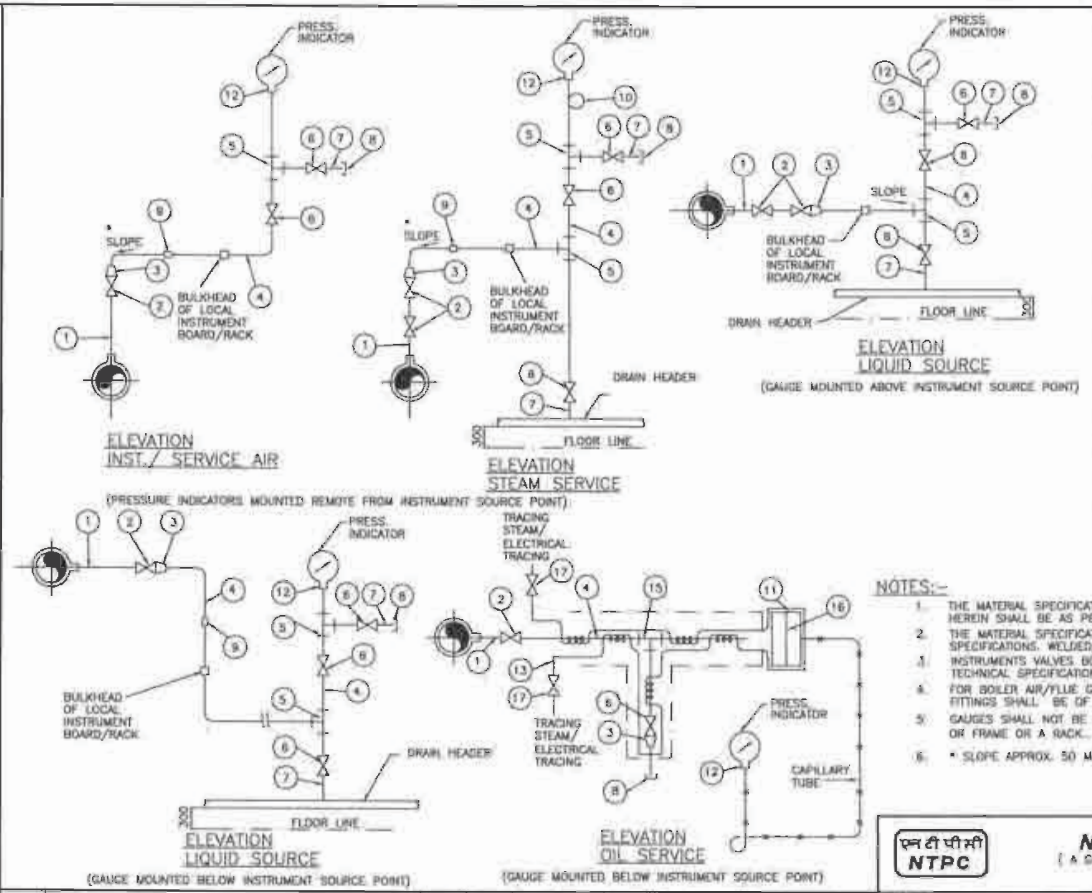
PROJECT: TYPICALTHERMAL POWER PROJECT

TITLE: INSTRUMENT SOURCE CONNECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	N.T.S.	0000-999-POI-A-035 Sh–14 Of 14	A

BHEL	**SIPAT STAGE-II (2X500 MW) FGD PROJECT** **C & I TECHNICAL SPECIFICATION FOR GYPSUM DEWATERING SYSTEM**	SPEC NO.:
		DOCUMENT NO.
		VOLUME
		SECTION
		ISSUE NO.
		REV. NO. 00 / DATE 12.12.2022

INSTRUMENT INSTALLATION DRAWING



LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	1/2" , 3/4" , 1" NPS SCH 40/80/160/XXS/P91 (AS PER PROCESS REQUIREMENT) NIPPLE OF MATERIAL SAME AS THAT OF MAIN PIPE.
2.	1/2"/3/4"/1" SW GLOBE VALVE/GATE VALVE
3.	3/4" / 1" x 1/2" SW REDUCING INSERT
4.	1/2" / 3/4" PIPE
5.	1/2" / 3/4" SW EQUAL TEE
6.	1/2" / 3/4" SW GLOBE VALVE.
7.	1/2" / 3/4" NPS SW x 1/2" / 3/4" NPT(M) CARBON/ALLOY STEEL NIPPLE.
8.	1/2" / 3/4" NPT(F) CAP.
9.	1/2" / 3/4" PIPE UNION.
10.	8" SS SYPHON
11.	1/2" BLIND 300lbs RF ANSI FLANGE DRILLED AND TAPED FOR 1" NPT PIPE.
12.	SUITABLE ADAPTER
13.	1/4" CHROME MOLY STEEL TUBE.
14.	
15.	1"/3/4" SW EQUAL TEE.
16.	DIAPHRAGM(WAFER ELEMENT)
17.	ISOLATION VALVE 316 SS,1/4"SW

NOTES:-

1. THE MATERIAL SPECIFICATION AND SCHEDULE NO. OF IMPULSE PIPE & NIPPLE AS LISTED HEREIN SHALL BE AS PER TECHNICAL SPECIFICATIONS.
2. THE MATERIAL SPECIFICATION AND RATING OF FITTINGS AS LISTED SHALL BE AS PER SPECIFICATIONS. WELDED/THREADED FITTINGS SHALL CONFIRM TO ANSI-B.16-11.
3. INSTRUMENTS VALVES BODY STEM MATERIAL AND PRESSURE CLASS SHALL BE AS PER TECHNICAL SPECIFICATIONS.
4. FOR BOILER AIR/FLUE GAS SERVICES SOURCE CONNECTIONS IMPULSE PIPING AND ALL FITTINGS SHALL BE OF 3/4" NB SIZE.
5. GAUGES SHALL NOT BE MOUNTED ON THE PIPE, IT WILL BE MOUNTED ON A CHANNEL OR FRAME OR A RACK.
6. * SLOPE APPROX. 50 MM / METRE.

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PROJECT: TYPICAL THERMAL POWER PROJECT

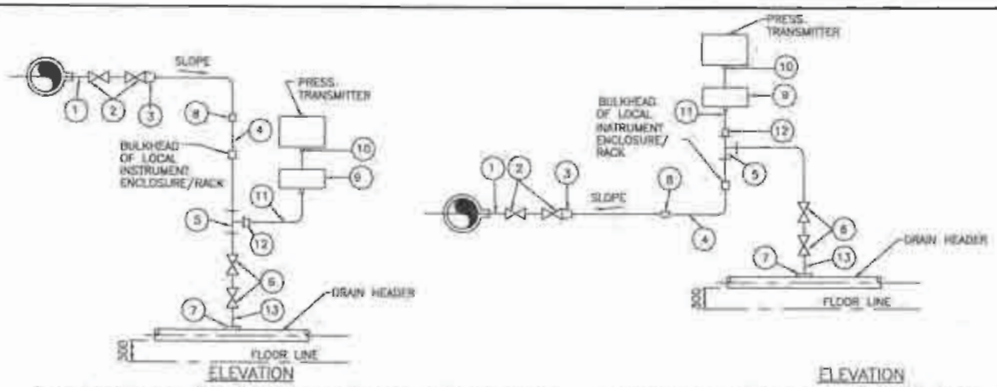
TITLE: INSTRUMENT INSTALLATION DIAGRAM (FOR PRESSURE GAUGE)

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE							T.G.			21.08.12

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SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-022	A

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ELEVATION

TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT

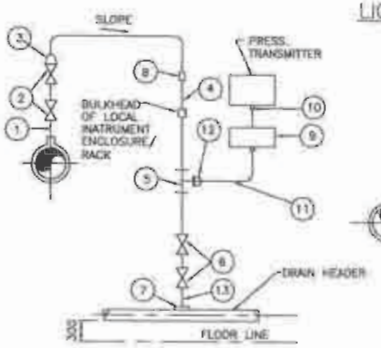
ELEVATION

TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

LIQUID PRESSURE MEASUREMENT

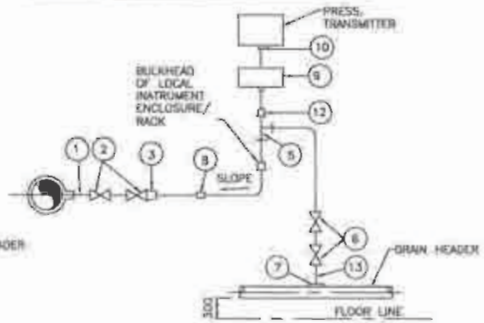
LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	1/2"/3/4"/1"NPS SCH. 80/160/XXS/PBT NIPPLE OF MATERIAL SAME AS THAT OF MAIN PIPE.
2.	3/4"/1" SW GLOBE VALVE.
3.	3/4"/1" TO 1/2" REDUCING INSERT
4.	1/2" NPS PIPE
5.	1/2" SW EQUAL TEE
6.	1/2"SW GLOBE VALVE.
7.	1/2"NPS SCH. 80/160 SWx1/2"CS/AS COUPLER
8.	1/2" PIPE UNION
9.	2/3 VALVE MANIFOLD (FOR DETAIL SEE DRAWING NO.0000-102-POI-A-023.
10.	SUITABLE ADAPTER
11.	SS TUBE
12.	1/2" PIPE x 1/2"TUBE UNION
13.	1/2"NPS SCH. 80/160 SWx1/2" NPT(M) CS/AS NIPPLE



ELEVATION

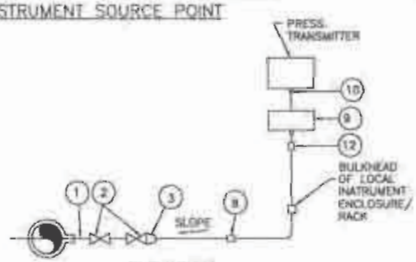
TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT



ELEVATION

TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

STEAM PRESSURE MEASUREMENT



ELEVATION

VACCUM PRESSURE MEASUREMENT

NOTES:-

1. SAME NOTES UNDER DRG. NO. 0000-999-POI-A-023.
2. FOR VACUUM APPLICATION OTHER PORT OF TRANSMITTER SHALL BE KEPT OPEN TO ATMOSPHERE.

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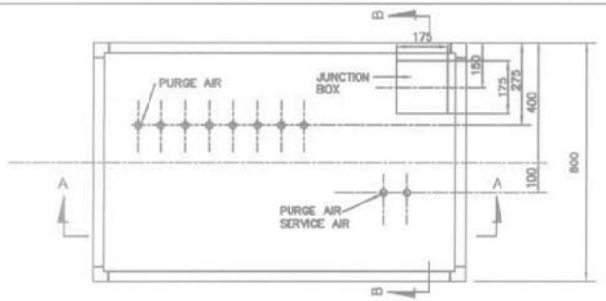
PROJECT: TYPICAL THERMAL POWER PROJECT

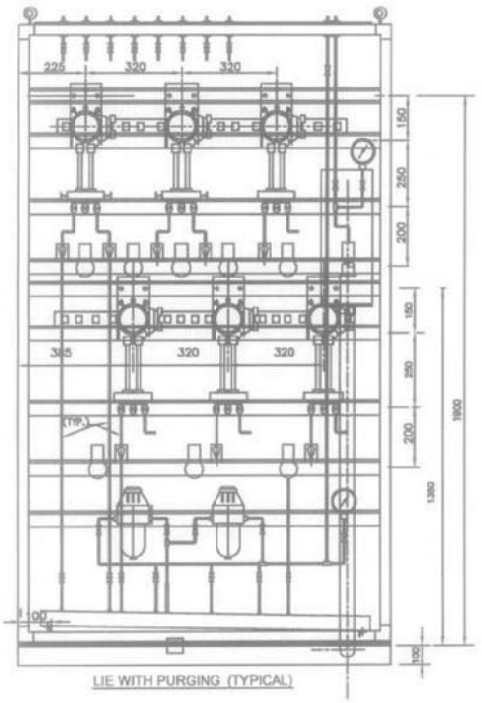
TITLE: INSTRUMENT INSTALLATION DIAGRAM (PRESSURE MEASUREMENT USING PRESS /DP TRANSMITTERS STEAM/LIQUID VACUUM)

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE							T.G.			21.08.12

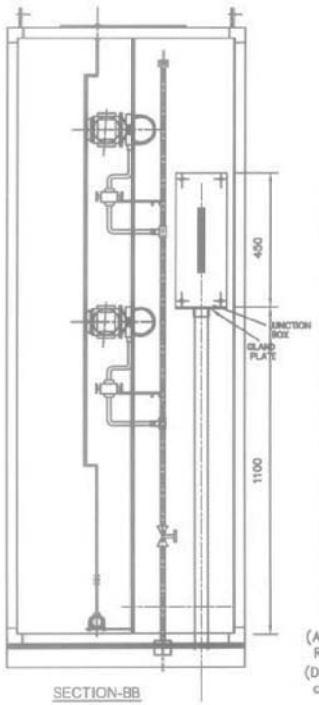
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SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-025	A





LIE WITH PURGING (TYPICAL)



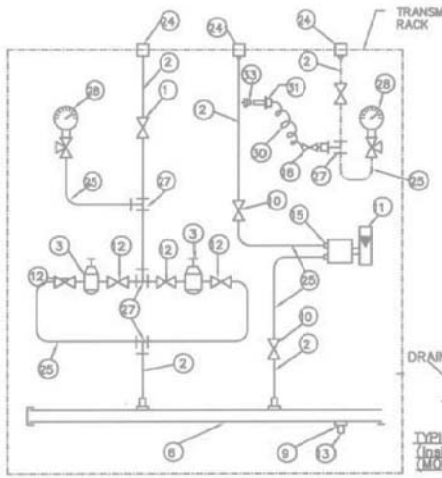
SECTION-BB

LIST OF MATERIALS

ITEM NO.	DESCRIPTION
1.	ISOLATION VALVE(gate/globe). SS.
2.	SEAMLESS SS PIPE.
3.	AIR FILTER REGULATOR.
6.	INST. AIR HEADER SS.
10.	COMP. NEEDLE VALVE SS.
11.	AIR PURGE SET.
12.	COMP VALVE SS.
13.	PLUG SS.
15.	TUBE SS CONNECTOR.
16.	TUBE COMP. EQUAL TEE UNION.
24.	BULKHEAD--SS SUITABLE FOR GI PIPE CONNECTION
25.	SEAMLESS TUBE SS.
27.	BRANCH TEE SS.
28.	PR. GAUGE.
30.	NYLON FLEX. HOSE BRAIDED WITH SS WIRE.
31.	HOSE BARBED CONN. SS.
33.	QUICK DISCONNECT SS (PURGE AIR CONNECTION TO INSTRUMENT SOURCE END).

LIST OF MATERIALS

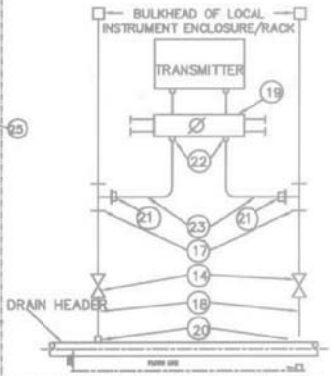
ITEM NO.	DESCRIPTION
14.	SW GLOBE VALVE.
17.	SW EQUAL TEE
18.	S.S. NIPPLE
19.	5 VALVE MANIFOLD
20.	SW HALF COUPLET CS
21.	PIPE x TUBE UNION
22.	SUITABLE ADAPTER
23.	SS TUBE



TYPICAL PURGE AIR CONNECTION INSIDE THE INST. ENCLOSURE

(APPLICABLE FOR MILL, AIR & FLUE GAS SERVICE INSTRUMENTS REQUIRING PURGE AIR)

(Drain Header of each LIE/LIR shall be connected to nearest plant drain)



TYPICAL ARRANGEMENT OF DP TRANSMITTER (Inside LIE/LIR) (MOUNTED BELOW INSTRUMENT SOURCE POINT)

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REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	GM	ARCH.	APPD	DATE
A	FIRST ISSUE										02.02.11

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PROJECT: TYPICAL THERMAL POWER PROJECT (TURNKEY EPC PACKAGE)

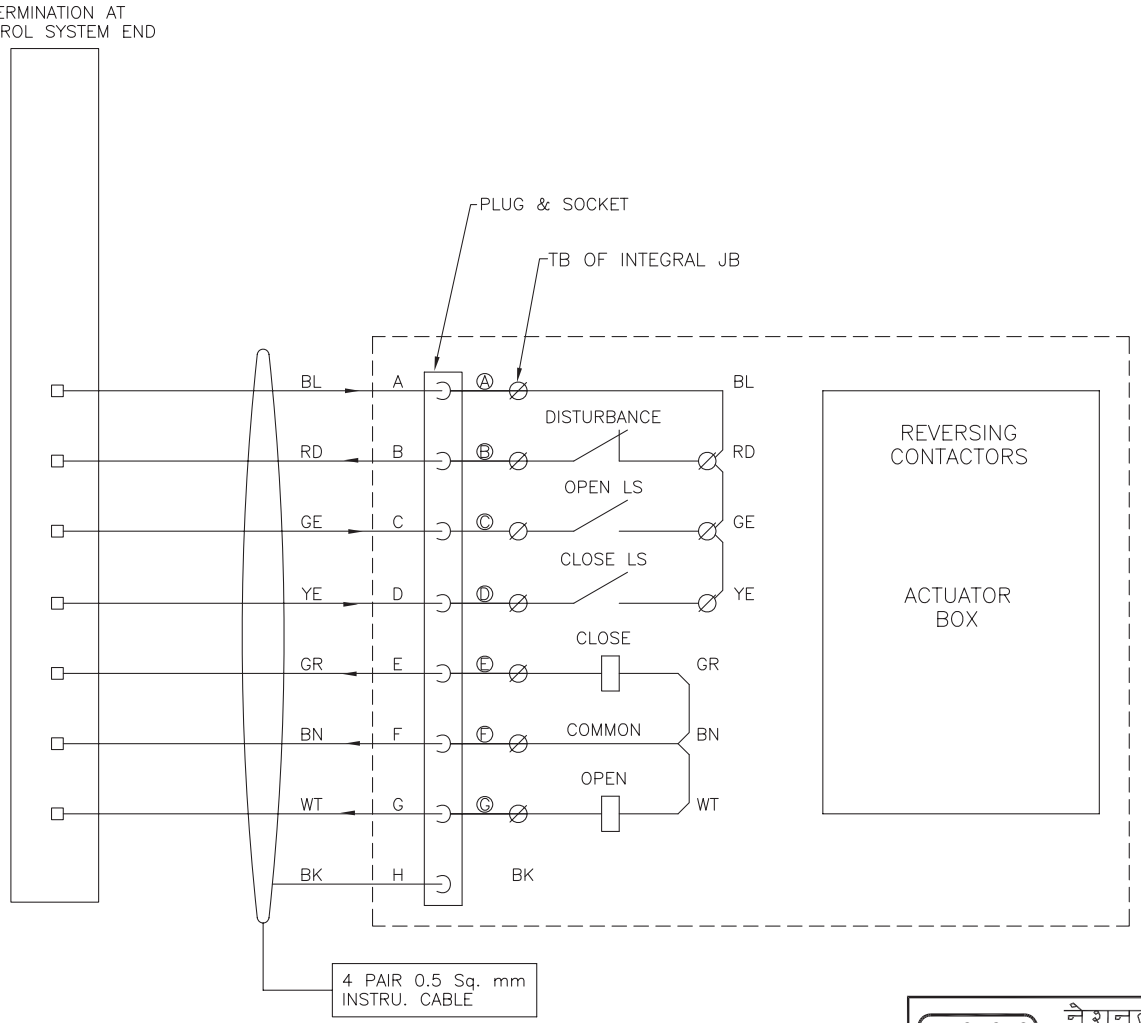
TITLE: TYPICAL GA OF LOCAL INSTRUMENT ENCLOSURE, PURGING SCHEME, DP TRANSMITTER

SIZE	SCALE	DRG. NO.	REV. NO.
A2	N.T.S.	0000-999-POI-A-036	A

BHEL	**SIPAT STAGE-II (2X500 MW) FGD PROJECT** **C & I TECHNICAL SPECIFICATION FOR GYPSUM DEWATERING SYSTEM**	SPEC NO.:
		DOCUMENT NO.
		VOLUME
		SECTION
		ISSUE NO.
		REV. NO. 00 / DATE 12.12.2022

CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY

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National Thermal Power Corporation Ltd.
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ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

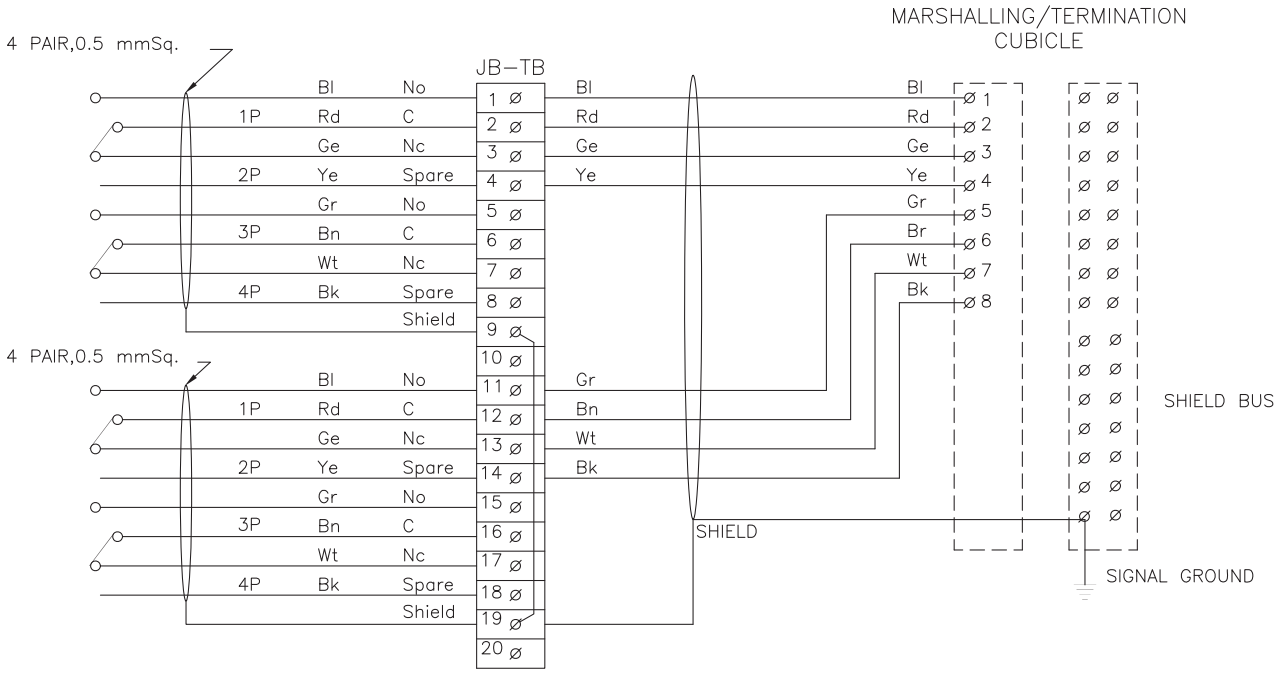
TITLE: INTERFACING OF ACTUATORS

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
D	FIRST ISSUE										21.08.12

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SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-063	D

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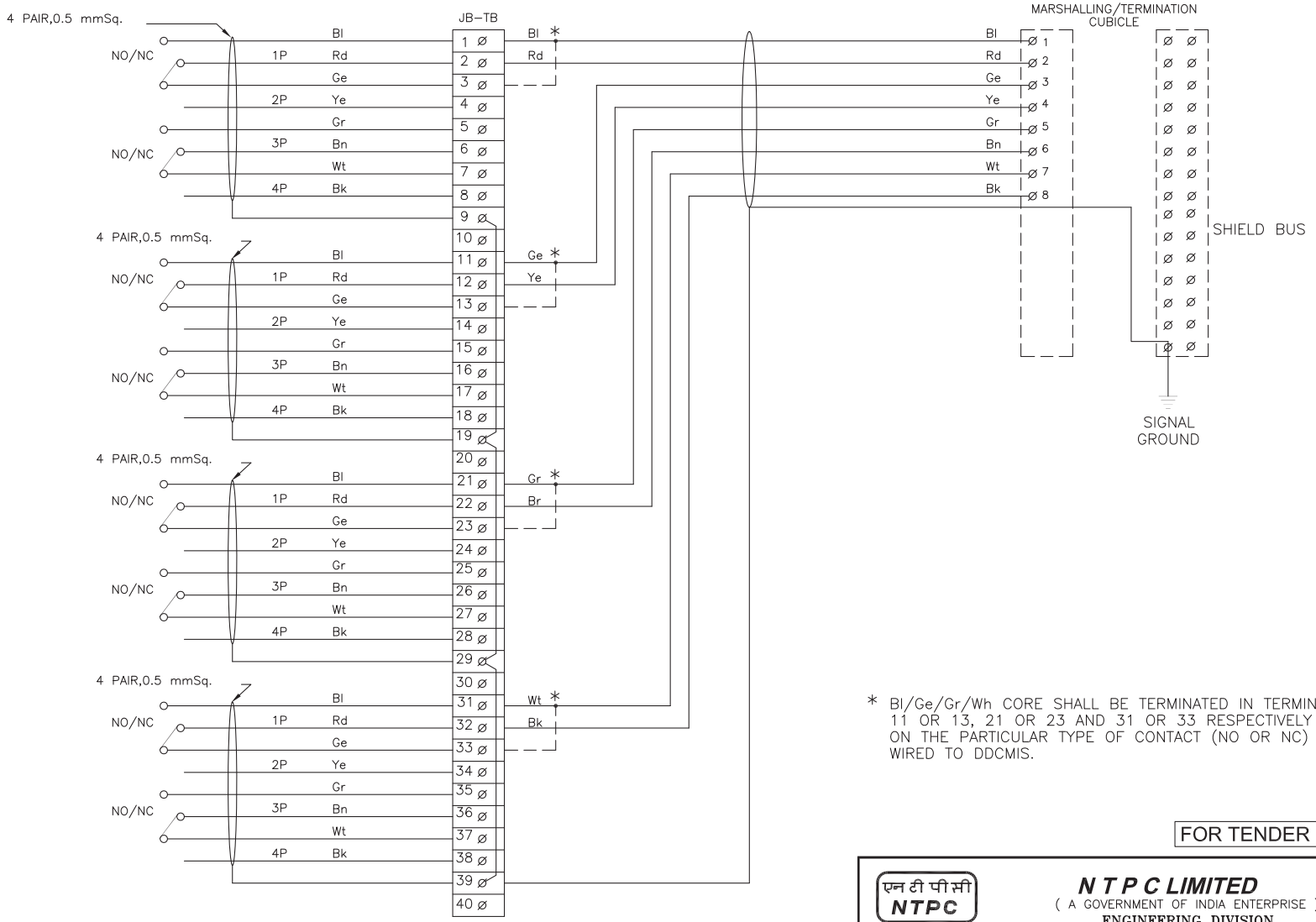
PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS/ SWGR SWITCH (COC) TERMINATION DETAILS

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										21.08.12
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SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 01 OF 15	A

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* Bl/Ge/Gr/Wh CORE SHALL BE TERMINATED IN TERMINAL 1 OR 3, 11 OR 13, 21 OR 23 AND 31 OR 33 RESPECTIVELY DEPENDING ON THE PARTICULAR TYPE OF CONTACT (NO OR NC) IS TO BE WIRED TO DDCMIS.

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REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										21.08.12

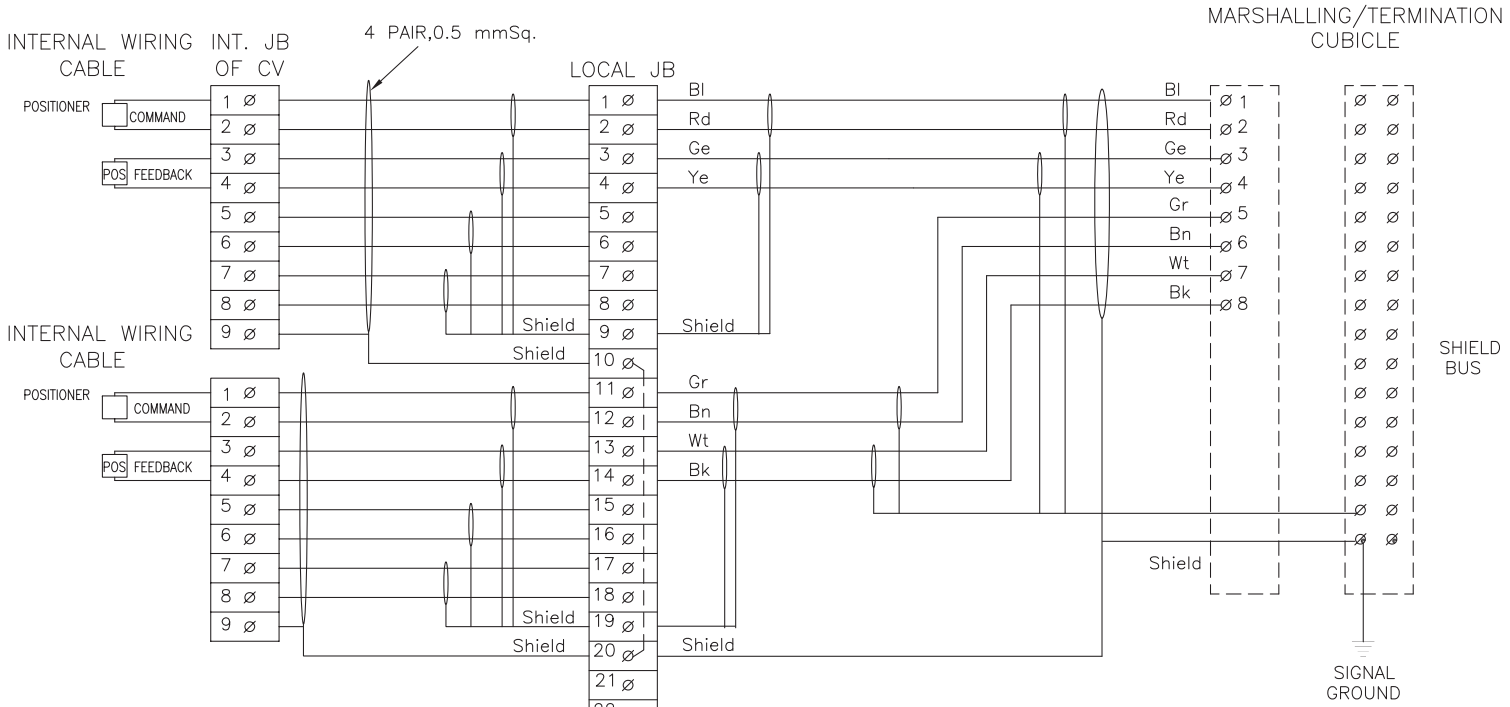
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PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
SWITCH TERMINATION DETAILS
NO/NC

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 02 OF 15	A

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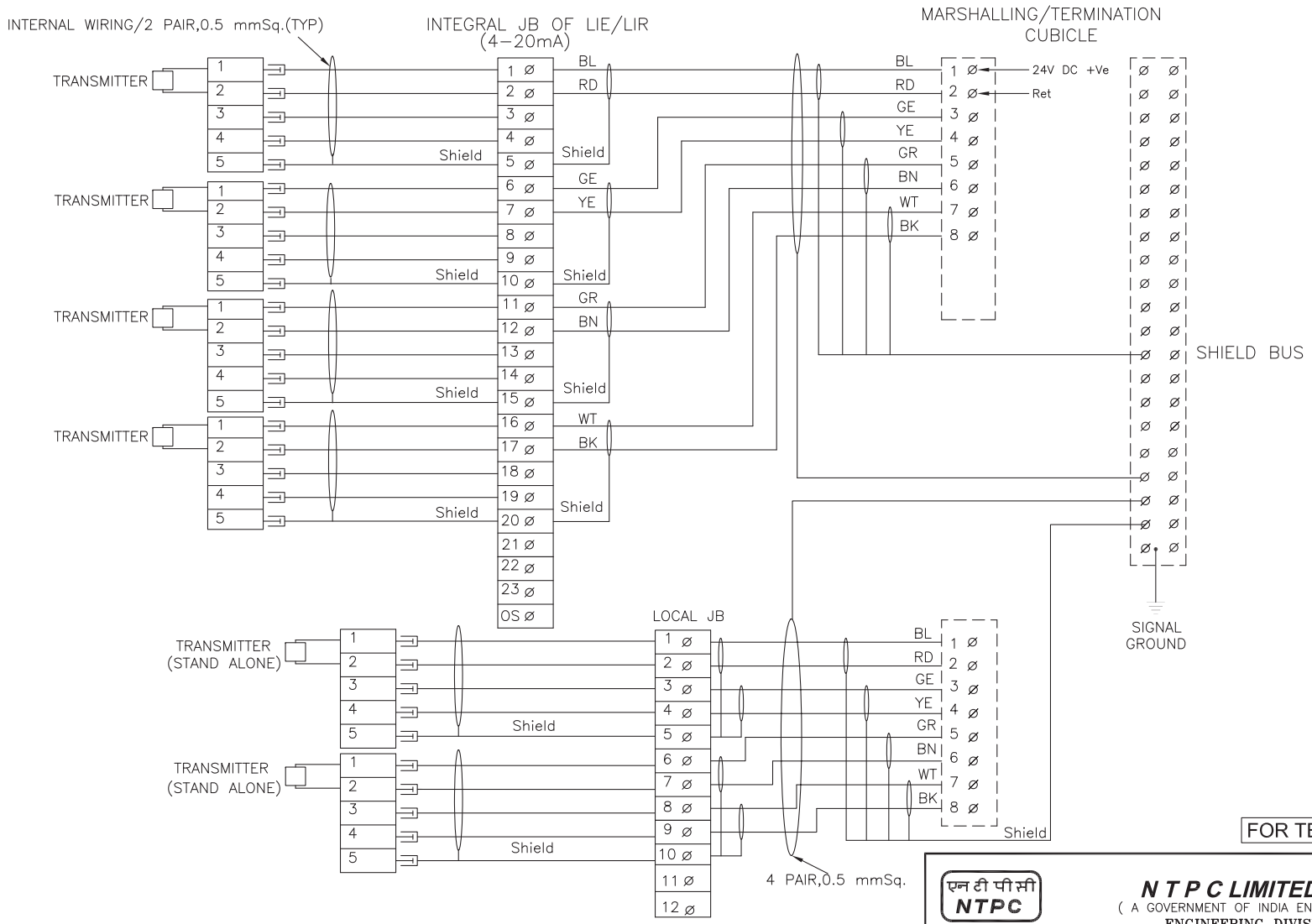
PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS CONTROL VALVE

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										21.08.12
					CLEARED BY						

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 03 OF 15	A

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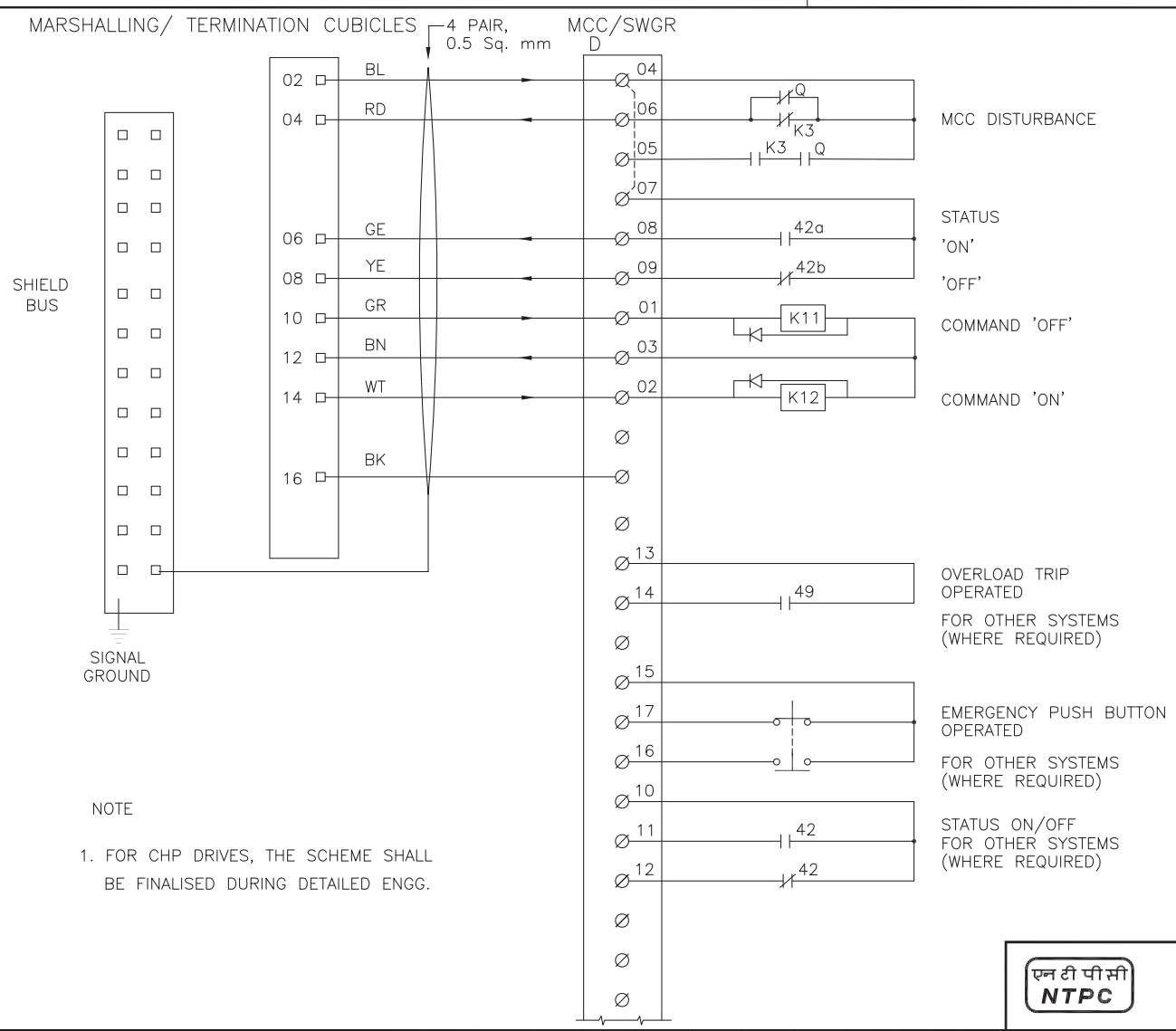
PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
4-20mA

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
B	INTERNAL WIRING FOR LIE/LIR MOUNTED SHOWN WIRING OF STAND ALONE TXTR SHOWN										21.08.12
A	FIRST ISSUE										12.1.05
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SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 04 OF 15	B

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NOTE

1. FOR CHP DRIVES, THE SCHEME SHALL BE FINALISED DURING DETAILED ENGG.

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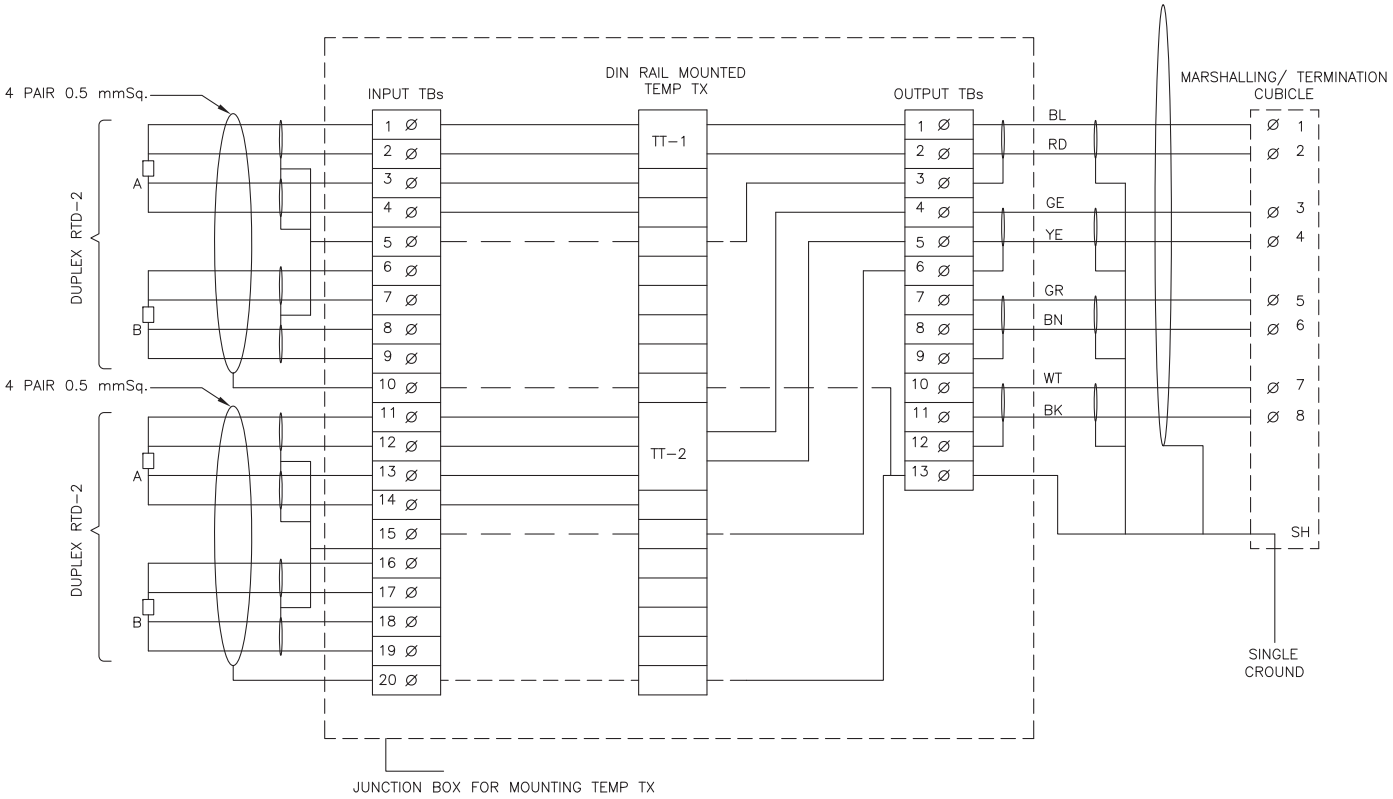
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										21.08.12
					CLEARED BY						

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF PLC WITH MCC/SWGR/ACTUATOR
(LT MOTORS)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 05 OF 15	A

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NOTE :– 1) ABOVE IS THE TYP. DRG. MOUNTED TEMP TRANSMITTER FRO T/C APPLICATION. EXACT TYPE OF TEMP TRANMITTERS SHALL BE AS PER PART–A OF SPECIFICATION.

2) THE EXACT GROUPING OF TEMP TXs SHALL BE FINISHED DURING DERAILED ENGG. STAGE.

3) PLEASE NOTE THAT THIS CONFIGURATION IS SHOWN FOR SINGLE INPUT DIN MOUNTED TT. FOR DUAL INPUT TT BOTH THE ELEMENTS OF RTD SHALL BE CONNECTED TO TT THROUGH INPUT TBs.

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ENGINEERING DIVISION

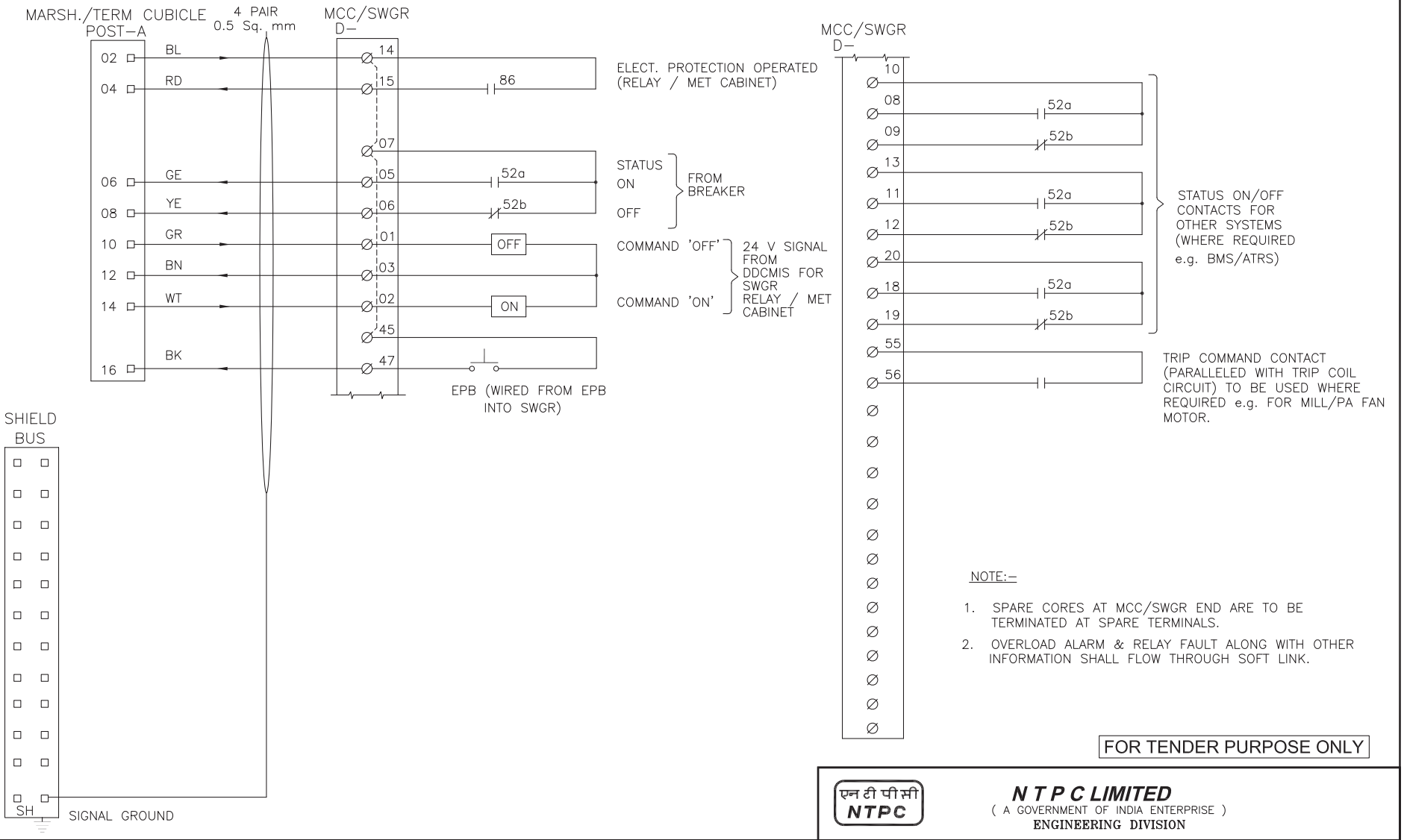
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										21.08.12
					CLEARED BY						

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
TYPICAL RTD CONNECTION WITH TEMP TRANSMITTERS IN JBs

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 06 OF 15	A

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NOTE:–

1. SPARE CORES AT MCC/SWGR END ARE TO BE TERMINATED AT SPARE TERMINALS.
2. OVERLOAD ALARM & RELAY FAULT ALONG WITH OTHER INFORMATION SHALL FLOW THROUGH SOFT LINK.

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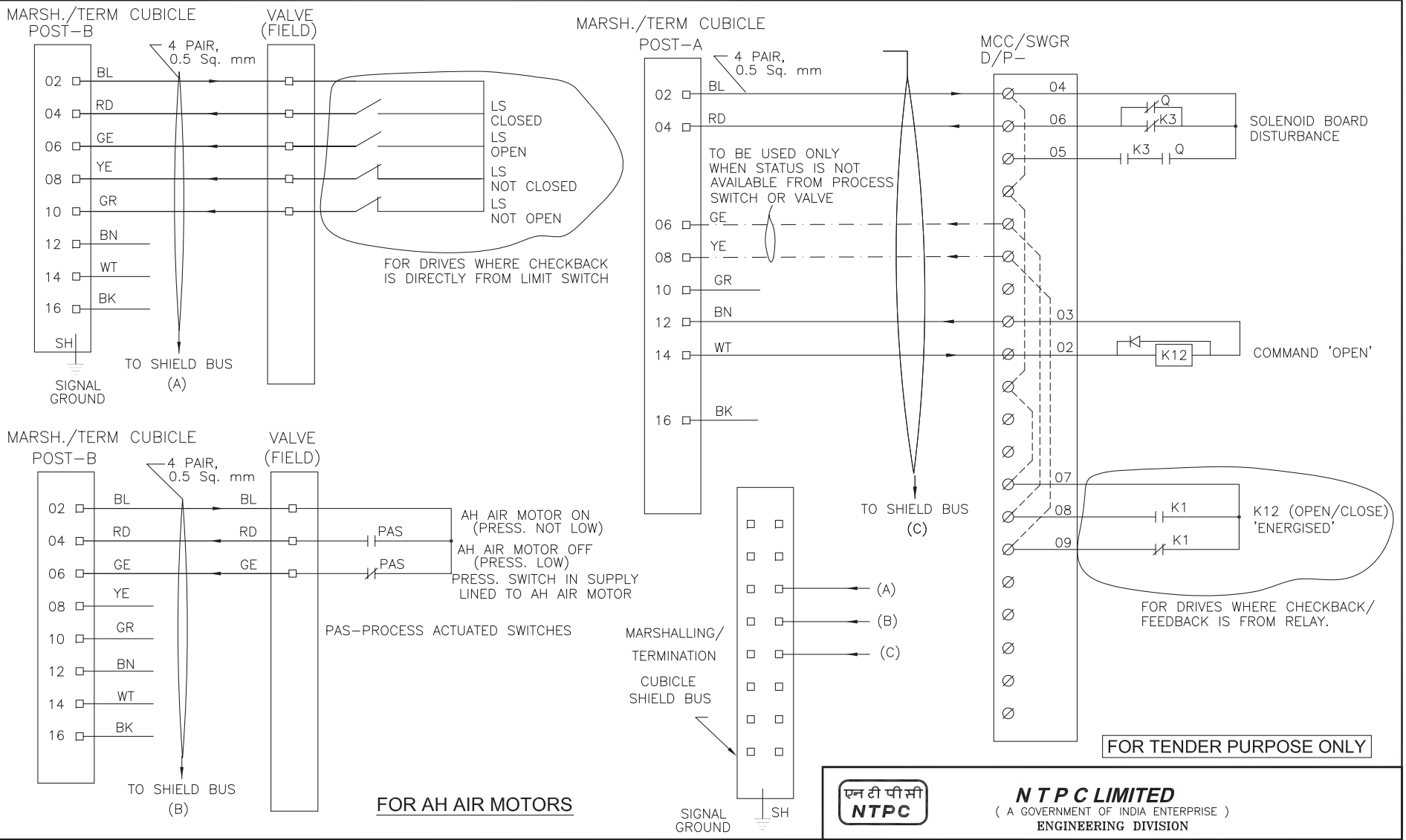
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										21.08.12
					CLEARED BY						

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF PLC WITH MCC/SWGR/ACTUATOR
(HT MOTORS)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 07 OF 15	B

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ENGINEERING DIVISION

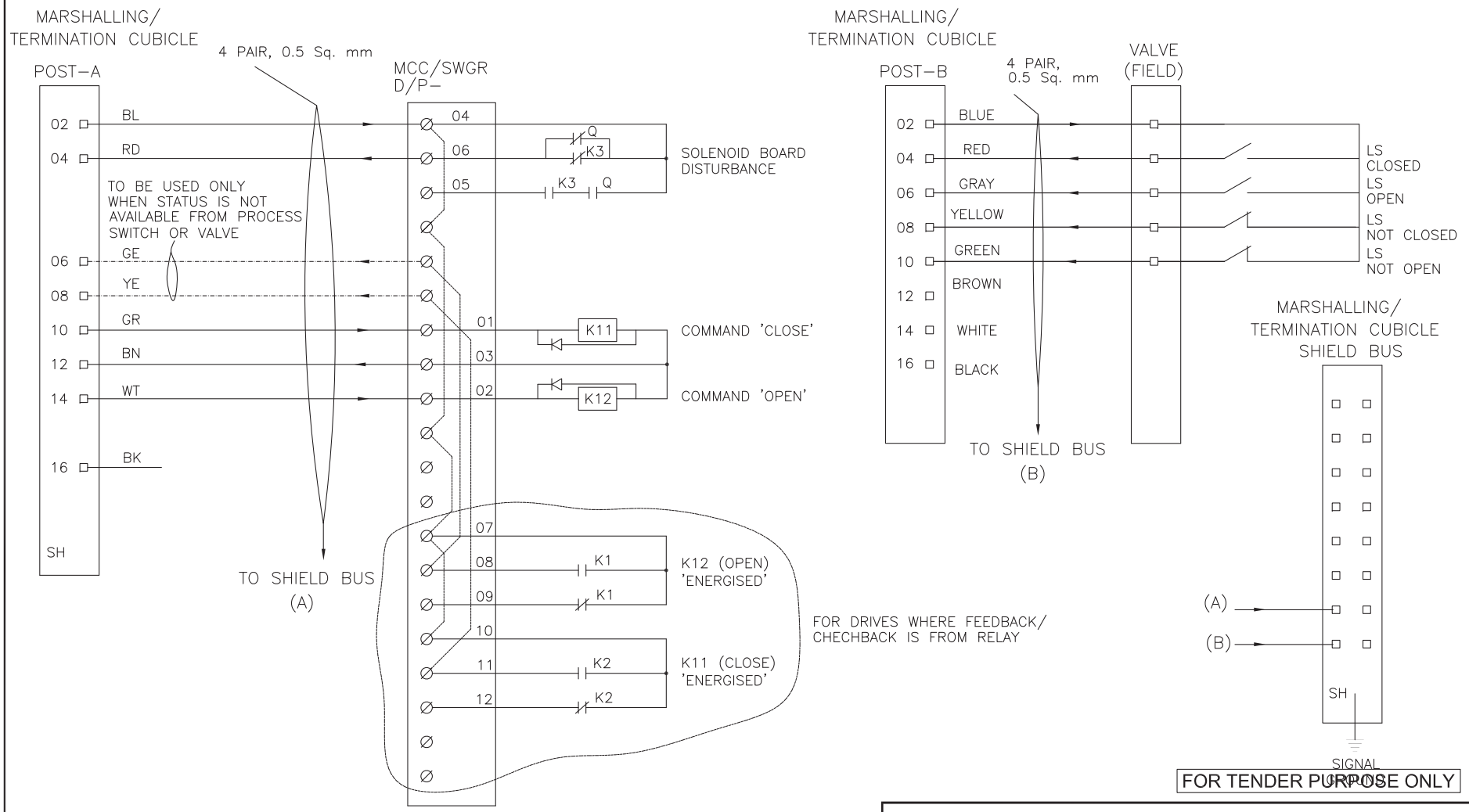
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										21.08.12
					CLEARED BY						

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF PLC WITH MCC/SWGR/ACTUATOR
(SINGLE COIL SOLENOID)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 08 OF 15	A

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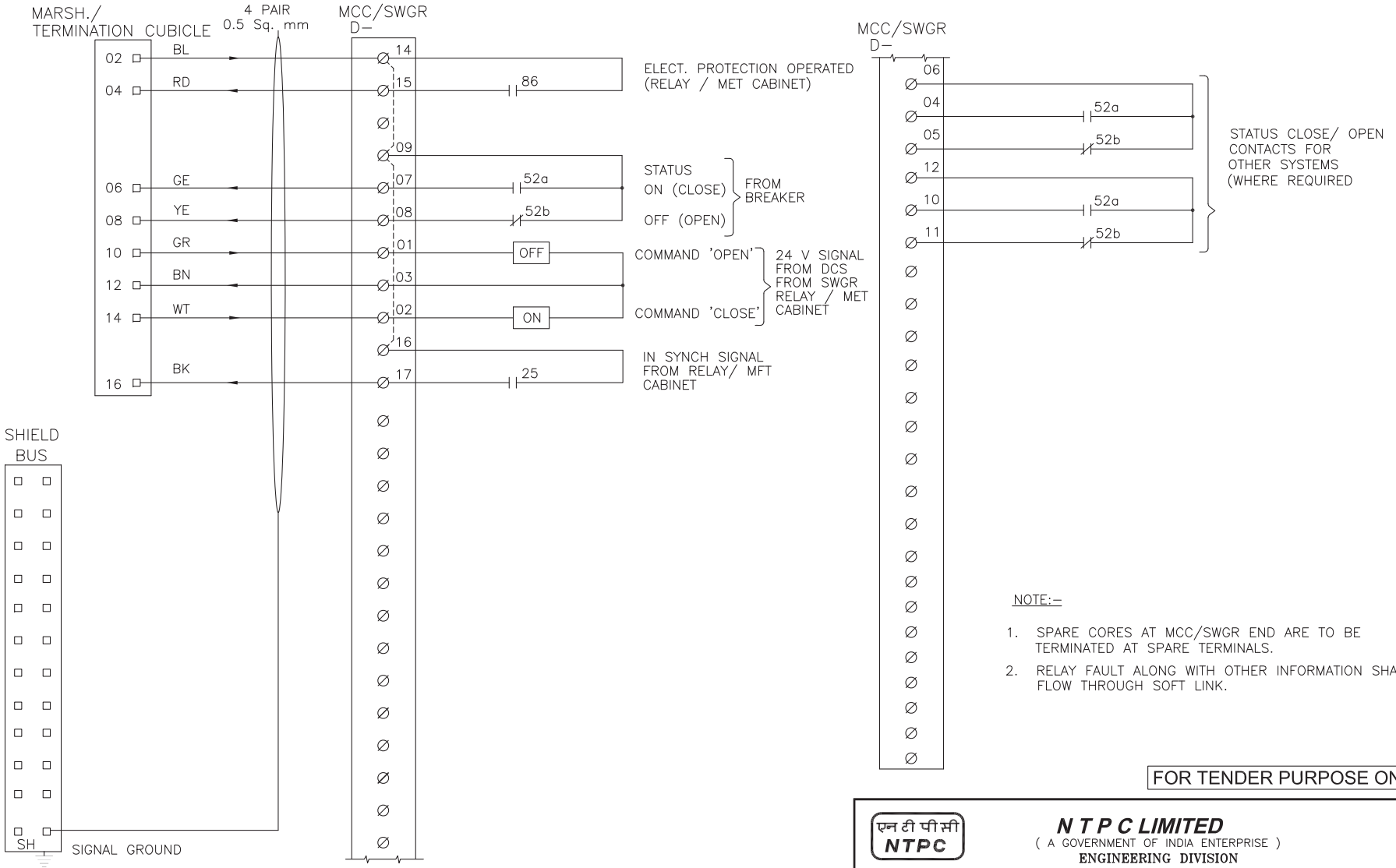
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										21.08.12
					CLEARED BY						

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF DDCMIS/PLC WITH MCC/SWGR/ACTUATOR
(DOUBLE COIL SOLENOIDS)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 09 OF 15	A

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NOTE:–

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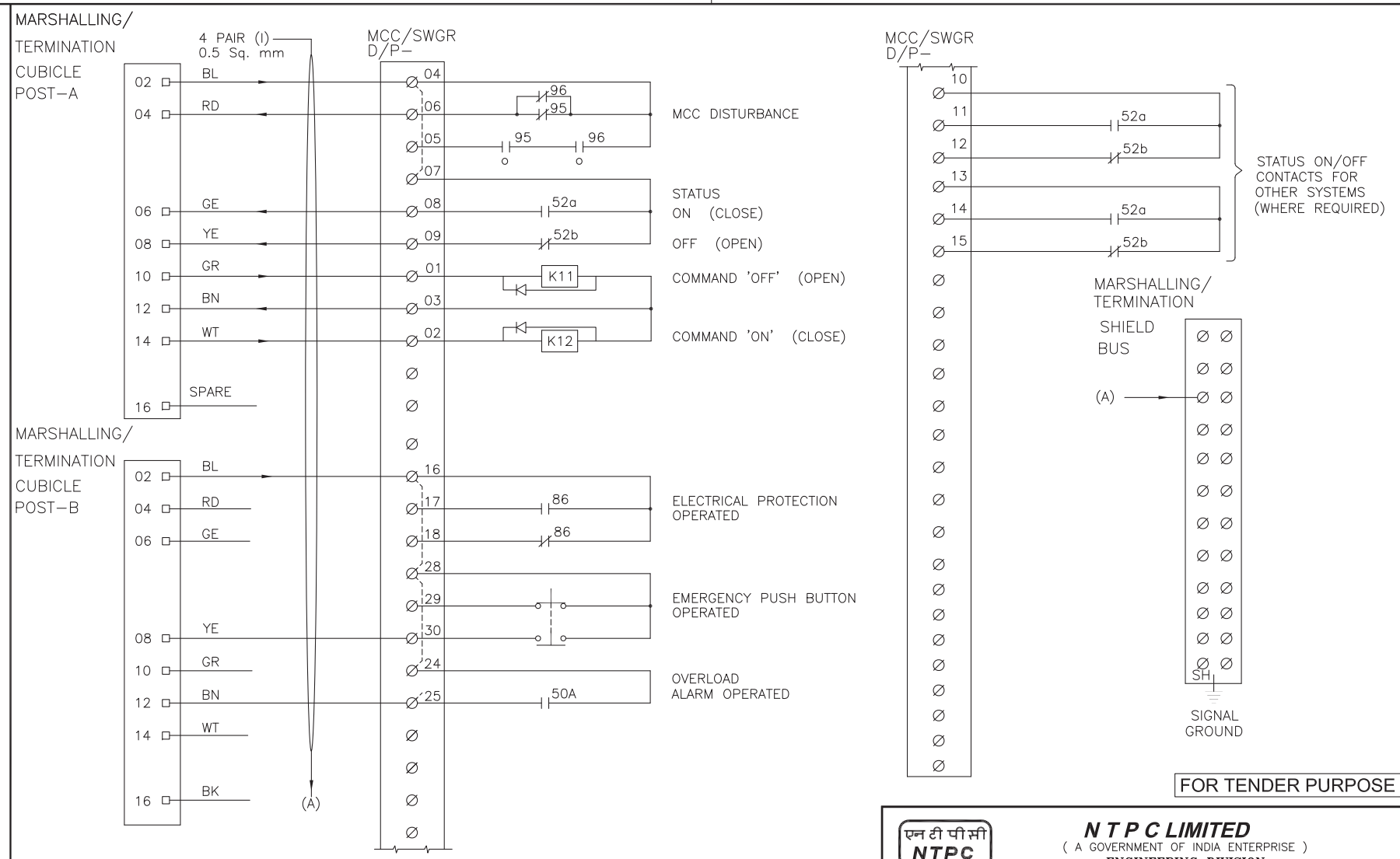
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										21.08.12
					CLEARED BY						

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF PLC WITH MCC/SWGR/ACTUATOR
(ELECT. BKR. SYNC.-LT)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 10 OF 15	B

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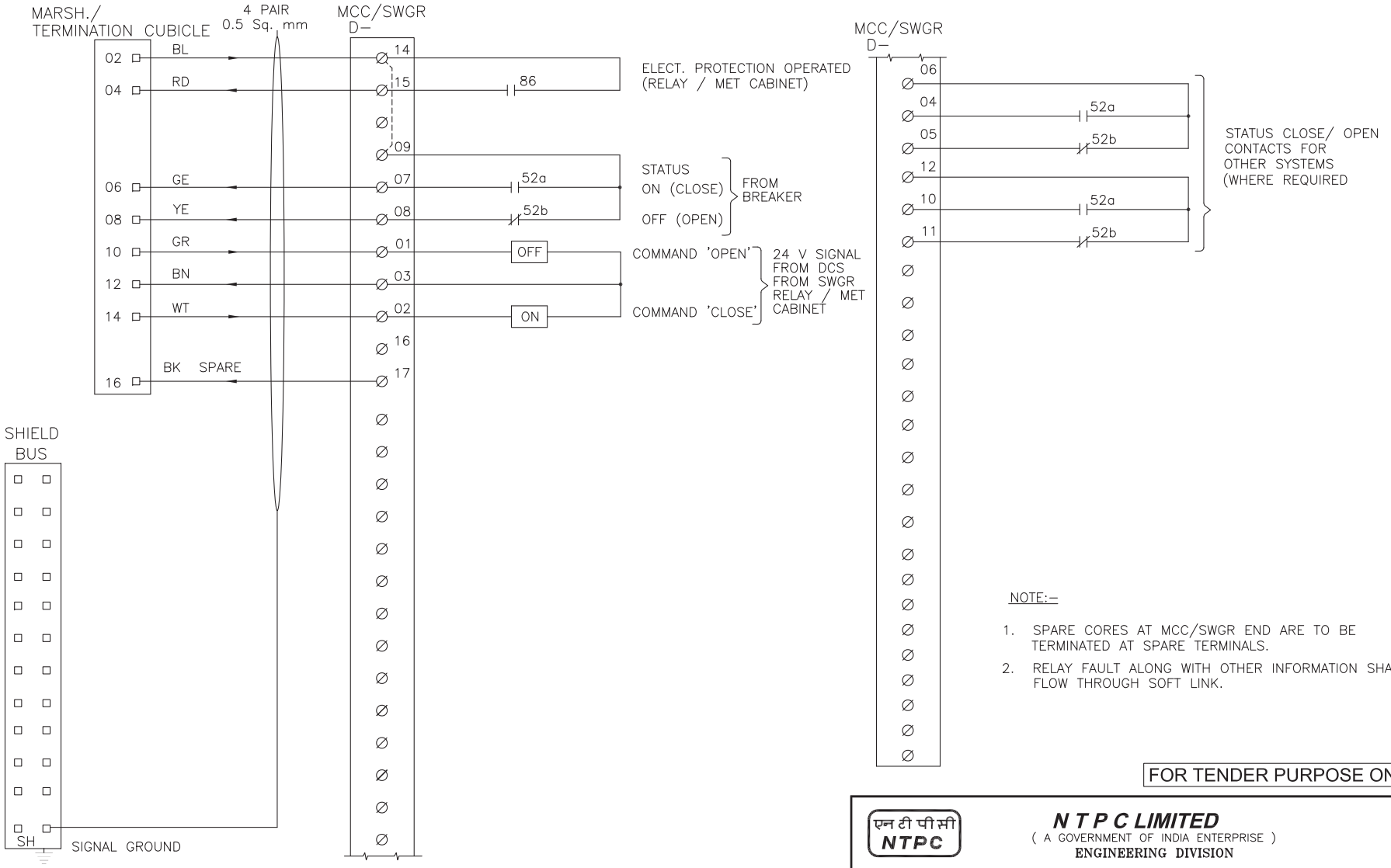
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										21.08.12
					CLEARED BY						

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF PLC WITH MCC/SWGR/ACTUATOR
(LT-A)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-405-POI-A-065 SH 11 OF 15	A

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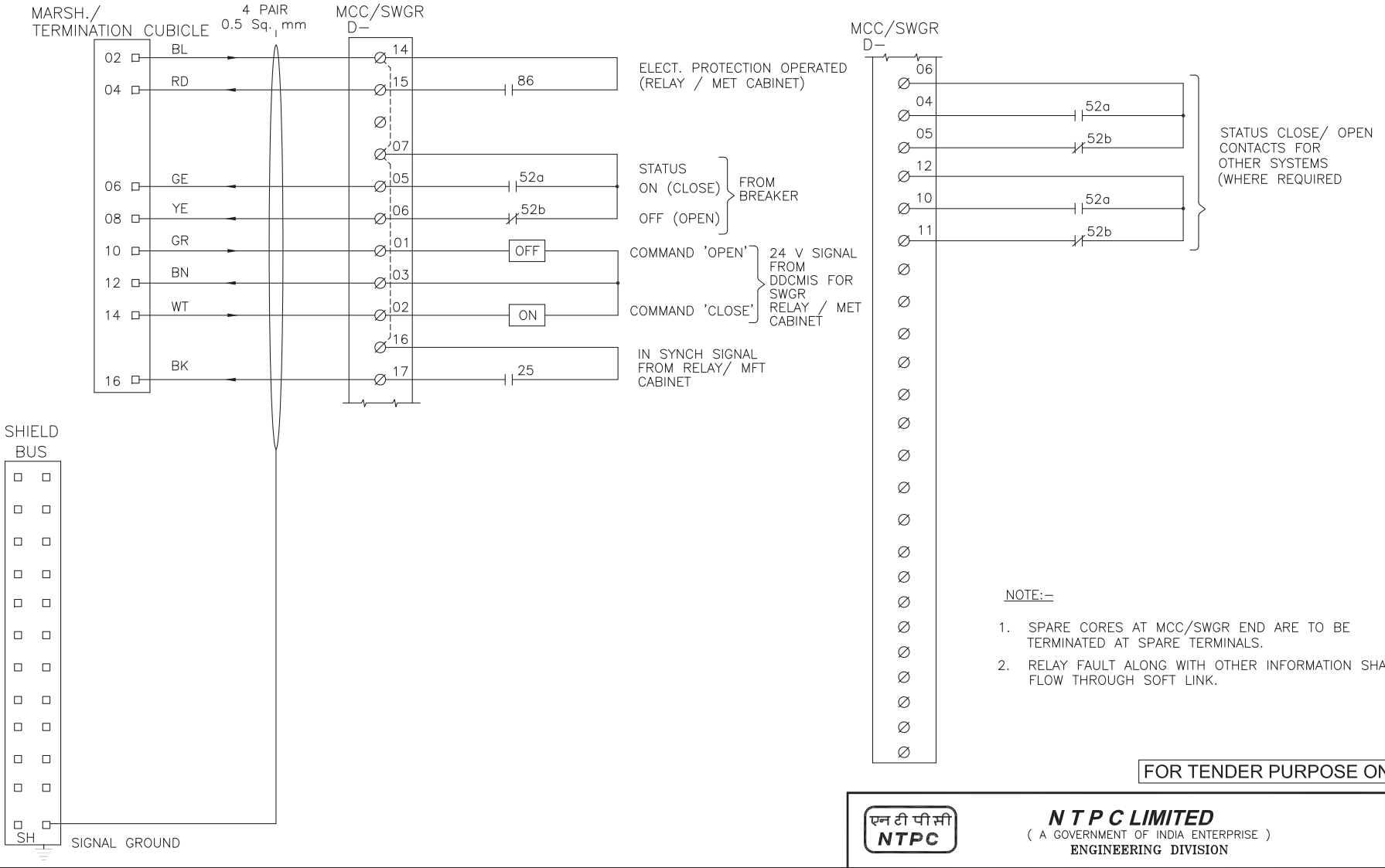
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										21.08.12
					CLEARED BY						

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF PLC WITH MCC/SWGR/ACTUATOR
(ELECT. BKR. SYNC-LT)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 12 OF 15	B

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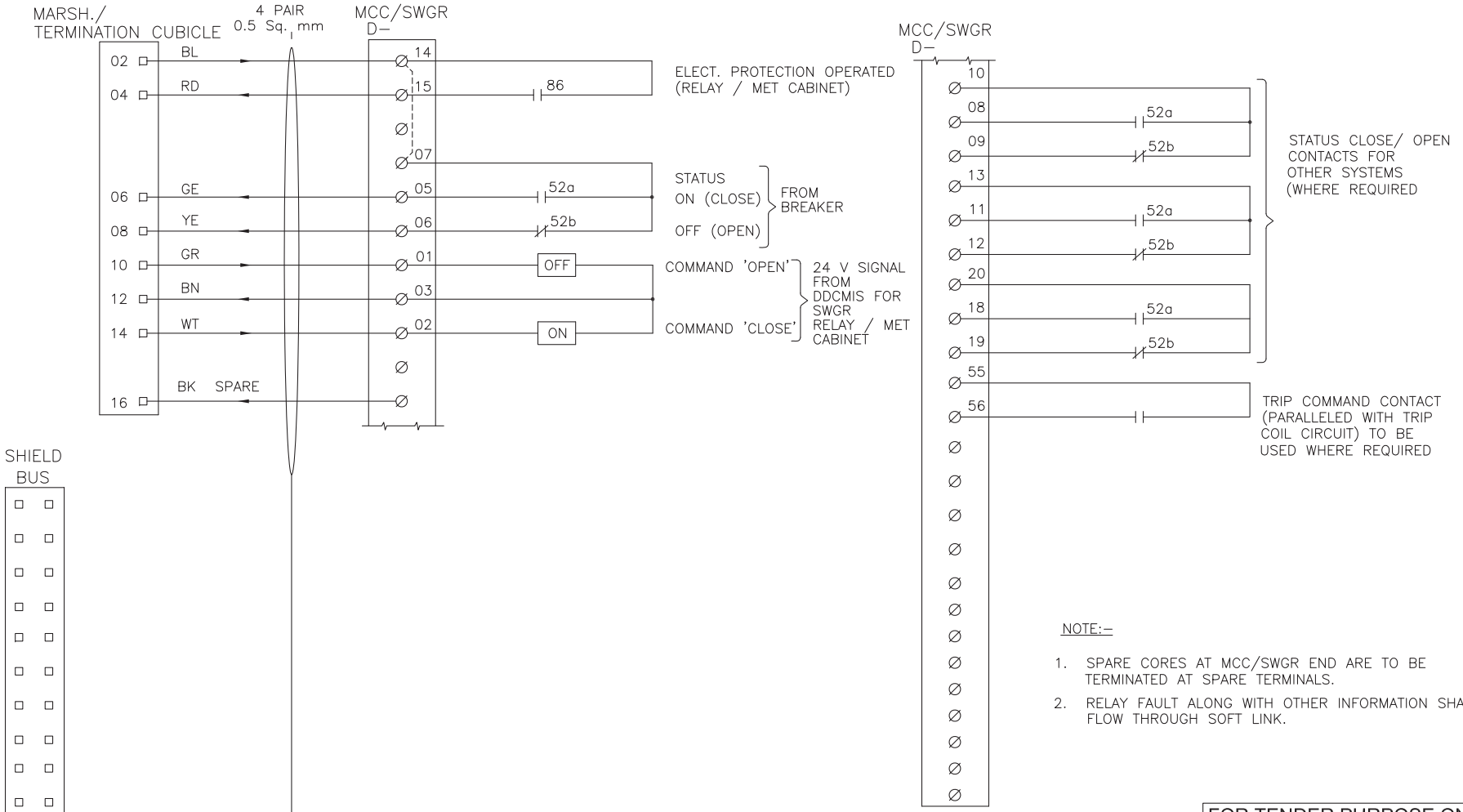
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										21.08.12
					CLEARED BY						

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF PLC WITH MCC/SWGR/ACTUATOR
(Elect. Brkr.- Sync.-HT)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 13 OF 15	B

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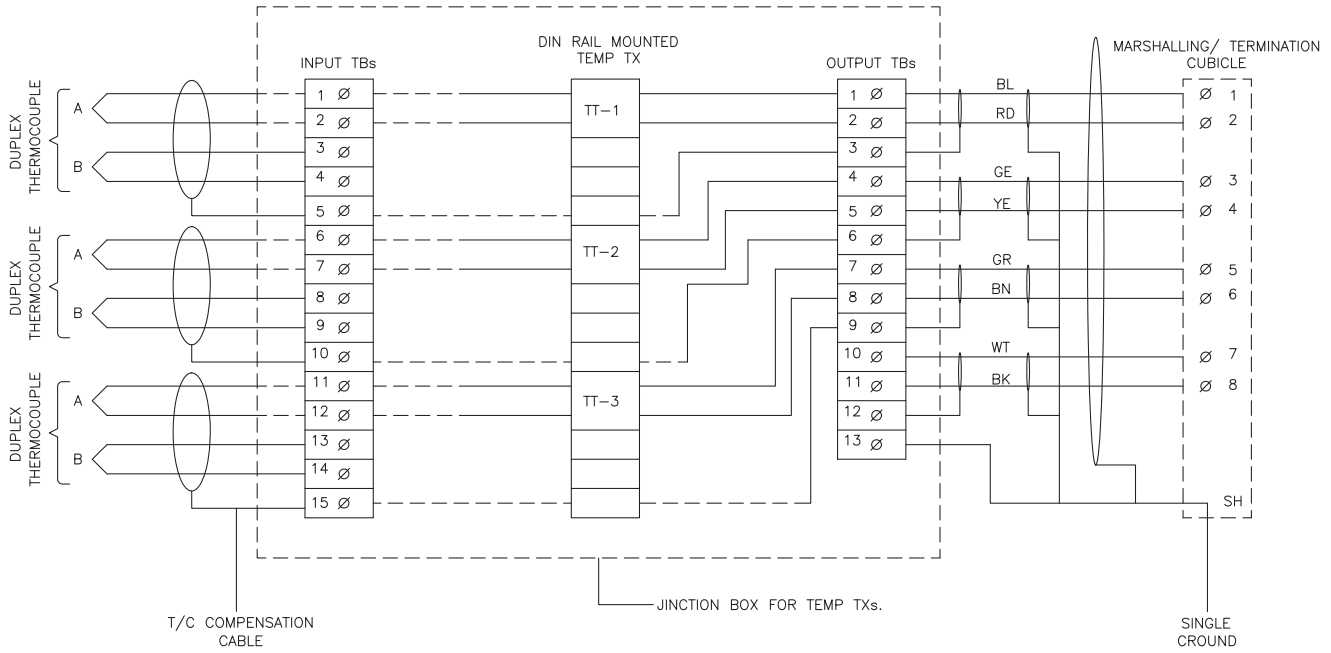
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										21.08.12
					CLEARED BY						

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF **PLC** WITH MCC/SWGR/ACTUATOR
(Elect. Brkr.- Non Sync.-HT)

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 14 OF 15	B

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NOTE :– 1) ABOVE IS THE TYP. DRG. MOUNTED TEMP TRANSMITTER FRO T/C APPLICATION. EXACT TYPE OF TEMP TRANMITTERS SHALL BE AS PER PART–A OF SPECIFICATION.

2) THE EXACT GROUPING OF TEMP TXs SHALL BE FINISHED DURING DERAILED ENGG. STAGE.

3) AFTER GLADDING OF T/C CABLES ON JB. THE CABLE PAIR OF FIRST ELEMENT WILL BE DIRECTLY CONNECTED TO TT AND THE CABLE PAIR OF SECOND ELEMENT SHALL BE WIRED TO INPUT TBs FOR FUTURE USE.

4) PLEASE NOTE THAT THIS CONFIGURATION IS SHOWN FOR SINGLE INPUT DIN RAIL MOUNTED TT. FOR DUAL INPUT TT BOTH THE ELEMENT OF T/C SHALL BE CONNECTED DIRECTLY TO TT WITHOUT INPUT TBs. HOWEVER 5 NOS OF INPUTS TBs ARE TO PROVIDED FOR EACH T/C FOR FUTURE USE.

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REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
B	CABLING OF 2ND RTD CHANGED TO MATCH COLOR CODE										21.08.12
A	FIRST ISSUE										29.04.06
					CLEARED BY						

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
TYPICAL T/C CONNECTION WITH TEMP TXs IN JBs

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 15 OF 15	B

QUALITY ASSURANCE FOR INSTRUMENTS

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY) PAGE- 1/2

TESTS / ITEMS	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Test as per standard(R)	Insulation Resistance (R)	IBR Certification (if applicable)(R)	Hydro Test(R)	Material Test certificate ®
1. PR Gauge (IS-3624)	Y	Y	Y	Y	Y				
2. Temp. Gauge (BS-5235)	Y	Y	Y	Y	Y				
3. Pr./D.P.Switch(BS-6134)	Y	Y	Y	Y	Y	Y			
4. Electronic Transmitter(IEC-60770)	Y	Y	Y	Y	Y	Y			
5. Temp. Switch	Y	Y	Y	Y	Y	Y			
6. Recorder(IS-9319/ANSI C-39.4)	Y	Y	Y	Y	Y	Y			
7. Vertical indicators	Y	Y	Y	Y		Y			
8. Digital Indicators	Y	Y	Y	Y		Y			
9. Integrators	Y	Y	Y	Y					
10. Electrical Metering Instrument (IS-1248)	Y	Y	Y	Y	Y	Y			
11. Transducer (IEC-688)	Y	Y	Y	Y	Y	Y			
12. Thermocouples (IEC – 754 / ANSI-MC-96.1)	Y	Y	Y	Y	Y	Y			
13. RTD(IEC-751)	Y	Y	Y	Y	Y	Y			
14. Thermowell	Y		Y				Y	Y	Y

R-Routine Test A- Acceptance Test Y – Test applicable

: Note: **1)** This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY) Page- 2/2

TESTS / ITEMS	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Requirement as per standard (R)	WPS approval (A)	Non-destructive testing (R)	Calculation for accuracy (R)	Insulation Resistance (R)	IBR Certification as applicable (R)	Hydro test (R)	Material test certificate (A)
15. Cold junction compensation box	Y	Y	Y	Y					Y			
16. Orifice plate(BS-1042)	Y	Y	Y	Y *	Y	Y **	Y **			Y	Y **	Y
17. Flow nozzle(BS-1042)	Y	Y	Y	Y *	Y	Y	Y			Y	Y	Y
18. Impact head type element	Y	Y	Y					Y				Y
19. Level transmitter/float type switch	Y	Y	Y	Y					Y	Y	Y	Y
20. Analysers	Y	Y	Y	Y								
21. Dust emission monitors	Y	Y	Y	Y								
*Calibration to be carried out on one flow element of each type and size if calibration carried out as type test same shall not be repeated.												
** If applicable												

R-Routine Test A- Acceptance Test Y – Test applicable

Note: 1) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.:PE-QP-999-145-I052	DATE:05.08.2021
	PROJECT:		PO NO.:	DATE:
	ITEM: TEMPERATURE ELEMENT	SYSTEM: MAX & MSE PKGS	SECTION:	SHEET 1 OF 2

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY **				REMARKS
					M/ S	C/ N				D	M	S	C	N	
1	2	3	4	5	6		7	8	9						
1.0	Raw Material														
1.1		Sensor (Continuity of T/C Wires & Insulation Resistance of RTD Leads wrt Body)	MA	Electrical /Measurement	100%	-	Approved Data Sheets	Approved Data Sheets	Test Certificate	√	P	V	V	V	
2.0	Inspection														
2.1		Type, Model No./Tag No.	MA	Verification	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
		Process Connection	MA	Measurement	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
2.2		Stability, Accuracy	MA	Measurement	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
2.3		Insulation Resistance	MA	Measurement	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
2.4		Thermal Response Time	CR	Measurement	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
2.5		Hydrostatic Test	MA	Pressure test	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
2.6		Temperature Curves / Charts	CR	Measurement	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
2.7		Ambient Temp. Effect Check	MA	Measurement	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
2.8		HV Test	MA	Measurement	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
2.9	Type Test	Degree of protection	CR	Mechanical protection	100%	-	Approved Data Sheets	Approved Data Sheets	Test Certificate	√	P	V	V	V	
3.0	Painting	Shade & Finish	MA	Visual	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
4.0	Packing	Soundness of Packing	MA	Visual	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection	√	P	V	V	V	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		Chetan Malik	Checked By:		Suman Nakwal
Reviewed by:		Suresh Chand Sharma	Reviewed By:		Ritesh Kumar Jaiswal

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.:PE-QP-999-145-I052	DATE:05.08.2021
	PROJECT:		PO NO.:	DATE:
	ITEM: TEMPERATURE ELEMENT	SYSTEM: MAX & MSE PKGS	SECTION:	SHEET 2 OF 2

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY **				REMARKS
1	2	3	4	5	6		7	8	9	D	M	S	C	N	
					M/ S	C/ N									
									Report						
5.0	Accessories	Nipple, union, fittings, flanges (for flanged connections), thermowell	MA	Visual	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	Witness of quantity as per BOQ

NOTES:

1. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
2. Supplier to provide compliance certificate for tests/checks verified by contractor and submit the same along with test certificates to be verified by BHEL.
3. IBR certificate to be provided if applicable.
4. BHEL reserves the right for conducting repeat test, if required.
5. In case of foreign supplier, all test certificates shall be furnished by the supplier, duly witnessed/ verified by supplier's TPI.
6. Project specific quality plan to be developed based on customer requirement.
7. Latest revision/ year of issue of all the standards (IS /ASME /IEC etc.) Indicated in QP shall be referred.
8. Material shall be packed suitably in order to avoid damage during transit and also during storage at site in tropical climate conditions.
9. For export job, packing shall be as per BHEL seaworthy packing specification.

LEGENDS:
*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
** **M**: ~~SUPPLIER~~/ MANUFACTURER/ SUB-SUPPLIER, **C**: ~~MAIN SUPPLIER~~/ BHEL/ THIRD PARTY INSPECTION AGENCY, **N**: CUSTOMER, S: SUPPLIER
P: PERFORM, **W**: WITNESS, **V**: VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR, **CR:** CRITICAL

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		Chetan Malik	Checked By:		Suman Nakwal
Reviewed by:		Suresh Chand Sharma	Reviewed By:		Ritesh Kumar Jaiswal

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.:PE-QP-999-145-I051	DATE:05.08.2021
	PROJECT:		PO NO.:	DATE:
	ITEM: TRANSMITTER (PT, DPT)	SYSTEM: MAX & MSE PKGS	SECTION:	SHEET 1 OF 2

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY				REMARKS
1	2	3	4	5	6		7	8	9	D	**				
					M/ S	C/ N					M	S	C	N	
1.0	Inspection														
1.1		Type, Model No./Tag No.	MA	Verification	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
1.2		Process Connection	CR	Measurement	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
1.3		Accuracy, Repeatability, Hysteresis	CR	Measurement	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
1.4		Effect of Temperature Variation on accuracy	CR	Measurement	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
1.5		Calibration, Span/ Zero Adjustment	CR	Measurement	One Per Type	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
1.6		Effect of Supply Voltage Variation	MA	Measurement	One Per Type	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
1.7		Effect of Loading (500 Ohm Meters)	MA	Measurement	One Per Type	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
1.8		High Pressure Test	CR	Measurement	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
1.9		Burn-In Test	MA	Review	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
1.10	Type Test	Degree of Protection	CR	Mechanical Protection	One Per Type	-	Approved Data Sheets	Approved Data Sheets	Test Certificate	√	P	V	V	V	
2.0	Painting	Shade & Finish	MA	Visual	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
3.0	Packing	Soundness of Packing	MA	Visual	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
4.0	Accessories	Mounting bracket, U-bolts, 2-way valve, 5-way valve, flange with nuts, bolts and gaskets , cable glands etc.	MA	Visual	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	Witness of quantity as per BOQ

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		Chetan Malik	Checked By:		Suman Nakwal
Reviewed by:		Suresh Chand Sharma	Reviewed By:		Ritesh Kumar Jaiswal

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.:PE-QP-999-145-I051	DATE:05.08.2021
	PROJECT:		PO NO.:	DATE:
	ITEM: TRANSMITTER (PT, DPT)	SYSTEM: MAX & MSE PKGS	SECTION:	SHEET 2 OF 2

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY				REMARKS
					M/ S	C/ N				D	M	S	C	N	
1	2	3	4	5	6		7	8	9		**				

NOTES:

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BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		Chetan Malik	Checked By:		Suman Nakwal
Reviewed by:		Suresh Chand Sharma	Reviewed By:		Ritesh Kumar Jaiswal

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I042	DATE:05.08.2021
	PROJECT:		PO NO.:	DATE:
	ITEM: FLOW SWITCH	SYSTEM: MAX & MSE PKGs	SECTION:	SHEET 1 OF 2

-	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M/ S	C/ N				D	M	S	C	N	
1.0	Raw Material														
1.1		Body, Wet parts, Sensing Element	MA	Physical & Chemical	One/ Lot	-	Approved Data Sheets	Approved Data Sheets	Test Certificate	√	P	V	V	V	
2.0	Inspection														
2.1		Type/ Model No./Tag No.	MA	Verification	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
2.2		Dimensions	MA	Measurement	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
2.3		Range	MA	Verification	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
2.4		End Connection	MA	Measurement	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
2.5		Size	MA	Measurement	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
2.6		Accuracy & Repeatability (Wet Calibration)	CR	Measurement	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
2.7		HV/ IR	CR	Measurement	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
2.8		Contact Rating / No. of Contacts	CR	Electrical	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
2.9		Over Pressure Test	CR	Measurement	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
2.10	Type Test	Degree of Protection	CR	Mechanical Protection	One/ Lot	-	Approved Data Sheets	Approved Data Sheets	Test Certificate	√	P	V	V	V	
3.0	Painting	Shade & Finish	MA	Visual	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
4.0	Packing	Soundness of Packing	MA	Visual	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	
5.0	Accessories	Tee, flange, nuts, bolts, gasket, cable gland etc.	MA	Visual	100%	-	Approved Data Sheets	Approved Data Sheets	Inspection Report	√	P	V	V	V	Witness of quantity as per BOQ

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared By:		Chetan Malik	Checked By:		Suman Nakwal
Reviewed By:		Suresh Chand Sharma	Reviewed By:		Ritesh Kumar Jaiswal

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I042	DATE:05.08.2021
	PROJECT:		PO NO.:	DATE:
	ITEM: FLOW SWITCH	SYSTEM: MAX & MSE PKGs	SECTION:	SHEET 2 OF 2

-	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M/ S	C/ N				D	M	S	C	N

NOTES:

1. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
2. Supplier to provide compliance certificate for tests/checks verified by contractor and submit the same along with test certificates to be verified by BHEL.
3. BHEL reserves the right for conducting repeat test, if required.
4. In case of foreign supplier, all test certificates shall be furnished by the supplier, duly witnessed/ verified by supplier's TPI.
5. Project specific quality plan to be developed based on customer requirement.
6. Latest revision/ year of issue of all the standards (IS /ASME /IEC etc.) Indicated in QP shall be referred.
7. Material shall be packed suitably in order to avoid damage during transit and also during storage at site in tropical climate conditions.
8. For export job, packing shall be as per BHEL seaworthy packing specification.

LEGENDS:
*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
** **M**: MANUFACTURER/ SUB-SUPPLIER, **S**: SUPPLIER, **C**: BHEL/ THIRD PARTY INSPECTION AGENCY, **N**: CUSTOMER,
P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR, **CR:** CRITICAL

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared By:		Chetan Malik	Checked By:		Suman Nakwal
Reviewed By:		Suresh Chand Sharma	Reviewed By:		Ritesh Kumar Jaiswal

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.:PE-QP-999-145-I044	DATE:05.08.2021
	PROJECT:		PO NO.:	DATE:
	ITEM: LEVEL SWITCH-FLOAT OPERATED	SYSTEM: MAX & MSE PKGS	SECTION:	SHEET 1 OF 2

-	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	**				REMARKS
					M/S	C/N				D	M	S	C	N	
1	2	3	4	5	6		7	8	9						
1.0	Raw Material														
1.1		Chamber & Float	CR	Physical & Chemical Properties	For Lot	-	Approved Data Sheet	Approved Data Sheet	Test Certificate	√	P	V	V	V	
2.0	Inspection														
2.1		Type, Model No./Tag No., End Connection	MA	Measurement & Verification	100%	-	Approved Data Sheet	Approved Data Sheet	Inspection Report	√	P	V	V	V	
2.2		On/Off Differential	CR	Measurement	100%	-	Approved Data Sheet	Approved Data Sheet	Inspection Report	√	P	V	V	V	
2.3		Repeatability	CR	Measurement	100%	-	Approved Data Sheet	Approved Data Sheet	Inspection Report	√	P	V	V	V	
2.4		IR Test	CR	Measurement	100%	-	Approved Data Sheet	Approved Data Sheet	Inspection Report	√	P	V	V	V	
2.5		HV Test	CR	Measurement	100%	-	Approved Data Sheet	Approved Data Sheet	Inspection Report	√	P	V	V	V	
2.6		Pressure Test on Chamber	MA	Measurement	100%	-	Approved Data Sheet	Approved Data Sheet	Inspection Report	√	P	V	V	V	
2.7		Contact Configuration. & Rating for Microswitch	CR	Electrical	For Lot	-	Approved Data Sheet	Approved Data Sheet	Inspection Report	√	P	V	V	V	
2.8		Welding Procedure, Welders & NDT as per ASME for Pr >40 Kg/Cm2	CR	Mechanical	100%	-	Approved Data Sheet	Approved Data Sheet	Inspection Report	√	P	V	V	V	
2.9		Temp. Suitability for Microswitch and Lead Wire	CR	Electrical	100%	-	Approved Data Sheet	Approved Data Sheet	Inspection Report	√	P	V	V	V	
2.10	Type Test	Degree of Protection	CR	Mechanical protection	One /Lot	-	Approved Data Sheet	Approved Data Sheet	Test Certificate	√	P	V	V	V	
3.0	Painting	Shade & Finish	MA	Visual	100%	-	Approved Data Sheet	Approved Data Sheet	Inspection Report	√	P	V	V	V	
4.0	Packing	Soundness of Packing	MA	Visual	100%	-	Approved Data Sheet	Approved Data Sheet	Inspection Report	√	P	V	V	V	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		Chetan Malik	Checked By:		Suman Nakwal
Reviewed by:		Suresh Chand Sharma	Reviewed By:		Ritesh Kumar Jaiswal

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.:PE-QP-999-145-I044	DATE:05.08.2021
	PROJECT:		PO NO.:	DATE:
	ITEM: LEVEL SWITCH-FLOAT OPERATED	SYSTEM: MAX & MSE PKGS	SECTION:	SHEET 2 OF 2

-	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY				REMARKS
1	2	3	4	5	6		7	8	9	D	**				
					M/ S	C/ N					M	S	C	N	
5.0	Accessories	Flange, nuts, bolts, gasket, drain valve, cable gland etc.	MA	Visual	100%	-	Approved Data Sheet	Approved Data Sheet	Inspection Report	√	V	V	V	V	Witness of quantity as per BOQ

NOTES:

1. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
2. IBR certificates shall be provided wherever required.
3. Supplier to provide compliance certificate for tests/checks verified by contractor and submit the same along with test certificates to be verified by BHEL.
4. BHEL reserves the right for conducting repeat test, if required.
5. In case of foreign supplier, all test certificates shall be furnished by the supplier, duly witnessed/ verified by supplier's TPI.
6. Project specific quality plan to be developed based on customer requirement.
7. Latest revision/ year of issue of all the standards (IS /ASME /IEC etc.) Indicated in QP shall be referred.
8. Material shall be packed suitably in order to avoid damage during transit and also during storage at site in tropical climate conditions.
9. For export job, packing shall be as per BHEL seaworthy packing specification.

LEGENDS:
*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
** **M**: MANUFACTURER/ SUB-SUPPLIER, **S**: SUPPLIER, **C**: BHEL/ THIRD PARTY INSPECTION AGENCY, **N**: CUSTOMER,
P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR, **CR:** CRITICAL

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		Chetan Malik	Checked By:		Suman Nakwal
Reviewed by:		Suresh Chand Sharma	Reviewed By:		Ritesh Kumar Jaiswal

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

STANDARD CHECK LIST FOR C&I INSTRUMENTS(for MSE& Max pckgs)

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 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 :

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

Note :

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

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	31.08.20	VIPUL KUMAR VERMA	Checked by:	31/8/20	KUNAL GANDHI
Reviewed by:	31.08.20	SURESH CHAND SHARMA	Reviewed by:	31/8/2020	RITESH KUMAR JAISWAL

STANDARD CHECK LIST FOR C&I INSTRUMENTS(for MSE& Max pckgs)
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 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 :

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

Note :

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

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	31.08.20	VIPUL KUMAR VERMA	Checked by:	3/19/20	KUNAL GANDHI
Reviewed by:	31.08.2020	SURESH CHAND SHARMA	Reviewed by:	31/8/2020	RITESH KUMAR JAISWAL

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-1056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 1 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
	RAW MATERIAL													
1.0	Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	√	P/W	V		
		2. Bend Test	CR	Mech. test	Sample	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	√	P/W	V		
		3. Surface finish	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	---		
		4. Waviness	MA	Visual	100%	10%	Manufacturing Standard	No Waviness	Inspection Report	√	P/W	---		
		5. Thickness	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	V		
		6. Mill marking	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	Sample	IS:2062	IS:2062	Test Certificate	√	P/W	---		
		2. Surface Defects	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	---		
		3. Straightness	MA	Measurement	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	---		
		4. Mill marking	MA	Visual	100%	10%	IS:2062	IS:2062	Inspection Report	√	P/W	V		

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD			Reviewed by:			
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 2 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/N					M	C	N	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
		2. IR and HV	MA	Electrical	100%	10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
		3. Conductor a) Resistance b) Size c) Sheet colour	 MA MA MA	 Electrical Measurement Visual	 100% 100% 100%	 10% 10% 10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
		4. Type / Routine Test Certificates	MA	Verification	100%	10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays	1. Verification at make and Type	CR	Visual	Sample	Sample	Approved Drg/Datasheet	Approved Drg/Datasheet	Test Certificate	√	P/W			
		2. Verification of Test Certificates	CR	Scrutiny of Type / Routine T.Cs.	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			
		3. Operation / Functional check	CR	Electrical	Sample+ 100% @	Sample+ 10% @	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			+ for relay & contactors only

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 3 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
	Timers, Space Heaters, Thermostat, Indicating meters etc.	4. I.R.	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			@ for all components except relays & contactors.
		5. H.V.	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			
		6. Calibration	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W	V		
		7. Pick up / Drop off Voltage	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	Sample	Manufacturing Standard	Manufacturing Standard	Test Certificate	√	P/W			
		2. Surface defects	MA	Visual	Sample	Sample	Manufacturing Standard	Manufacturing Standard	Test Certificate	√	P/W			
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	Sample	Manufacturing Standard	Manufacturing Standard	Test Certificate	√	P/W			
	IN PROCESS INSPECTION													

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 4 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/N					M	C	N	
6.0	Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Surface defects after bending	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W			
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Deburring	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
	ASSEMBLY													
8.0	Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Alignment	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		3. Welding Quality	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		4. Surface defects	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 5 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**		
					M	C/N				D	M	C	N	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Periodic	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		3. Dipping / Removal Time	MA	Measurement	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		4. Surface quality after every dip	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		5. Primer after phosphating	MA	Visual, Thickness	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		6. Putty Application & Rubbing after primer	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		7. Paint first coat	MA	Visual, Thickness	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	14/4/2020	CHETAN MALIK	Checked by:	14/04/20	KUNDAN PRASAD			Reviewed by:			
Reviewed by:	14/4/2020	RK RAINA	Reviewed by:	14/4/2020	RK JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 6 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		3. Ferrule numbers	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		4. Colour of wiring	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	V		
		5. Size of Conductor	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	V		
11.	Component Mounting	1. Correct components	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Fixing	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			

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ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD			Reviewed by:			
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 7 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**		
					M	C/N				D	M	C	N	
	FINAL TESTING												
12.	Final Inspection	1. Workmanship	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	W		
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		At Random by BHEL, based on 100 % internal test reports by Mfr.
		3. Components identification Marking / Name plates	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		5. Dimensions	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		6. Door functioning	MA	Functional	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		At Random by BHEL, based on 100 % internal test reports by Mfr.
		7. Paint Shade	CR	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	14/12/2020	CHETAN MALIK	Checked by:	14/12/2020	KUNDAN PRASAD			Reviewed by:			
Reviewed by:	14/12/2020	RK RAINA	Reviewed by:	14/12/2020	RK JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 8 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/N					M	C	N	
		8. Paint Thickness	CR	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		9. Workmanship of Gaskets	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	W		
		10. Wiring Layout	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		11. Wire Termination	MA	Pulling manually	Sample	Sample	-----	Firm termination	Inspection Report	√	P/W	W		
		12. Continuity	MA	Electrical	100%	10%	-----	Continuity OK	Inspection Report	√	P/W	W		
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	Sample	Approved Drg/Datasheet Relevant IS-13947 Part-1, IS-2148.	Approved Drg/Datasheet Relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	√	P/W	V		
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	10%	Approved Drg/Datasheet Relevant IS.	Approved Drg/Datasheet Relevant IS.	Inspection Report	√	P/W	W		

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
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	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 9 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
15	FUCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		2. Instrument Calibration	CR	Electrical	10%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		3. Temperature rise	CR	Electrical	100%	10%	Approved Drg/Datasheet Relevant IS.	Approved Drg/Datasheet Relevant IS.	Inspection Report	√	P/W	W		

NOTES:

1. Customer's specification for painting shall be included in the technical specification. In the absence of Customer's spec. for painting, vendor to obtain BHEL's approval on their painting specification / procedure.
2. Copies of all TC's (Test Certificates) for components shall be submitted to BHEL for verification and acceptance.
3. BHEL reserves the right to conduct repeat tests, if required.

LEGENDS:
*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION, **D**: DOCUMENTATION,
** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **C**: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **N**: CUSTOMER,
P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR, **CR:** CRITICAL

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

SUB-SECTION-V-QE13

VFD MODULE

VFD MODULE SQE_28				
ATTRIBUTES / CHARACTERISTICS / **ITEMS/COMPONENTS, SUB SYSTEM ASSEMBLY**	Visual & Dimensional checks	Make / Type / Rating etc.	Final Inspection as ISS / IEC	Remarks
HT Breaker (IEC 56)	Y	Y	Y	
DC Reactor	Y	Y		For details refer table for DC Reactor
Transformer	Y	Y		For details refer table for Transformer
Motor	Y	Y		For details refer separate table for Motor
VFD Panel	Y	Y		For details refer table for VFD

Note : 1) This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed alongwith relevant supporting documents during QP finalisation.

2) Make of all major Bought Out Items will be subject to NTPC approval.

DC REACTOR

ATTRIBUTES / CHARACTERISTICS / ITEMS/COMPONENTS, SUB SYSTEM ASSEMBLY	Visual	Dimensional	Mech. & Chem. Property	Electrical Characteristics	Pretreatment by Seven Tank	Painting by Stove Enameling	Final Inspection as per IS-2026	Welding/NDT
Winding Material (Aluminium)	Y	Y	Y	Y				
Insulation Material	Y	Y		Y				
Sheet Steel	Y	Y	Y					
Winding	Y	Y		Y				
Fabrication of Enclosures	Y	Y			Y	Y		Y
Assembly	Y	Y						
Routine Tests	Y	Y					Y	

Note : 1) This is an indicative list of tests/checks. The manufacturer to furnish a detailed Quality Plan indicating their practice & procedure along with relevant supporting documents during QP finalisation for all items.

2) All major Bought Out Items will be subject to NTPC approval.

TRANSFORMER (OIL FILLED)

Attributes / Characteristics / Items/Components Sub Systems	Visual & Dimensional Checks	Mechanical properties	Electrical strength	Thermal properties	Chemical Composition	Compatibility with oil	NDT / DPT / MPI / UT	Ageing Test.	Voltage Ratio, Vector Group & Polarity, Magnetic Balance Test	Make / Type / Rating / Model / TC / General Physical Inspection.	WPS & PQR	Routine Test as per relevant test	Routine Test
Tank, H.V. & L.V. Cable Box / Flange throat	Y	Y					Y						
Conservator / Radiator / Cooler / Pipes	Y	Y					Y						
Copper Conductor (IS:191)	Y	Y	Y		Y								
Insulating Material	Y	Y	Y	Y	Y	Y							
CRGO Lamination & Built Core	Y	Y	Y		Y	Y							
Bushing / Insulator (IS:2544 / 5621)	Y	Y								Y		Y	
Gasket	Y				Y	Y		Y				Y	
Transformer Oil (IS:335 / IEC296)												Y	
Off-Circuit Tap Changer	Y									Y			
Core Coil Assembly & Pre-tanking	Y								Y				
Marshalling Box	Y	Y					Y					Y	
WTI, OTI, MOG, PRD, Breather, Terminal Connector, Bucholz Relay, Globe & Gate Valve,	Y									Y			
Welding (ASME Sect-IX)	Y										Y		
Complete Transformer (IS:2026/ IEC-60076)	Y												Y

Note: 1) This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2) All major Bought Out Items will be subject to NTPC approval.

DRY TYPE TRANSFORMER

Attributes / Characteristics / Items/Components Sub Systems	Visual & Dimensional check	Mechanical properties	Electrical strength	Thermal Properties	Chemical Properties	NDT / DP / MPI	Voltage Ratio, Vector Group & Polarity	Make / Type / Rating / Model /TC / General Physical Inspection	WPS & PQR	Routine Test as per relevant standard	Measurement of capacitance & tan delta between winding	Routine Test
Enclosure door, H.V. & L.V. Cable Box / Flange Throat	Y	Y						Y				
Copper Conductor	Y	Y	Y		Y							
Insulating Material	Y			Y	Y							
CRGO Lamination & Built Core	Y											
Bushing /Insulator (IS:2544 / 5621)	Y							Y		Y		
Gasket	Y							Y		Y		
Off-Circuit Tap Changer	Y							Y				
Core Coil Assembly	Y						Y					
Marshalling Box	Y									Y		
WTI, Thermister, Terminal Connector	Y							Y				
Welding									Y			
Complete Transformer (IS:11171 / IEC 60076)	Y										Y	Y

Notes: 1) This is an indicative List of test/checks. The manufacturer is to furnish a detailed Quality Plan indicating his practice and procedure along with relevant supporting documents during QP finalization for all item.

2. All major Bought out Items will be subject to NTPC approval.

VFD PANEL

Attributes Characteristics **Item Components Sub System Assembly**	Electrical Properties	Mechanical Properties	Chemical Properties	Dimensions / Finish	Type/ Rating/Functional check	HV/IR	Routine test as per relevant std.	Constructional Features	IS:6005 ,Seven tank process	Paint finish/ shade/thickness	Mountings / BOM/ Make, Completeness	Interlock Functional & Operation Testing / Simulation check	Degree of Protection Test	Final testing as per Relevant
Sheet Steel (IS-513)		Y	Y	Y										
Aluminum / Copper Bus-bar(IS-5082/IS-613/IS-1987)	Y	Y	Y	Y										
Support Insulator (BS-2782/IEC-660/IS-10912)	Y	Y	Y	Y										
Control / Selector Switch(IS-6875)					Y	Y	Y							
Contactor/ MCB(IS-13947)					Y	Y	Y							
O/L Protection relays(IS-3231)					Y		Y							
C.T /V.T/ Indicating Meter(IS-2705/3156/1248)					Y	Y	Y							
Fuse/ Fuse carrier(IS-13703)					Y	Y	Y							
Terminals/lugs/pvc wires(IS-13947//IS-694)	Y			Y	Y	Y	Y							
Timers(IS-3231)					Y	Y	Y							
Push Button/ Lamp/ (IS-6875)					Y	Y	Y							
Control Transformer (IS-12021)					Y	Y	Y							
Mimic, Annunciater					Y		Y							
GASKET(IS-11149)		Y	Y	Y	Y		Y							
Fabrication								Y						
Pretreatment & Painting									Y	Y				
VFD panel										Y	Y	Y	Y	Y

NOTE:

1. This is an indicative list of Test/ Checks. The manufacturer to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. All major Bought Out Items will be subject to NTPC approval.

SUB-SECTION-III-C6

TYPE TEST REQUIREMENTS

1.00.00 **TYPE TEST REQUIREMENTS**

1.01.00 General Requirements

1.01.01 The Contractor shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification. If the bidder proposes a different standard/code from that indicated at clause no 2.01.00 and at table 3.00.00, same is acceptable provided the equivalence of the proposed standard is established by the bidder. A list of such tests are given for various equipment in table titled 'TYPE TEST REQUIREMENT FOR OTHER C&I SYSTEMS' at the end of this chapter and under the item "Special Requirement for Solid State Equipments/Systems".

(a) Out of the tests listed, the Bidder/ sub-vendor/ manufacturer is required to conduct certain type tests specifically for this contract (and witnessed by Employer or his authorized representative) even if the same had been conducted earlier, as clearly indicated subsequently against such tests.

(b) For the rest, submission of type test results and certificate shall be acceptable provided.

i. The same has been carried out by the Bidder/ sub-vendor on exactly the same model /rating of equipment.

ii. There has been no change in the components from the offered equipment & tested equipment.

iii. The test has been carried out as per the latest standards alongwith amendments as on the date of Bid opening.

(c) In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Bidder/ sub-vendor within the quoted price and no extra cost will be payable by the Employer on this account.

1.01.02 The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion.

1.01.03 For the type tests to be conducted, Contractor shall submit detailed test procedure for approval by Employer. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording precautions to be taken etc. for the tests to be carried out.

1.01.04 The Bidder shall indicate in the relevant BPS schedule, the cost of the type test for each item only for which type tests are to be conducted specifically for this project. The cost shall only be payable after conduction of the respective type test in presence of authorize representative of Employer. If a test is waived off, then the cost shall not be payable.

2.00.00 **SPECIAL REQUIREMENT FOR SOLID STATE EQUIPMENTS/ SYSTEMS**

2.01.00 The type test reports which are to be submitted for each of the C&I systems(indicated in clause 2.01.01) shall be as indicated below:

i) Surge Withstand Capability (SWC) for Solid State Equipments/ Systems

All solid state systems/ equipments shall be able to withstand the electrical noise

and surges as encountered in actual service conditions and inherent in a power plant. All the solid state systems/ equipments shall be provided with all required protections that needs the surge withstand capability as defined in ANSI / IEEE C37.90.1.. Hence, all front end cards/ devices which receive external signals like Analog input & output modules, Binary input & output modules etc. including power supply, data highway, data links shall be provided with protections that meets the surge withstand capability as defined in ANSI / IEEE C37.90.1. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted along with the proposal. As an alternative to compliance to ANSI / IEEE C37.90.1, the system shall comply to IEC-61000-4-4, IEC-61000-4-5 and IEC-61000-4-18.

ii) Dry Heat test as per IEC-60068-2-2 or equivalent.

iii) Damp Heat test as per IEC-60068-2-30 or IEC-60068-2-78 or equivalent.

iv) Vibration test as per IEC-60068-2-6 or equivalent.

v) Electrostatic discharge tests as per IEC 61000-4-2 or equivalent.

vi) Radio frequency immunity test as per IEC 61000-4-6 or equivalent.

vii) Electromagnetic Field immunity as per IEC 61000-4-3 or equivalent.

2.01.01 **C&I Systems-**

Sl. No	Item	Remark	Test To Be Specifically Conducted	NTPC's Approval Req. On Test Certificate
1	Control System of DDCMIS		No	Yes
2	PLC, excluding its HMI	Not applicable for integral PLCs and PLCs which are governed by standard practice of OEM	No	Yes
3	VMS System (Applicable for each module of VMS)		No	Yes
4	Main Turbine & BFP Drive Turbine TSI System (Applicable for each module of TSI System)		No	Yes
5	Vibration Analysis System (Applicable for each module of Vibration Analysis System)		No	Yes

6	TG related Special modules like Auto synchronizer, Load transducer module and speed measurement module		No	Yes
7	Master Clock		No	Yes

Note:

Type Tests are to be conducted only for the items, which are being supplied as a part of this Package.

3.00.00 TYPE TEST REQUIREMENT FOR OTHER C&I SYSTEMS

Sl. No	Item	Test Requirement	Standard	Test To Be Specifically Conducted	NTPC's Approval Req. On Test Certificate
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6
1	Electronic transmitter	As per standard (col 4)	BS-6447 / IEC-60770	No	Yes
2	Instrumentation Cables Twisted & Shielded*				
	-Conductor	Resistance test	VDE-0815	No	Yes
		Diameter test	IS-10810	No	Yes
		Tin Coating test (Persul-phate test)	IS-8130	No	Yes
	-Insulation	Loss of mass	VDE 0472	No	Yes
		Ageing in air ovens**	VDE 0472	No	Yes
		Tensile strength and elongation test before and after ageing**	VDE 0472	No	Yes
		Heat shock	VDE 0472	No	Yes
		Hot deformation	VDE 0472	No	Yes

		Shrinkage	VDE 0472	No	Yes
		Bleeding & blooming	IS-10810	No	Yes
	-Inner sheath***	Loss of mass	VDE 0472	No	Yes
		Heat shock	VDE 0472	No	Yes
		Cold bend/ cold impact test	VDE 0472	No	Yes
		Hot deformation	VDE 0472	No	Yes
		Shrinkage	VDE 0472	No	Yes
	-Outer sheath	Loss of mass	VDE 0472	No	Yes
		Ageing in air ovens**	VDE 0472	No	Yes
		Tensile strength and elongation test before and after ageing**	VDE 0472	No	Yes
		Heat shock	VDE 0472	No	Yes
		Hot deformation	VDE 0472	No	Yes
		Shrinkage	VDE 0472	No	Yes
		Bleeding & blooming	IS-10810	No	Yes
		Colour fastness to water	IS-5831	No	Yes
		Cold bend/ cold impact test	VDE-0472	No	Yes
		Oxygen index test	ASTMD-2863	No	Yes
		Smoke Density Test	ASTMD-2843	No	Yes
		Acid gas generation test	IEC-60754-1	No	Yes

-fillers	Oxygen index test	ASTMD-2863	No	Yes
	Acid gas generation test	IEC-60754-1	No	Yes
-AL-MYLAR shield	Continuity test		No	Yes
	Shield thickness		No	Yes
	Overlap test		No	Yes
-Over all cable	Flammability Test	IEEE 383	No	Yes
	Swedish Chimney Test	SEN 4241475	No	Yes
	Noise interference	IEEE Trans-actions	No	Yes
	Dimensional checks	IS 10810	No	Yes
	Cross talk	VDE-0472	No	Yes
	Mutual capacitance	VDE-0472	No	Yes
	HV test	VDE-0815	No	Yes
	Drain wire continuity		No	Yes

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

2.0 In case the Contractor is not able to submit report of the type test(s) conducted within last Ten years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests either in an independent laboratory or at manufacturer's works in presence of Owner's representative under this contract free of cost to the Owner and submit the reports for approval.

**These tests shall be carried out as per VDE0207 Part 6 & ASTMD-2116 for TEFLON insulated & outer sheathed cables

***Applicable for armoured cables only

3 DC Power Supply System (Applicable for each model and rating)

1)The Type Test reports for offered rectifier module and the controller module irrespective of the rectifier bank shall be acceptable

	Surge Withstand Capability(SWC)	(ANSI / IEEE C37.90.1)or (IEC-61000-4-4, IEC-61000-4-5 and IEC-61000-4-18).	No	Yes
	Dry Heat Test	IEC-60068-2-2 or equivalent	No	Yes
	Damp Heat test	IEC-60068-2-30 or IEC-60068-2-78 or equivalent	No	Yes
	Vibration test	IEC-60068-2-6 or equivalent	No	Yes
	Electrostatic discharge test	IEC 61000-4-2 or equivalent	No	Yes
	Radio frequency immunity test	IEC-61000-4-6 or equivalent	No	Yes
	Electromagnetic field immunity	IEC 61000-4-3 or equivalent	No	Yes
	Degree of Protection	IS-13947 or equivalent	No	Yes
4	Battery ##	As per standard (col 4)	IS-10918 (Ni-Cd Batteries)	No	Yes
			IS-1652 (Lead Acid Plante Batteries)	No	

5 UPS (Applicable for each model and rating)

1) Type Test reports of same series of UPS with similar PCB's cards and controllers as the target UPS system shall be acceptable.

2) For Dry heat, Damp heat and vibration, the tests conducted on individual PCB's shall be acceptable.

	Surge Withstand Capability(SWC)	(ANSI / IEEE C37.90.1)or	No	Yes

			(IEC-61000-4-4, IEC-61000-4-5 and IEC-61000-4-18).		
		Dry Heat Test	IEC-60068-2-2 or equivalent	No	Yes
		Damp Heat test	IEC-60068-2-30 or IEC-60068-2-78 or equivalent	No	Yes
		Vibration test	IEC-60068-2-6 or equivalent	No	Yes
		Electrostatic discharge test	IEC 61000-4-2 or equivalent	No	Yes
		Radio frequency immunity test	IEC-61000-4-6 or equivalent	No	Yes
		Electromagnetic field immunity	IEC 61000-4-3 or equivalent	No	Yes
		Degree of protection test	IS-13947	No	Yes
		Fuse Clearing Capability	Approved procedure	No	Yes
		Short Circuit current capability	IEC 60146-2	No	Yes
6	Public Address System				
	IP based PA system components	As per Standard	IEC 60268-16	No	Yes
7	Control Valves	CV test	ISA 75.02& 75.11	No	Yes
8	Flow Nozzle Orifice plates	Calibration	ASME PTC BS 1042	No	Yes

The contractor shall submit for Employers approval the reports of all the type test as per latest IS-10918 carried out within last ten years from the date of Bid opening and the test(s) should have been either conducted at an independent laboratory or in presence of owner's representative. The complete type test reports shall be for any rating of Battery in a particular group based on plate dimensions being manufactured by supplier.

Note:

Type Tests are to be conducted only for the items, which are being supplied as a part of this Package.

MANDATORY SPARES

1. Unless stated otherwise a 'set' means items or sub-items required for each type/size range of the assembly/ sub-assembly, required for replacement in one main equipment. It is further intended that the assembly/ sub-assembly which have different orientation (like left hand or right hand, top or bottom), different direction of rotation or mirror image positioning or any other reasons which result in maintaining two different sets of the spares to be used for the subject assembly/ sub-assembly, these shall be considered as different types of assembly/ sub-assembly.
2. Wherever quantity has been specified as percentage (%), the quantity of mandatory spares to be provided by contractor shall be the specified percentage (%) of the total population of the plant. In case the quality so calculated happens to be a fraction, the same shall be rounded off to next higher whole number.
3. Whenever the quantities have been indicated for each type, size, thickness, material, radius, range etc., these shall cover all the items supplied and installed and the breakup for these shall be furnished in the bid.
4. In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the above list.
5. Price of each and every item is to be given separately.
6. Wherever rubber part viz: coupling, V belt, flexible hose etc have been used, minimum quantity as specified above is to be supplied and any item which is not covered above minimum 10% or 01 no whichever is higher is to be supplied.
7. Wherever non-metallic fabric/paper filter etc have been used, minimum quantity as specified above is to be supplied and any item which is not covered above minimum 10% or 01 no whichever is higher is to be supplied.
8. Any special tool required for maintenance of any of the equipment being supplied is to be included in mandatory T&P along with the equipment.

1.25.00 **CONTROL AND INSTRUMENTATION**

(EXCLUDING AIR CONDITIONING AND VENTILATION SYSTEM, COMPRESSED AIR SYSTEM, FIRE DETECTION AND PROTECTION SYSTEM. For mandatory spare of these systems, refer mandatory spare clauses specified under respective systems)

1.00.00 **CONTROL AND INSTRUMENTATION**

1.01.00 **MEASURING INSTRUMENTS**

1.01.01	(i) Transmitters of all types and model no. (for measurement of pressure, differential pressure, flow, level, temp, etc.). This shall include magnetic/ electromagnetic flow meter, mass flow meter also.	10% or 1 no. of each type and model, whichever is more.
	(ii) Density meter	10% or 1 no. of each type and model, whichever is more.
1.01.02	Temp Elements along with thermo well (except winding temp elements of motor)	10% or 2 no. of each type, model & length, whichever is more.
1.01.03	(i) Process Actuated Switches (Pressure, Differential pressure, flow, level, temp)	10% or 2 no. of each type and model, whichever is more.
	(ii) Limit switches (for pneumatic and manual valves)	10% or 2 no. of each type and model, whichever is more.
1.01.04	Local Gauges for Pressure, Differential pressure, flow, level, temp	5% or 1 no. of each type, model and range, whichever is more.
1.01.05	Vibration monitoring system	
(i)	Sensors	10% or Minimum 2 Nos. of each type, make and model whichever is more. *if prefab cable or prefab extension cable is used same should be supplied in proportion.
(ii)	Power Supply Module Cards	10% or minimum 2 nos which ever is more
(iii)	Driver / Interface Cards & all other electronic cards.	10% or minimum 2 nos which ever is more
~~1.02.00~~	**Continuous Emission Monitoring System (CEMS)**	
(i)	Analyzer for SO2, NOx, CO2, CO.	1 no. complete analyser of each type and model.

(ii)	Flue gas flow measurement instrument	1 no. complete instrument along with sender/receiver unit.
(iii)	Analyser for Particulate Matter	1 no. complete analyser
(iv)	Analyser for Mercury	1 no. complete analyser
(v)	O2 Analyser	1 no. complete analyser
(vi)	Electronic card assembly/ PCBs, moisture/condensate monitor, power supply modules	10% of each type, model and rating
(vii)	Set of gaskets/O-rings/ seals	200% of each type, model, rating and size
(viii)	Temp. Sensor	20% of each type and model
(ix)	Heater assembly, Coolers/dryers, Pumps, etc..	20% of each type and model
(x)	Complete Probe with shield assembly (Not applicable for In situ- path)	1 no. of each type and model
(xi)	Solenoids	2 nos. of each type, model and rating
(xii)	Filters, light source, sensor, detector, etc.	100% of each type, model and rating
(xiii)	Calibration gases, Calibration cell and other consumables for calibration: - of all types and ranges.	One year supply
(xiv)	Blower assembly	1 no. of each type, size and rating.
1.03.00	**Other FGD Analysers**	
(i)	Analysers for SO2, pH	1 no. complete analyser of each type and model.
(ii)	Set of gaskets/O-rings/ seals	200% of each type, model, rating and size
(iii)	Heater assembly, Coolers/dryers, pumps	20% of each type and model
(iv)	Filters, light source, sensor, detector, etc.	100% of each type, model and rating
(v)	Complete Probe with shield assembly (Not applicable for In situ- path)	1 no. of each type and model
(vi)	Solenoids	2 nos. of each type, model and rating

(vii)	Electronic card assembly/ PCBs, moisture/condensate monitor, power supply modules	10% of each type, model and rating
(viii)	Calibration gases, Calibration cell and other consumables for calibration: - of all types and ranges.	One year supply
1.04.00	**Analyzers for PT and UFRO system**	
i)	PH Analyzer	
	(a) Flow Through type cell and Electrode	1 no of each type
	(b) Electronic Transmitter unity without sensor	1 no of each type
	(c) Pre-fabricated cable with connector	1 set
ii)	Conductivity Analyzer	
	(a) Flow Through type cell and Electrode	1 no of each type
	(b) Electronic Transmitter unity without sensor	1 no of each type
	(c) Pre-fabricated cable with connector	1 set
iii)	Turbidity Analyzer	
	(a) Flow Through type cell and Electrode	1 no of each type
	(b) Electronic Transmitter unity without sensor	1 no of each type
	(c) Pre-fabricated cable with connector	1 set
iv)	Residual Chlorine Analyzer	
	(a) Sensor	1 no of each type
	(b) Transmitter	1 no of each type
	(c) Pre-fabricated cable with connector	1 set
	(d) All Chemical Reagents for 12 month operation (Supply to be staggered as per the shelf life)	1 set
v)	Silica Analyzer	
	(a) Main PCB assembly	1 no of each type
	(b) Power supply Cards(if applicable)	1 no of each type
	(c) Rubber Tubes & Capillary Tubes	1 set
	(d) Pre-fabricated cable with connector	1 set
	(e) Solenoid Valves	1 set
	(f) All Chemical Reagents for 12 month operation(Supply to be staggered as per the shelf life)	1 set

	vi)	Any other online analyser other than those covered above (as applicable)	1 set
	vii)	Electronic cards / PCB's for each type and model and model including power supply cards.	10%, or 2 nos. of each type and model whichever is more.
	viii)	Rubber tubes & capillary tubes of all types & sizes	100%
	ix)	Valves of each type & rating	20% or 1 No. of each type and rating
	x)	Filter/filter elements of all types	10%
	1.05.00	**PROCESS CONNECTION PIPING (For Impulse Piping / Tubing and Air Supply Piping as Applicable)**	
		1. Valves of all types and models	10% or 1 no. of each type, class, size and model whichever is more.
		2. 2 way, 3way, 5way valve manifolds	10% or 1 no. of each type, class, size and model whichever is more.
		3. Fittings	10% or 1 packet of each type, class, size and model whichever is more.
		4. Purge meters	5% of each model or 1 no. whichever is more.
		5. Filter regulators	20% of each model or 2 nos. whichever is more.
	1.06.00	CABLES	
		1. Pre fabricated cable of each type.	10% of installed quantity
		2. Pre fabricated cable connector of each type	10% or 1 no. of each type and model, whichever is more.
		3. Other cables	5% of each type, pair and size of actual installed quantity
	1.07.00	**24V – DC POWER SUPPLY SYSTEM**	

1.07.01	AC/DC isolators, contactors, timers, relays	10% of each type and rating.
1.07.02	Fuses of each type and rating	200%
1.07.03	Fuse free Circuit breakers	5% of each type and rating.
1.07.04	Electronic modules of all types	10% of each type.
1.07.05	Cooling Fans	2 nos. of each type
1.07.06	Relays of all types including overload relays	10% of each type and rating

1.08.00 DISTRIBUTED DIGITAL CONTROL MONITORING AND INFORMATION SYSTEM (DDCMIS)

Sl No	ITEM	QUANTITY
1.	**HMI Devices**	
A)	**Work station/PC station/servers**	
	(i) OWS with licensed software	2 nos. of each type and model
	(ii) Server/Information Workstation with licensed software (as applicable)	1 no. of each type and model
	(iii) Programmer cum documentation station along with licensed software	1 no. of each type and model
	(iv) Keyboard	2 nos. of each type and model
	(v) Mouse	4 nos. of each type and model
B)	**Printers**	
	(i) Color laser printer (A4)	1 no
	(ii) Print head assembly for A4 color laser printer	2 nos of each type and model
C)	**Network Components**	

		(i) Switch/repeaters/hubs/firewalls for DDCMIS	2 nos. of each type and model
		(ii) Wireless equipment like power supplies ,modems, electronic modules, media converter(if applicable),connectors patch card, antenna etc.	2 nos. of each type and model
		(iii) Any other device/equipment not covered under above items but required to make system complete.	2 nos. of each type and model
	D)	**Miscellaneous items**	
		(i) Hard disk drive unit of each type as offered in main offer complete with disks and other accessories	4 nos. (to be divided based on main population)
		(ii) Bulk Storage drive unit	2 nos. of each type and model
		(iii) Graphic processors modules/Card for work station/server	2 nos. of each type and model
	(E)	Any other device/items for HMIPIS system which are not covered in above items but are required to make the system complete.	1 no of each type and model
	2.	**Cables and Connectors.**	
		(i)Prefab interconnecting cables with connectors	2 no. of each type and length.
		(ii)System bus cable with connectors	2 no. of each type and length.
		(iii)I/O bus cable with connectors for remote I/O units	2 no. of each type and length.
		(iv)Loose Connectors	5 nos. (sets) of each type
	3.	Power Supply Modules & Power Packs for control system	20% or 4 nos. of each type model and rating, whichever is more.
	4.	Electronic modules of each type and model for control system, Data communication system etc. (This shall include all type of cards like I/O cards, Remote I/O cards, communication/Interface cards,	20% or 2 Nos of each type, model and rating whichever is more subject to maximum of 20 Nos of each type.

	controller cards, CPU module or Card, logic cards, etc.)	
5.	Bus coupler/Interface hardware / other communication devices.	20% of each type and model or minimum 2 nos. whichever is more.
6.	Relays	10% of each type and model or minimum 2 nos which ever is more
7.	Batteries used for battery backup of RAMs(If applicable)	10% of each type and model or minimum 2 nos whichever is more
8.	Fuses	200 % of each type and rating
9.	Cooling fans for Power supply and cabinets.	10 % of each type and model
10	Intelligent mini UPS for workstation server, PCs, L3 switch.	1 no. of each size and rating
11	For all items of Fieldbus system (including field accessories) except fieldbus cables	20% or 2 Nos. of each type, model and rating whichever is more subject to maximum of 40 Nos of each type.
12	Fieldbus cable	10% of total length used in the project.
1.09.00	**OTHER RELATED CONTROL AND INSTRUMENTATION SYSTEMS / EQUIPMENTS**	
	1. Lime Feeders	
	1.1 Motion monitor	10% or 2 nos. whichever is more.
	1.2 Speed pick-up	10% or 2 nos. whichever is more.
	1.3 Torque switch (if applicable)	10% or 2 nos. whichever is more.
	1.4 Load Cell	10% or 2 nos. whichever is more.
	1.5 Electronic cards & Power Supply cards	10% or 2 nos. whichever is more.
	1.6 Clutch (if applicable)	10% or 2 nos. whichever is more.
	1.7 Local indication lamps	200 %
	1.8 Panel meters	10% or 2 nos. whichever is more.
	1.9 Limit switch assembly for	10% or 2 nos., whichever is more.

	lime-on- belt, no lime flow, shear pin failure, etc.	
1.10.00	**CONTROL VALVES, ACTUATORS & ACCESSORIES (Following items shall be provided under this clause for all modulating control valves being supplied under this package)**	
	1. Pneumatic and electro-hydraulic actuator assembly	10% or 1 no. of each type, model and rating, whichever is more.
	2. Valve trim (including cage, plug, stem, seat rings, guide bushings etc.)	1 set for each type of control valve.
	3. Diaphragms, O' rings, seals etc. of all types make etc.	100%
	4. Pressure Gauges of all types, make, rating etc.	10% or 2 nos. of each type whichever is more
	5. Solenoid valves (if applicable)	10% or 2 nos. of each type whichever is more
	6. Positioner units (complete unit)& accessories (link assembly)	10% or 1 no. of each type whichever is more
	7. Pneumatic air-filter/Regulator of each type, make rating etc.	10% or 2 Nos., whichever is more
	8. Air lock relays	10% or 2 nos. of each type whichever is more
1.11.00	**PNEUMATICS ISOLATION / BLOCK VALVES, ACTUATORS & ACCESSORIES (For all ON/OFF valves supplied under this package)**	
	1. Pneumatic actuator assembly	10% or 1 no. of each type, model and rating, whichever is more.
	2. Diaphragms, O' rings, seals etc. of all types make etc.	100%
	3. Limit switches (complete unit)& accessories (link assembly)	10% or 2 Nos., whichever is more
	4. Pneumatic air-filter/Regulator of	10% or 2 Nos.,

	each type, make rating etc.	whichever is more

1.12.00 ELECTRIC ACTUATORS

1	Actuators	1 no of each type and rating
2	Electronic PCB of all types	10% of each type & model
3	Absolute Encoder (replaceable part)	5% of each type & model
4	Electronic Torque sensor	5% of each type & model

1.13.00 Uninterrupted Power supply (UPS) including Static Switch

SI No	ITEM	QUANTITY
(i)	Silicon controlled thyristors, diodes and power transistors.	100 %
(ii)	Capacitors	1 set
(iii)	CT's, CVT's VT's chokes, AC/DC isolators, contactors, timers, relays	10% of each type and rating.
(iv)	Fuses of each types and rating	200%
(v)	Fuse free Circuit breakers	5% of each type and rating
(vi)	Electronic modules	10% of each type
(vii)	Indication lamps	100% of each type
(viii)	Lamp holders with series resistor, if any	10% of each type
(ix)	Cooling Fans	2 nos. of each type
(x)	Digital/analog panel meters/ indicators	1 no. of each type
(xi)	Relays of all types including overload relays.	10%
(xii)	Static Switch	10% or minimum 1 no (whichever is higher) of each type and rating

1.14.00 Solenoid Valves

SI No	ITEM	QUANTITY
(i)	Solenoid Valves	10% of each type, rating and model

	(ii)	Solenoid Valve COILS	10% of each type, rating and model

KKS TAGGING 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**.

ANNEXURE-1

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

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

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*

		N1	N2 N3
Motorised *(on/off duty)*	-	*0*	*01 to 50*
Motorised (inching duty)	-	*0*	*51 to 99*
Pneumatic (Control)	-	*1*	*01 to 50*
Motorised (thyrestor Control)	-	*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.

SUB VENDOR LIST

Sub-Vendor List as on 13-Dec-2022

Sl No	Package Name	Supplier Name	Supplier Communication Address
1	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in
2	TEMPERATURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in
3	TRANSMITTERS	ABB INDIA LIMITED	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com
4	ELECTROMAGNETIC FLOW METER	Adept Fluidyne Pvt. Ltd.	Vinayak Gadre Plot No 4,S.No.17/1-B Kothrud Industrial Estate Pune Phone- 020 25464551 Pincode : 411038 Email : info@adeptfluidyne.com
5	ULTRASONIC FLOW METERS	Adept Fluidyne Pvt. Ltd.	Vinayak Gadre Plot No 4,S.No.17/1-B Kothrud Industrial Estate Pune Phone- 020 25464551 Pincode : 411038 Email : info@adeptfluidyne.com
6	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	JIGNESH MAHENDRA AJMERA DENA BANK BLDG.,SHREE NAGESH INDL. ESTATE,STATION ROAD, MUMBAI Phone- 022 67973578 Pincode : 400 088 Email : ajmera@ajmera.net, jmajmera@yahoo.com
7	INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.	Mr.Sanjay Brahman/Mr.Shyam Vazirani 102, Vora Industrial Estate No.4 Navghar, Vasai Road (E) Dist.Thane, Mumbai Phone- +91-250-2392246 Pincode : 401210 Email : arya@aryaengg.com
8	INSTRUMENT FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
9	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
10	INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
11	SIGHT FLOW INDICATORS	B.K.EQUIPMENTS PVT.LTD.	T. BALAKRISHNAN/S.VENKATESH 217 , ARCOT ROAD PORUR , CHENNAI Phone- 9444057761 Pincode : 600116 Email : bkequip@gmail.com
12	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Barksdale GmbH, Germany	Michael Weileder Dorn Assenheimer, Strasse 27 Reichelsheim Phone- +91-9999107840 Pincode : D-61203 Email : msingh@barksdale.de
13	LEVEL SWITCH-CAPACITANCE TYPE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
14	LEVEL SWITCH-FLOAT TYPE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
15	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
16	TEMP. ELEMENT	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com

Sub-Vendor List as on 13-Dec-2022

Sl No	Package Name	Supplier Name	Supplier Communication Address
17	TEMPERATURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
18	LEVEL GAUGE	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com
19	LEVEL SWITCH-CONDUTIVITY TYPE	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com
20	SIGHT FLOW INDICATORS	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com
21	CONTROL VALVE	BOMAFA SPECIAL VALVE SOLUTIONS PVT LTD	Mr. K.M. Anklesaria/ R. M. Anklesaria Plot No: 285/2, Panchratna Estate, Near Ramol Bridge, Vatva Ahmedabad Phone- 079-40083825 Pincode : 382445 Email : info@bomafa-india.com
22	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	BOSE PANDA INSTRUMENTS PVT.LTD.	Mr. Partha Bose 44, Saheed Hemanta Kumar Bose, Sarani, Kolkata Phone- +91 33 2548 7220 Pincode : 700074 Email : parthabosebpi@gmail.com; bosepanda@vsnl.net
23	FLOW ELEMENT - ORIFICE	CHEMTROLS INDUSTRIES PVT. LTD.	Mr. K. NANDAKUMAR AMAR HILL, SAKI VIHAR ROAD, POWAI, MUMBAI Phone- 022-67151261 Pincode : 400072 Email : manikandan@chemtrols.com
24	CONTROL VALVE	CIRCOR FLOW TECHNOLOGIES INDIA PVT. LTD.	Mr. Vinodh Gopinath, Senior Director SF No. 337/2, No.15 Naranapuram Village,Ponnandampalayam Coimbatore Phone- 9500928448 Pincode : 641659 Email : santhosh.ponnusamy@circor.com
25	INSTRUMENT FITTINGS	Comfit & Valve Pvt. Ltd.	Mr. Jeetu Jain/Mr. Vinay Sosa Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway Laxmipura, Nandasan Phone- 02764-267036/37 Pincode : 382705 Email : marketing@com-fit.com
26	LEVEL SWITCH-FLOAT TYPE	D.K. INSTRUMENTS PVT.LTD.	N.SIKDAR/ SUMIT SIKDAR 76/2,SELIMPUR RD DHAKURIA Kolkata Phone- 033-2415-1310. Pincode : 700031 Email : dkinst@vsnl.net
27	TEMP. ELEMENT	DETRIVE INSTRUMENTATION & ELECTRONICS LTD.	320, TV INDUSTIAL ESTATE, OFF.DR.A.BESANT ROAD, BEHIND GLAXO, WORLI, MUMBAI Phone- 24934125,24938403 Pincode : 400025 Email : trivtech@vsnl.com
28	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com
29	TEMPERATURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com
30	FLOW ELEMENT - NOZZLE	DYNAFLUID VALVES AND FLOW CONTROLS (P) LTD.	Mr. Yogish M. Kulkarni Plot # 23, Udyambag, Belgaum Phone- 0831-4210386 Pincode : 590008 Email : yogish@dyna-fluid.com
31	FLOW ELEMENT - ORIFICE	DYNAFLUID VALVES AND FLOW CONTROLS (P) LTD.	Mr. Yogish M. Kulkarni Plot # 23, Udyambag, Belgaum Phone- 0831-4210386 Pincode : 590008 Email : yogish@dyna-fluid.com
32	ELECTROMAGNETIC FLOW METER	Electronet Equipments Pvt Ltd.	Mr. Rajendra Nagaonkar/MD, Plot No. 84, 85 & 86, Tiny Industrial Estate Kondhwa Budruk, Pune Phone- 9822015256 Pincode : 411048 Email : ho@eeplindia.com

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Sl No	Package Name	Supplier Name	Supplier Communication Address
33	FLOW ELEMENT - ORIFICE	Electronet Equipments Pvt Ltd.	Mr. Rajendra Nagaonkar/MD, Plot No. 84, 85 & 86, Tiny Industrial Estate Kondhwa Budruk, Pune Phone- 9822015256 Pincode : 411048 Email : ho@eeplindia.com
34	ULTRASONIC FLOW METERS	Electronet Equipments Pvt Ltd.	Mr. Rajendra Nagaonkar/MD, Plot No. 84, 85 & 86, Tiny Industrial Estate Kondhwa Budruk, Pune Phone- 9822015256 Pincode : 411048 Email : ho@eeplindia.com
35	TRANSMITTERS	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	Mr. Amit Paithankar/Vikram Raj Singh 206-210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com
36	CONTROL VALVE	EMERSON PROCESS MANAGEMENT CHENNAI LIMITED	147, KARAPAKKAM VILLAGE, CHENNAI Phone- 23722184, 23716242 Pincode : 600096 Email : jatinder.singh@emerson.com
37	TRANSMITTERS	Endress + Hauser (India) Pvt. Ltd.,	Mr. Prakash Vaghela 215-216, DLF Tower 'A', Jasola District Centre, New Delhi, Phone- 9717593001, Pincode : 110025, Email : prakash.vaghela@in.endress.com,
38	ELECTROMAGNETIC FLOW METER	EUREKA INDUSTRIAL EQUIPMENTS PVT. LTD.	Mr V. K. Pandit/Mr Ashish Shaha 17-20, Royal chambers, Paud Road Pune Phone- 9370469466 Pincode : 411038 Email : sales@eurekaflow.com
39	FLOW ELEMENT - ORIFICE	EUREKA INDUSTRIAL EQUIPMENTS PVT. LTD.	Mr V. K. Pandit/Mr Ashish Shaha 17-20, Royal chambers, Paud Road Pune Phone- 9370469466 Pincode : 411038 Email : sales@eurekaflow.com
40	ULTRASONIC FLOW METERS	FLASH FORGE PVT LTD	Mr. Gautam Makker, 503, 'A'-wing, Delphi, Orchard Avenue Road, Powai Mumbai Phone- 022-42784300 Pincode : 400076 Email : hemendrapatil@f-f.co.in
41	ULTRASONIC FLOW METERS	FLEXIM Flexible Industriemesstechnik GmbH	Boxberger Str., 4, Berlin Berlin Phone- 0049 30 93 66 76 60 Pincode : 12681 Email : info@flexim.de
42	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Mr. Dineshbhai Zaveri C-1/ 27&37, GIDC, Kabilpore, Navsari Phone- 02637-265140,265003 Pincode : 396424 Email : flexpro@flexproltd.com
43	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
44	INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
45	INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
46	INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.	Mr. Abbas Bhola Potia Building No. 2, Office No. 3,292, Bellasis Road,Mumbai Central (East) Mumbai Phone- 9920044113 Pincode : 400008 Email : ab@fluidfitengg.com
47	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com

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Sl No	Package Name	Supplier Name	Supplier Communication Address
48	TEMPERATURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com
49	CONTROL VALVE	FORBES MARSHALL ARCA PVT.LTD.	A-34/35 , MIDC ESTATE, H-BLOCK, PIMPRI, PUNE, Phone- 020-27442020, Pincode : 411018 Email : mnadgaundi@forbesmarshall.com
50	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,
51	TEMP. ELEMENT	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,
52	TEMPERATURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,
53	LEVEL SWITCH-FLOAT TYPE	GENERAL INSTRUMENTS CONSORTIUM	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com
54	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	GENERAL INSTRUMENTS CONSORTIUM	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com
55	TEMP. ELEMENT	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,
56	TEMPERATURE GAUGE	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,
57	TEMPERATURE GAUGE	GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	FLAT -B , GF, HILL CROWN APTS., COLLEGE ROAD, MAPUSA Phone- Pincode : 403525 Email : gtilworks@pyro-electric.in
58	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net
59	TEMPERATURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net
60	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com
61	TEMPERATURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com
62	LEVEL SWITCH-CONDUTIVITY TYPE	HI-TECH SYSTEMS & SERVICES LTD.	Mr. Vikash Agrawal/Mr. Tarun Debnath 119, PARK STREET , KOLKATA Phone- 033-22290045 Pincode : 700016 Email : sandeep@hitech.in
63	TRANSMITTERS	Honeywell Automation India Limited	Mr. Ritwij Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com
64	INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.	S. Harichandran/P.S. Pandi B-11, Mugappair Industrial Estate, CHENNAI Phone- 044 26252537 Pincode : 600037 Email : sales@hpvalvesindia.com

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Sl No	Package Name	Supplier Name	Supplier Communication Address
65	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com
66	TEMPERATURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com
67	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS INDUSTRIES LIMITED	B-20-21, INDUSTRIAL AREA, MEERUT ROAD, GHAZIABAD Phone- 0120-2712016 Pincode : Email : mktg@indfos.com
68	FLOW ELEMENT - ORIFICE	INSTRUMENTATION ENGINEERS PVT LTD	SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD Phone- 9848407365 Pincode : 500055 Email : iedelhi@ieflowmeters.com
69	SIGHT FLOW INDICATORS	INSTRUMENTATION ENGINEERS PVT LTD	SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD Phone- 9848407365 Pincode : 500055 Email : iedelhi@ieflowmeters.com
70	CONTROL VALVE	INSTRUMENTATION LTD.	KANJIKODE WEST, PALALKKAD, PALAKKAD Phone- 2566127-130,2567128 Pincode : 678623 Email : mraj@ilpgt.com;dgmc@ilpgt.com;qireesh@ilpgt.com
71	FLOW ELEMENT	INSTRUMENTATION LTD.	KANJIKODE WEST, PALALKKAD, PALAKKAD Phone- 2566127-130,2567128 Pincode : 678623 Email : mraj@ilpgt.com;dgmc@ilpgt.com;qireesh@ilpgt.com
72	FLOW ELEMENT - NOZZLE	INSTRUMENTATION LTD.	KANJIKODE WEST, PALALKKAD, PALAKKAD Phone- 2566127-130,2567128 Pincode : 678623 Email : mraj@ilpgt.com;dgmc@ilpgt.com;qireesh@ilpgt.com
73	FLOW ELEMENT - ORIFICE	INSTRUMENTATION LTD.	KANJIKODE WEST, PALALKKAD, PALAKKAD Phone- 2566127-130,2567128 Pincode : 678623 Email : mraj@ilpgt.com;dgmc@ilpgt.com;qireesh@ilpgt.com
74	FLOW ELEMENT - ORIFICE	JAV FORGINGS & ENGINEERINGS PRIVATE LIMITED	H-30, LANE W-10, WESTERN AVENUE, SAINIK FARM Delhi Phone- 9310035304 Pincode : 110062 Email : info@thejavgroup.com
75	JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.	S Raghavan No. 72, 3rd Main, 1st Stage Industrial Suburb, Yeshwanthpur Bangalore Phone- 9880385770 Pincode : 560022 Email : sales1@ksinstruments.net
76	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Kaustubha Udyog,	S.No. 36/1/1, Sinhgad Road, Vadgaon Khurd, Near Lokmat Press, Pune, Phone- 020-24393577, Pincode : Email : pressure@vsnl.com,
77	CONTROL VALVE	Koso India Private Limited,	H 33 & 34, MIDC, Ambad, Nashik, Phone- 09650233433 Pincode : 422010, Email : enquiry@koso.co.in;jetmal.gour@koso.co.in
78	CONTROL VALVE	KSB MIL CONTROLS LTD.	Mr.Jacob Cherian/Mr.Geo Jolly Meladoor, Annamanada P.O. MALA, Thrissur Phone- 0480-2695700 Pincode : 680741 Email : biju.simon@ksb.com
79	LEVEL SWITCH-CAPACITANCE TYPE	LEVCON INSTRUMENTS PVT. LTD.	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com
80	LEVEL SWITCH-CONDUTIVITY TYPE	LEVCON INSTRUMENTS PVT. LTD.	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com
81	LEVEL SWITCH-FLOAT TYPE	LEVCON INSTRUMENTS PVT. LTD.	Mr Shayak Gupta/Badal Jana Rajkamal', 7th floor, 13, Camac Street KOLKATA Phone- 0 33 2283 2766 Pincode : 700017 Email : b_jana@levcongroup.com

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Sl No	Package Name	Supplier Name	Supplier Communication Address
82	CONTROL VALVE	Mascot Valves Pvt. Ltd.	166-167 GIDC Naroda Ahmedabad Phone- 0792282 1619 Pincode : 382330 Email : dom.sales@mascotvalves.com
83	FLOW ELEMENT	MICRO PRECISION PRODUCTS PVT. LTD.	Mr. Anil Bhati, H.B. No.-40, Revenue Estate, Village-Dudhola,Tehsil & Distt. Palwal FARIDABAD Phone-9560742713;095607427 Pincode : 121002 Email : anil.bhati@wika.com
84	FLOW ELEMENT - NOZZLE	MICRO PRECISION PRODUCTS PVT. LTD.	Mr. Anil Bhati, H.B. No.-40, Revenue Estate, Village-Dudhola,Tehsil & Distt. Palwal FARIDABAD Phone-9560742713;095607427 Pincode : 121002 Email : anil.bhati@wika.com
85	FLOW ELEMENT - ORIFICE	MICRO PRECISION PRODUCTS PVT. LTD.	Mr. Anil Bhati, H.B. No.-40, Revenue Estate, Village-Dudhola,Tehsil & Distt. Palwal FARIDABAD Phone-9560742713;095607427 Pincode : 121002 Email : anil.bhati@wika.com
86	FLOW ELEMENT - NOZZLE	MINCO (INDIA) FLOW ELEMENTS PVT. LTD.	Mr. Raghavendra M. Kulkarni D2-49/50, Tivim Industrial Estate, Karaswada Mapusa Phone- 0832-2257059 Pincode : 403526 Email : gicflowelement@giconindia.com
87	FLOW ELEMENT - ORIFICE	MINCO (INDIA) FLOW ELEMENTS PVT. LTD.	Mr. Raghavendra M. Kulkarni D2-49/50, Tivim Industrial Estate, Karaswada Mapusa Phone- 0832-2257059 Pincode : 403526 Email : gicflowelement@giconindia.com
88	FLOW ELEMENT - NOZZLE	MINCO (INDIA) PRIVATE LIMITED	Mr. Rajeev Vasudeva, D/35, TIVIM INDUSTRIAL ESTATE, KARASWADA, MAPUSA, Goa, Phone- 9313637073 Pincode : 403526, Email : gicdelhi@general-gauges.com
89	FLOW ELEMENT - ORIFICE	MINCO (INDIA) PRIVATE LIMITED	Mr. Rajeev Vasudeva, D/35, TIVIM INDUSTRIAL ESTATE, KARASWADA, MAPUSA, Goa, Phone- 9313637073 Pincode : 403526, Email : gicdelhi@general-gauges.com
90	TRANSMITTERS	Moore Industries International Inc.	Leonard.W. Moore/ Matt Moren 16650 Schoenborn St. North Hills Phone- +1 818 830 5548 Pincode : 91343 Email : mmoren@miinet.com
91	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Nesstech Instruments Private Limited	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi Phone- 9920576002 Pincode : 396105 Email : sales@nesstech.co.in
92	TEMP. ELEMENT	Nesstech Instruments Private Limited	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi Phone- 9920576002 Pincode : 396105 Email : sales@nesstech.co.in
93	ELECTROMAGNETIC FLOW METER	NIVO CONTROLS PVT. LTD.	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com
94	TRANSMITTERS	NIVO CONTROLS PVT. LTD.	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com
95	INSTRUMENT FITTINGS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,
96	TRANSMITTERS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,

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Sl No	Package Name	Supplier Name	Supplier Communication Address
97	INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.	MD Hussain Shaikh/Shahanawaz Khan Gala No. 168, Loheki Chwal,216/ 218, Maulana Azad Rd. Nagpada Junction Mumbai Phone- 91-9324383121 Pincode : 400008 Email : shahanawaz.khan@perfectinstrumentation.com
98	INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
99	INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
100	INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
101	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com
102	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com
103	TEMPERATURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com
104	LEVEL SWITCH-CAPACITANCE TYPE	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com
105	LEVEL SWITCH-FLOAT TYPE	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com
106	TRANSMITTERS	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com
107	TEMP. ELEMENT	PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD.	M. D. BICHU/R. M. BICHU G.B, HILL CROWN APARTMENTS, COLLEGE ROAD, MAPUSA Phone- 9326114601 Pincode : 403507 Email : priyanka.marketing@pyro-electric.in
108	LEVEL SWITCH-CONDUTIVITY TYPE	RAMAN INSTRUMENTS PVT.LTD.	Mr. N R Shenoy/Mr G B Vijh 8, First Floor.Plot : 160A Bait-Ush-Sharaf, 29th Road,Bandra(W) MUMBAI Phone- 09892331381 Pincode : 400050 Email : ramanbpl@vsnl.com
109	ELECTROMAGNETIC FLOW METER	Rockwin Flowmeter India Pvt. Ltd.	B-24, Site-IV, Sahibabad Industrial Area Ghaziabad, Phone- 9810129687 Pincode : 201010, Email : amiya@rockwin.com
110	ULTRASONIC FLOW METERS	Rockwin Flowmeter India Pvt. Ltd.	B-24, Site-IV, Sahibabad Industrial Area Ghaziabad, Phone- 9810129687 Pincode : 201010, Email : amiya@rockwin.com
111	CONTROL VALVE	SAMSON CONTROLS PVT. LTD.	Mr. Atul raje-MD D 281, MIDC Ranjangaon Ta Shirur Pune Phone- 02067246600 Pincode : 412220 Email : sales@samsoncontrols.net
112	LEVEL SWITCH-CONDUTIVITY TYPE	Sapcon Instrument Pvt Ltd.	131, PALSHIKAR COLONY Contact Person- Mr. Ashwin (9826080207) INDORE Phone- +91-731-4085751, Pincode : 452004 Email : sales@sapconinstruments.com

Sub-Vendor List as on 13-Dec-2022

Sl No	Package Name	Supplier Name	Supplier Communication Address
113	LEVEL SWITCH-FLOAT TYPE	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE, Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in
114	TRANSMITTERS	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE, Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in
115	ELECTROMAGNETIC FLOW METER	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
116	FLOW ELEMENT - ORIFICE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
117	LEVEL SWITCH-CAPACITANCE TYPE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
118	LEVEL SWITCH-FLOAT TYPE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
119	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
120	SIGHT FLOW INDICATORS	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
121	TEMP. ELEMENT	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
122	CONTROL VALVE	Severn Glocon India Pvt. Ltd.	F96 & F97, Sipcot Industrial Park, Irungattukottai, Chennai, Phone- 044-47104200, Pincode : 602117, Email : info@severnglocon.co.in,
123	JUNCTION BOX	Shrenik & Company,	Mr. Mitesh Shah/Mr. Pulin Shah 39 A/3 ,Panchratna Industrial Estate, Sarkhej-Bavla Road Ahmedabad Phone- 9825024921 Pincode : 382213 Email : sales@pustron.com, pulin@sumip.com
124	TRANSMITTERS	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com
125	LEVEL GAUGE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
126	LEVEL SWITCH-CAPACITANCE TYPE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in

Sub-Vendor List as on 13-Dec-2022

Sl No	Package Name	Supplier Name	Supplier Communication Address
127	LEVEL SWITCH-CONDUTIVITY TYPE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
128	LEVEL SWITCH-FLOAT TYPE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
129	SIGHT FLOW INDICATORS	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
130	TRANSMITTERS	SMART INSTRUMENTS LTD, BRAZIL	Agents: Digital Electronic Ltd. 74/11 'C' Cross Road MIDC Andheri (East) MUMBAI Phone- 28208477 Pincode : 400093 Email : corp@delbby.rpgms.ems.vsnl.net.in
131	DIFFERENTIAL PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
132	LEVEL SWITCH-CONDUTIVITY TYPE	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
133	LEVEL SWITCH-FLOAT TYPE	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
134	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
135	TEMPERATURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
136	FLOW ELEMENT	STAR-MECH CONTROLS (I) PVT.LTD.	SUSHILLOTAM, SUSHILLOTAM, 29/3A/3, SASANE NAGAR, HADAPSAR, PUNE Phone- 02026970450 Pincode : 411028 Email : marketing@starmech.net
137	FLOW ELEMENT - NOZZLE	STAR-MECH CONTROLS (I) PVT.LTD.	SUSHILLOTAM, SUSHILLOTAM, 29/3A/3, SASANE NAGAR, HADAPSAR, PUNE Phone- 02026970450 Pincode : 411028 Email : marketing@starmech.net
138	FLOW ELEMENT - ORIFICE	STAR-MECH CONTROLS (I) PVT.LTD.	SUSHILLOTAM, SUSHILLOTAM, 29/3A/3, SASANE NAGAR, HADAPSAR, PUNE Phone- 02026970450 Pincode : 411028 Email : marketing@starmech.net
139	JUNCTION BOX	SUCHITRA INDUSTRIES	NO-2,OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE Phone- Pincode : Email : suchitra.industriesblr@gmail.com

Sub-Vendor List as on 13-Dec-2022

Sl No	Package Name	Supplier Name	Supplier Communication Address
140	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	Mr. V S Jayaprakash, 128, SIDCO North Phase, Ambattur Estates CHENNAI Phone- 044-26252017/2018 Pincode : 600050 Email : sales@switzerprocess.co.in
141	TEMPERATURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	Mr. V S Jayaprakash, 128, SIDCO North Phase, Ambattur Estates CHENNAI Phone- 044-26252017/2018 Pincode : 600050 Email : sales@switzerprocess.co.in
142	FLOW ELEMENT - ORIFICE	TANSA EQUIPMENTS PVT. LTD.	Mr. Vardhan Tamhankar, Unit No35/36/41,Om Anand Industrial Est. Mohanjee Sundarjee Road,Raghunath Nagar, Thane Phone- 022-25832323 Pincode : 400604 Email : tansaindia@gmail.com
143	TEMP. ELEMENT	Tempsens Instrument (I) Pvt Ltd	MR. V.P.RATHI/MR. HEMANT RATHI B-188A ROAD NO.5 , M.I.A UDAIPUR Phone- 09352420069 Pincode : 313003 Email : info@tempsens.com
144	TEMP. ELEMENT	Thermal Instrument India Pvt. Ltd.	Mr. Raghavendra M. Kulkarni 194/195, Gopi Tank Road Behind Citylight Cinema,Mahim Mumbai Phone- 09322664709 Pincode : 400016 Email : ramk@giconindia.com
145	FLOW ELEMENT	TM TECNOMATIC SPA	MR. ANTONIO NOVIELLO/Mrs. Enrica Bazzocc VIA DELLE INDUSTRIE, 36 CREMONA Phone- 39037221574 Pincode : 26100 Email : info@tmtecnomatic.com
146	LEVEL GAUGE	TOSHNIWAL BROTHERS PVT.LTD.	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com
147	TEMPERATURE SWITCH	TOSHNIWAL BROTHERS PVT.LTD.	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com
148	TEMP. ELEMENT	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,
149	TRANSMITTERS	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,
150	ULTRASONIC FLOW METERS	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,
151	LEVEL SWITCH-CAPACITANCE TYPE	V. AUTOMAT & INTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
152	LEVEL SWITCH-CONDUTIVITY TYPE	V. AUTOMAT & INTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
153	LEVEL SWITCH-FLOAT TYPE	V. AUTOMAT & INTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
154	SIGHT FLOW INDICATORS	V. AUTOMAT & INTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
155	TRANSMITTERS	V. AUTOMAT & INTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
156	ELECTROMAGNETIC FLOW METER	V.A Valves	Mr.Vishal Jain, Udyog Nagar, Gadaipur, Jalandhar Phone- 9872626376 Pincode : 144004 Email : support@fedrelflowmeters.com
157	INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com

Sub-Vendor List as on 13-Dec-2022

Sl No	Package Name	Supplier Name	Supplier Communication Address
158	INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
159	INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
160	TRANSMITTERS	YOKOGAWA INDIA LIMITED,	PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE, Phone- 080-41586000, Pincode : Email : uday.shankar@in.yokogawa.com,

Note:
1) The above sub-vendor list is tentative & reference only. However Sub-Vendor List is subject to BHEL/end user approval without any commercial/ delivery implication.
2) New Sub-Vendor if proposed by Vendor during contract stage shall subject to BHEL/ end user approval without any commercial/ delivery implication.

ANNEXURE-I

1. REFER ELECTRICAL AND C&I SPECIFICATION FOR APPLICABLE SUB-VENDOR LIST FOR THE RELEVANT ITEMS.

2. THE LIST OF ALL BOUGHT OUT ITEMS WITH MAKES AND COUNTRY OF ORIGIN AND CONTACT DETAILS OF THE MANUFACTURERS TO BE MENTIONED ALONG WITH OFFER TO BE SUBMITTED IN THE FORMAT ATTACHED IN SECTION III AS AN INFORMATION TO BHEL.

3. ACCEPTANCE OF MAKES SHALL BE SUBJECT TO BHEL/ END-CUSTOMER ACCEPTANCE DURING THE DETAILED ENGINEERING WITHOUT COST AND DELIVERY IMPLICATION TO BHEL.

ANNEXURE-II

LIST OF MANDATORY SPARES

I. MECHANICAL		
Sl. NO.	**PARTICULARS**	**QUANTITY**
1.	**Hydro-cyclones (Gypsum Primary Dewatering, Secondary Waste Water and any other Hydrocyclone)**	
a.	Hydro-cyclone Isolation Valve	10% of each type OR 1 no. whichever is higher
b.	Hydro-Cyclone	10% of each type OR 1 no. whichever is higher
c.	Hydro-Cyclone rubber lining-Feed chamber and Overflow chamber	10% of each type OR 1 no. whichever is higher
d.	Vortex finder & Apex inserts	10% of each type OR 1 no. whichever is higher
2.	**Vacuum Belt Filter**	
a.	Filter Cloth	4 sets
b.	Belt	1 sets
c.	Vacuum Box Seals	2 sets
d.	Drive Motor	1 no.
3.	**Vacuum Pumps**	
a.	Pump Impeller Assembly	1 no.
b.	Pump Bearing	1 set
c.	Seals	1 set
d.	Motor	1 no.
4.	**Vacuum Breaker Valves**	
a.	Valve Assembly	1 no.
b.	Actuator	1 no.
5.	**Slurry Valves**	4 nos. of each type and size
6.	**Slurry Line Bends**	4 nos. of each type and size
7.	**Horizontal Centrifugal Pumps**	
a.	Complete Impeller Assembly	1 nos. of each type
b.	Casing Liners	1 set* of each type
c.	Bearing	1 set*
d.	Motor	1 no. of each type
e.	Pump discharge valve assembly	1 nos. of each type

Any change in size, material, design etc., which obviates one to one replacement of the part shall be considered a different type.
*Unless otherwise stated, a set shall mean complete replacement for one equipment.

Note(s):

1. One set means 100% complete replacement of the particular component/equipment, as mentioned i.e., Set for the particular equipment, would include all components required to replace the item. For example, a set of bearing shall include all hardware normally required while replacing the bearings. It is further, intended that the assembly / sub-assembly which have different orientation (like left hand or right hand, top or bottom), different direction of rotation or mirror image positioning or any other reasons which result in maintaining two different sets of the spares to be used for the subject assembly / sub-assembly, these shall be considered as different types of assembly/sub-assembly.

2. Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc. these shall cover all the items supplied and installed.

3. In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the above list.

4. Any item which is quoted as “not applicable” in the above list and is found to be “applicable” at a later date shall be supplied by the Bidder without any commercial implications. The Bidder shall note that if there in any change/ variation in equipment/ system during detail engineering which causes any change/ variation in the essential spares quantity, the same shall be supplied without any commercial implications. The price indicated for the mandatory spares shall be considered for the purpose of evaluation.

5. Mandatory spares shall not be dispatched before dispatch of corresponding main equipment. The spares shall be treated and packed for a long storage under the climatic condition prevailing at site.

6. All spares supplied under this contract shall be strictly interchangeable with parts for which they are intended for replacements. These spares should include all mounted accessories like components, boards, add or items, fitting, connectors etc. and be complete in all respects so that the replacement of the main items by these spares does not require any additional item. The vendors must conform the pair to pair compatibility of each electrical spares modules with the modules should be supplied in the original package. All electronic modules should be pre-set and/or pre-programmed for ready use at site. Alternatively, suitable instruction sheet indicating the details of required PCB jumper position, BCD which is setting, EPROM/PROM listing etc should be packed along with each module. Also a caution mark sign should be put on all such module which needs pre-setting/pre-programming before putting them in to service. The spare shall be treated and properly packed for long term storage.

7. Each spare shall be clearly marked and labelled on the outside of the packing with its description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purpose of identification.

II. MANDATORY SPARES - CONTROL & INSTRUMENTATION		
SI. NO.	**PARTICULARS**	**QUANTITY**
1.01.00	**MEASURING INSTRUMENTS**	
1.01.01	(i) Transmitters of all types and model no. (for measurement of pressure, differential pressure, flow, level, temp, etc.). This shall include magnetic/ electromagnetic flow meter, mass flow meter also.	10% or 1 no. of each type and model, whichever is more.
	(ii) Density meter	10% or 1 no. of each type and model, whichever is more.
1.01.02	Temp Elements along with thermo-well (except winding temp elements of motor)	10% or 2 no. of each type, model & length, whichever is more.
1.01.03	(i) Process Actuated Switches (Pressure, Differential pressure, flow, level, temp) (ii) Limit switches (for pneumatic and manual valves)	10% or 2 no. of each type and model, whichever is more.
1.01.04	Local Gauges for Pressure, Differential pressure, flow, level, temp	5% or 1 no. of each type, model and range, whichever is more.
1.01.05	Vibration monitoring system	
(i)	Sensors	10% or Minimum 2 Nos. of each type, make and model whichever is more.
		*if prefab cable or prefab extension cable is used same should be supplied in proportion.
(ii)	Power Supply Module Cards	10% or minimum 2 nos whichever is more.
(iii)	Driver / Interface Cards & all other electronic cards.	10% or minimum 2 nos whichever is more.
1.02.00	**PROCESS CONNECTION PIPING (For Impulse Piping / Tubing and Air Supply Piping as Applicable)**	
a.	Valves of all types and models	10% or 1 no. of each type, class, size and model whichever is more.
b.	2 way, 3way, 5way valve manifolds	10% or 1 no. of each type, class, size and model whichever is more.
c.	Fittings	10% or 1 packet of each type, class, size and model whichever is more.
d.	Purge meters	5% of each model or 1 no. whichever is more.
e.	Filter regulators	20% of each model or 2nos. whichever is more.
1.03.00	**CABLES**	

	1. Pre fabricated cable of each type.	10% of installed quantity
	2. Pre fabricated cable connector of each type	10% or 1 no. of each type and model, whichever is more.
	3. Other cables	5% of each type, pair and size of actual installed quantity
1.03.00	**ACCESSORIES** **(Following items shall be provided under this clause for all modulating control valves being supplied under this package**	
a.	Pneumatic and electro-hydraulic actuator assembly	10% or 1 no. of each type, model and rating, whichever is more.
b.	Valve trim (including cage, plug, stem, seat rings, guide bushings etc.)	1 set for each type of control valve.
c.	Diaphragms, O' rings, seals etc. of all types make etc.	100%
d.	Pressure Gauges of all types, make, rating etc.	10% or 2 nos. of each type whichever is more
e.	Solenoid valves (if applicable)	10% or 2 nos. of each type whichever is more
f.	Positioner units (complete unit) & accessories (link assembly)	10% or 1 no. of each type whichever is more
g.	Pneumatic air-filter/Regulator of each type, make rating etc.	10% or 2 Nos., whichever is more
h.	Air lock relays	10% or 2 nos. of each type whichever is more
1.04.00	**PNEUMATICS ISOLATION / BLOCK VALVES, ACTUATORS & ACCESSORIES (For all ON/OFF valves supplied under this package)**	
a.	Pneumatic actuator assembly	10% or 1 no. of each type, model and rating, whichever is more.
b.	Diaphragms, O' rings, seals etc. of all types make etc.	100%
c.	Limit switches (complete unit) & accessories (link assembly)	10% or 2 Nos., whichever is more
d.	Pneumatic air-filter/Regulator of each type, make rating etc.	10% or 2 Nos., whichever is more
1.05.00	**ELECTRICAL ACTUATORS**	
a.	Actuators	1 no of each type and rating
b.	Electronic PCB of all types	10% of each type & model
c.	Absolute Encoder (replaceable part)	5% of each type & model
d.	Electronic Torque sensor	5% of each type & model
1.06.00	**VFD SYSTEM**	

1	Electronic cards	
a	Control modules	1 nos. of each type & rating
b	I/O module	1 nos. of each type & rating
c	Power supply modules	1 nos. of each type & rating
d	Gate module including gate transformer	100% of one channel
2	Power device (Thyristor, IGBT etc.) bridge leg	1 no. (Qty. for one ph.)
3	Over voltage limiter and surge suppressor network	1 set
4	Semiconductor fuses for Power device (thyristor, IGBT etc)	1 set
5	Power & Control fuse	25% of installed quantity
6	Control Transformer	1 nos. of each type & rating
7	Contactor/Breaker	1 no.
8	CT/VT	1 nos. of each type & rating
9	Indicating lamps	100% of each type & rating
10	Auxiliary contactors & relays	1 nos. of each type & rating
11	Indicating lamp holder full set	15% of each type & colour
12	Panel mounted meters	1 nos. of each type & rating
NOTE:		
1	Wherever set is mentioned, one set of the spares of that item shall be for complete replacement of that particular item for one equipment.	
2	Any fraction of a item shall mean the next higher.	
3	Wherever quantity has been specified as percentage (%), the quantity of mandatory spares to be provided by contractor shall be the specified percentage (%) of the total population of the plant. In case, the quantity so calculated happens to be fraction, the same shall be rounded off to next higher whole number.	
4	Wherever the quantities have been indicated for each type, size, thickness, material, radius, range, etc., these shall cover all the items supplied and installed and the breakup for these shall be furnished in the bid.	
5	In case, spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the above list.	
6	(*) Unless otherwise stated, a set shall mean complete replacement for one equipment.	
7	Mandatory spares listed above is bare minimum requirement. In case any additional mandatory spares requirement is covered elsewhere in the tender specification apart from specified above, same shall be deemed to have been covered in bidders' scope of supply. Bidder is also required to refer to notes mentioned at Annexure-II, Sub Section-E, Section-I in technical specification.	

ANNEXURE- III

1.01.00 INSPECTION AND TESTS DURING MANUFACTURE

1.01.01 The method and techniques to be used by the Bidder for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner.

1.01.02 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.

1.01.03 Before any item of plant or equipment leaves its place of manufacture, the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.

1.01.04 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend, the Bidder may proceed with manufacturing having forwarded to the Owner duly certified copies of his own inspection and test results.

The owner's representative shall have at all reasonable times access to bidder's or his sub-vendor's premises and shall have power to inspect/ examine materials and workmanship or equipment under manufacture.

The Bidder shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Further nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere in the specification.

For electrical equipment, routine tests as per relevant IS/International standard as detailed in the specification are to be carried out on all equipments. Type tests are also to be carried out on selected equipment as detailed in the specifications of the electrical equipment concerned.

1.01.05 Under no circumstances, any repair or welding of castings be carried out without the consent of the Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer.

1.01.06 All the individual and assembled rotating parts shall be statically and dynamically balanced at the works. Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Bidder shall allow for trial assembly prior to dispatch from place of manufacture.

1.01.07 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative

material. Equipment or parts coming under any statutory Regulations shall be certified by a Competent Authority under the regulations in the specified format.

1.01.08 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than 30 minutes. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than 30 minutes.

1.01.09 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.

1.01.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR, as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnaflux and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major butt welding joints shall be radiographed unless otherwise stipulated.

Bidder's scope shall include to preparation of all necessary documents, co-ordination and follow up for above approval related to bidder's works. Owner shall only forward assistance/ endorsement of documents /design /drawings /reports/records to be submitted for approval as stipulated/ required by Statutory Authorities till registration of the unit and clearance for commercial operation.

1.02.00 PERFORMANCE TESTS AT SITE

1.02.01 The full requirements for testing the equipment/ system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Bidder on site under normal operating conditions. The Bidder shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.

1.02.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.

1.02.03 The Bidder shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to tests on completion and commissioning of the complete system/equipment.

1.03.00	SPECIFIC INSPECTION REQUIREMENT FOR COMPONENTS/EQUIPMENTS
1.	**Hydro-cyclones**
a.	Visual
b.	Dimensional etc.
2.	**Pumps :**
c.	All pressure parts shall be hydraulically tested at 150% of the shut-off head or 200% of rated head, whichever is higher for 30 minutes. No leakage is allowed.
d.	Impeller and rotor shall be first statically balanced and then dynamically balanced according to ISO 1940 (in the case of impellers this shall be done before and after mounting of the service rotor shaft).
e.	Vibration levels measured on the non-rotating parts shall not exceed the zone limit “B” as defined in ISO 10816 at steady conditions and shall not exceed the zone limit “C” as defined in ISO 10816 at transient conditions.
f.	List of Non-Destructive test over and above the material test are as follows: Casing: Material test, Magnetic particle (MPI), DP and Hydro test, as applicable Impeller- DPT and MPI as applicable Shaft- Ultrasonic (UT), DPT and MPI Sleeve- DP and Hardness test/ Manufacturer’s recommendation Mechanical Seal- Manufacturer’s recommendation. Base Plate- Stress relieving of weld. Replaceable Rubber liner- Shore Hardness, Class and Type certificate
g.	Vibration test and Noise level test shall be witnessed at shop. (as already stated above.)
h.	Mechanical running and the performance test shall be conducted for Pump at the Bidder’s works before dispatch or where the test facilities are available. All pumps to be performance tested as per Hydraulic Institute Standard/Indian Standard. Performance test to include check for noise, vibration level and temperature rise.
i.	The Bidder shall conduct performance test for the remaining pump and submit the reports.
3.	**Vacuum Belt Filters:**
a.	Impeller, casing and shaft of vacuum pumps shall be tested for chemical and mechanical properties as per relevant standard. All plates above 40 mm shall be 100% Ultrasonically tested.
b.	UT on shaft (if greater or equal to 40mm) and impeller shall be carried out.
c.	All vacuum pumps shall be tested at shop for capacity, power, pressure, efficiency, noise and vibration etc.
d.	Filter cloths and belts shall be tested for physical properties as per relevant Standard.

4.	General Inspection Requirements to be considered are as below:

1.

Sl.No.	Item	Inspection & Test Item	Remarks
1.	Hydro-cyclones	Material certificate check	
		Dimensional Inspection	
2.	Pumps	Material certificate check	Shaft & impeller only
		Dimensional inspection	
		Non-destructive testing	DPT on shaft & impeller
		Hydrostatic test	
		Balancing Test	Static & dynamic
		Performance test	Incl. Noise & Vibration
3.	Motors	Material certificate check	
		Non Destructive Testing	
		Dimensional inspection	
		Balancing Test	Static & dynamic
		Function test	
4.	Vacuum Belt filter (with Accessories)	Material certificate check	
		Dimensional inspection	
		Function test	Short time no load test
5.	Vacuum Receiver	Material certificate check	
		Dimensional inspection	
		Hydrostatic Test	
6.	Belt Filter Vent Fan	Material certificate check	
		Dimensional inspection	
		Performance Test	
7.	Conveyor & Silo Extraction Device	Material certificate check	
		Dimensional inspection	
		Function Test	Short time no load test
8.	Rubber lining Pipe	Dimensional inspection	
		Visual Inspection	
		Spark Test	
9.	Flow Nozzles	Material certificate check	
		Dimensional Inspection	

	10.	Control Panel	Insulation Resistance Test	
			Dielectric Strength Test	
			Function Test	
			Dimensional Inspection	
	11.	Control valve & valves	Material certificate check	
			Hydrostatic test	
			Seat leak test	
			Function test	
			Dimensional Inspection	
	12.	RTD	Material certificate check	
			Performance test	
			Hydrostatic test	
	13.	Shut off valve	Material certificate check	
			Hydrostatic test	
			Seat Leak test	
			Function Test	
			Dimensional Inspection	
	14.	Flow meter	Material certificate check	
			Calibration Test	
			Dimensional Inspection	
			Hydrostatic test	
	15.	Butterfly Valve	Material Certificate check	
			Non-destructive testing	
			Hydrostatic test	
			Operation test	Motorized valve only
2.	Valves and Specialties shall be tested as per relevant standards / codes. Seat Leakage and hydraulic test to be carried out as per relevant standards /codes.			
3.	Pipes and fittings shall be tested as per relevant standards/ codes.			
4.	MQP (Manufacturing Quality Plan) shall be submitted by the bidder along with the technical offer. Above mentioned item-wise inspection requirement is tentative only and shall be mutually discussed and finalized during detailed engineering.			

5.	Bidder shall furnish written copies of shop production, fabrication and quality test procedures and drawings to be used for review by BHEL / BHEL's Customer prior to manufacture. Inspection of above mentioned tests by BHEL/ BHEL's Customer representative at bidder's works is envisaged.
6.	The Bidder shall furnish performance test procedure along with standard. The test procedure will be reviewed and approved by the BHEL / BHEL's Customer.
7.	A dynamic balancing certificates stating that the rotating assembly has been balanced dynamically shall be sent to BHEL/ BHEL's Customer within one (1) week of the successful completion of balancing.
8.	Vibration levels shall be measured during shop running/performance tests.
9.	For surfaces with rubber lining, Welding shall be visually inspected to verify the absence of rough area and unacceptable transition between surfaces which prevent the adequate adherence of rubber. The acceptance criteria shall be as per latest standard.
10.	For surfaces with rubber lining, degree of cleaning shall be visually checked before the application of the coating. There must be no area with oxidation, dirt or partially or generalized corrosion defects.
11.	Test certificates shall be issued for each lot of raw material used in the coating, corresponding to specific weight and traction resistance.
12.	For surfaces with rubber lining, adherence test shall be conducted on production samples. Adherence test shall be conducted on the actual surface through hammering. In order to verify the absence of air pockets (or) surface without adherence.
13.	For surfaces with rubber lining, Coating thickness shall be checked at 100%. A High voltage porosity test will be conducted on 100 % of the coated surface.
14.	Equipment shall not be released for shipment, until shop tests data and performance tests curves have been approved by Owner.
15.	Bidder should furnish performance guarantee as per applicable standard guarantee for the design, manufacture, material and safe operation of the equipment's.
16.	BHEL/BHEL's Customer of their authorized third party inspection agency representative shall witness the test at Bidder's works and a notice of minimum three (3) weeks shall be given for attending the inspection. The charges for Inspection agency (TPIA) in India will be in BHEL scope. However, the charges for inspection outside India will be in bidder's scope.
17.	Bidder to arrange all calibrated gauges, Instruments during inspection at works and also during performance test at site. All inspection, measuring and test equipment(s) used by Bidder shall be calibrated *(at accredited laboratory, as applicable)* periodically depending on its use and criticality of the test/measurement to be done. The Bidder shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by the Owner. Wherever asked specifically, the Bidder shall re-calibrate the measuring/test equipment in the presence of Project Manager/Inspector.
18.	Mechanical running test shall be carried out for Vacuum Belt Filter, Vacuum Pump & Belt Filter Wash Pump. Bidder to arrange suitable Motor for the shop test and inspection.
19.	In case, order is placed on a foreign vendor (i.e. supplies from outside India), vendor will tie-up with BHEL approved inspection agency on their own cost and carry out inspection as per the Quality Plan approved by BHEL/ BHEL's Customer. Vendor shall furnish BHEL

	the inspection reports and other documents required as per approved Quality plan duly signed by the Inspection Agency after their witness for review and acceptance.

QAP FORMAT (Typical)

BHARAT HEAVY ELECTRICALS LIMITED

CORPORATE QUALITY ASSURANCE

PROJECT: SYSTEM :

VENDOR : ITEM :

SL NO	COMPONENT /OPERATION OPERATIONS	CHARACTERISTICS CHECKED	CATEGORY	TYPE /METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11

Legend: 1. BHEL 2. Vendor 3. Sub-Vendor

QP No	CQS/SQP/31	Signature	Date			
	Rev		Name			
Page No	1 of 1		Party	Customer/Consultant	Bhel	Vendor

A Quality Plan Doc No. PE-V0-466-571-A101 is enclosed with this specification for reference of the bidder. The Quality Plan shall be finalized during the detailed engineering.

PART–B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION- V-Q (QUALITY ASSURANCE)

Introduction to the Quality Assurance Specification:

For fulfilment of the relevant clauses (regarding Testing, Inspection etc.) of the General Conditions of Contract and General Technical Requirements of Contract, the Quality Assurance Specification acts as a part of the Technical Specification and is included in the Contract.

This part of the Technical Specification shall be read in conjunction with other parts of the technical specifications, General Technical Requirements and Erection Conditions of the Contract.

This document specifies the quality requirements, to be detailed in terms of Tests/Checks/Procedures to be followed at the times of manufacturing, Testing, Inspection and also during installation of various Equipment / Components at the place of manufacturer and / or on the site.

Various standards referred in this document shall be the latest revisions.

The quality requirements are spelt out in the following ways;

1) Through description
2) In tabular form

In either of the above two formats the tests /checks / procedures that are required to be performed are mentioned against particular item/ equipment/ component/ system etc.

This specification also contains the Indicative vendor list (with disclaimer) mentioned against particular item/ equipment/ component/ system etc.

The quality requirements specified in this document and also the vendor list are only indicative and not exhaustive.

SUB-SECTION-V-QM1

FLUE GAS DESULPHURISATION SYSTEM

FLUE GAS DESULPHURISATION SYSTEM

1.00.0	**FLUE GAS DESULPHURISATION SYSTEM**
1.01.0	**Mills:**
1.01.01	Raw material for shaft, coupling, gears and pinions, top and bottom races and other rotating components shall be subjected to UT. MPI/LPI shall be carried out to check surface soundness.
1.01.02	Wear-resistant parts, if applicable shall be UT/RT tested to check soundness after suitable heat treatment. Check for chemical composition, hardness and microstructure shall be carried out.
1.01.03	Butt welds in the tube/body casing of the mill shall be tested by RT and MPI. All other welds in main tube/ body casing shall be tested by MPI/LPI for acceptance.
1.01.04	All gearboxes shall be run tested for adequate duration to check rise in oil temperature, noise level and vibration. Check for leak tightness of gear case also shall be performed.
1.01.05	No load run test of the assembly shall be demonstrated at shop/site depending upon its design/feasibility.
1.02.0	**Feeders:**
1.02.01	Any welds in the casing/pulley fabrication shall be checked with MPI.
1.02.02	Routine tests shall be done as per relevant Indian Standards or equivalent International Standards.
1.02.03	All major items like plates for casing, head pulley, tail pulley, pulley shaft and major castings shall be procured with respective material test certificates.
1.02.04	Calibration check shall be carried out on all feeders.
1.03.0	**Dampers:**
1.03.01	All the dampers shall be subjected to operational test/checks.
1.03.02	Gas tight Dampers shall be subjected to shop leakage test to demonstrate the guaranteed tightness as per NTPC Tech Specification.
1.04.0	**PIPING, VALVE AND SPECIALITIES:**
1.04.01	All pipes and fittings shall be tested as per applicable code.
1.04.02	All valves shall be hydraulically/Air tested for body, seat and back-seat (if applicable) as per relevant standard.
1.04.03	NDT on valves shall be as per relevant standard.
1.04.04	Valves shall be offered for hydro test in unpainted conditions.

1.04.05 Functional checks of the valves for smooth opening and closing shall also be done.

1.05.00 TANKS / VESSELS:

1.05.01 Atmospheric tanks:

i) All welds joints shall be DP tested and complete tanks shall be water fill tested.
ii) All atmospheric storage tanks fabricated and erected at site shall be subjected to tests (Hydro, NDT and Vacuum) according to design code/standard as applicable.
iii) Lining of the tanks/vessels shall be tested for hardness and spark test etc, as per applicable standard.

1.05.02 Pressure vessels:

1) NDT on weld joint shall be as per respective code requirements or the minimum as specified as below:

   i) 100% DPT on root run of butt weld, nozzle welds and finished fillet welds.
   ii) 10% DPT on all finished butt welds.
   iii) 10% RT (covering all 'T'/cross joints) of butt welds.

2) Butt welds of dished ends shall be stress relieved and subjected to 100% RT.

3) Each finished vessels shall be hydraulically tested to 150% of the design pressure for a duration of 30 minutes.

1.06.00 HEAT EXCHANGER/HEATER:

1.06.01 All material shall be tested for chemical and mechanical properties and NDT as per relevant standard.

1.06.02 NDT on welds and other checks shall be as per relevant code.

1.06.03 Air heaters shall be subjected to dimensional and clearance checks as per standard practice

1.06.04 Lub. oil system, drive system, soot blowing system etc. of Air heaters shall be checked suitably as per standard practice

1.07.00 PUMPS:

1.07.01 UT on shaft forgings (greater or equal to 40mm) and MPI/DPT shall be done on shafts and impeller to ensure freedom from defects.

1.07.02 The pump casing shall be hydraulically tested at 200% of pump rated head or at 150% of shut off head, whichever is higher. The test pressure shall be maintained for at least half an hour.

1.07.03 The pump rotating parts shall be subjected to static and dynamic balancing.

1.07.04 All pumps shall be tested at shop for capacity, head efficiency and brake horse power at rated speed as per relevant/applicable standard.

1.07.05 Noise and vibration shall be measured during the performance testing at shop.

1.08.00 STRUCTURES , DUCTS, HOPPERS:

1.08.01 All materials shall be tested for chemical and mechanical properties as per relevant standard. All plates above 40mm shall be 100% ultrasonically tested.

1.08.02 Visual inspection of all welds shall be performed in accordance with AWSD1.1.

1.08.03 NDT requirements of structural steel welds shall be as under:

i) 100% RT/UT on butt-welds of plate thickness>= 32mm.
ii) For plates of 25mm<=thickness<32mm-10% RT and 100% MPI.
iii) For plates of thickness <25mm-10% MPI/LPI.

1.08.04 Edge for shop and field weld shall be examined by MPI for plate thickness >= 32mm.

1.08.05 Cladding material and its application on the ducts shall be tested as per applicable standard.

1.09.00 VACUUM BELT FILTER SYSTEM:

1.09.01 Impeller, casing and shaft of vacuum pumps shall be tested for chemical and mechanical properties as per relevant standard. All plates above 40mm shall be 100% ultrasonically tested.

1.09.02 UT on shaft (if greater or equal to 40mm) and impeller shall be carried out.

1.09.03 All vacuum pumps shall be tested at shop for capacity, power, pressure, efficiency, noise and vibration etc.

1.09.04 Filter cloths and belts shall be tested for physical properties as per relevant standard

1.09.05 Hydro cyclones shall be checked by visual, dimensional etc.

1.10.00 SPRAY NOZZLES:

1.10.01 Spray nozzles shall be tested for physical properties

1.10.02 Spray nozzles also shall be subjected to performance test.

1.11.00 AGITATORS:

1.11.01 Lining of the agitator shall be tested for hardness and spark test etc. as per applicable standard.

1.11.02 Impellers shall be tested for dimensional and balancing check

1.11.03 Gear Boxes shall be tested for run test as per standard practice

1.12.00 FANS:

1.12.01	Impeller, casing, blades and shafts of fans shall be tested for chemical and mechanical properties as per relevant standard. All plates above 40mm shall be 100% ultrasonically tested.
1.12.02	Rotor components shall be subjected to ultrasonic test at mill and magnetic particle inspection / liquid penetrant examination after rough machining.
1.12.03	Butt welds in rotor components shall be subjected to 100% RT and all welds shall be magnetic particle/dye penetrant tested after stress relieving.
1.12.04	All rotating components and assemblies of fan shall be balanced dynamically
1.12.05	Performance test shall be carried out on fans as per Technical specification/ Relevant standard
1.12.06	Test for Natural Frequency and hardness of Fans blades shall be carried out as per Technical specification/ relevant standard.
1.13.0	**OXIDATION BLOWER**
1.13.01	Impeller, casing, gears and shafts of oxidation blowers shall be tested for chemical and mechanical properties as per relevant standard. All plates above 40mm shall be 100% ultrasonically tested.
1.13.02	Butt welds in rotor components shall be subjected to 100% RT and all welds shall be magnetic particle/dye penetrant tested after stress relieving (if applicable).
1.13.03	All rotating components and assemblies of blower shall be balanced dynamically.
1.13.04	Performance test shall be carried out on blowers as per Technical specification/ relevant standard.
1.14.00	**ABSORBER**
1.14.01	All weld joints shall be tested to suitable NDT techniques as applicable to the materials being welded, joint design & weld profile etc. according to design code/ standard as applicable
1.14.02	Cladding / Bonding material and its application shall be tested as per applicable standard.
1.14.03	Absorber fabricated and erected at site shall be subjected to all tests according to design code/ standard as applicable.
1.15.00	**Thermal Insulation, Lagging & Cladding:** (a) **Lightly resin bonded mineral wool:** LRB mattresses/sections of Rockwool/ Glasswool shall conform to & tested as per relevant clauses of Indian Standards and shall meet the requirements of NTPC data sheet. Type tests except Thermal Conductivity shall be regularly carried out once in three months, Thermal Conductivity Type Test shall be carried out minimum once in twelve months by the manufacturer. Requirements of various components like Binding wires, Lacing wires, Wire mesh, etc. shall be as per NTPC approved data sheet / as given in respective Sub-Section of Technical Requirements of Steam Generator & Auxiliaries.

(b) **Lagging & Cladding:**

All insulation shall be protected by means of an outer covering of Aluminium sheeting confirming to ASTM B-209-1060 temper H14 from reputed manufacturer meeting the requirements of NTPC data sheet.

1.16.0 OTHER CRITICAL EQUIPMENTS:

1.16.01 Checks/ NDTs shall be done as per relevant Indian Standards or equivalent International Standards.

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-491-571-A101	DATE:
	CUSTOMER : M/s NTPC LIMITED		QP NO.: -	DATE: APR-2023
	PROJECT: 2 X 500 MW NTPC SIPAT TPS, STAGE-II - FGD		PO NO.:	DATE:
	ITEM: GYPSUM DEWATERING EQUIPMENT	SYSTEM: FGD	SECTION:	SHEET 1 of 11

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/ N				D	M	C	N	
1.0 RAW MATERIAL (*Material shall be as per Drawing)														
1.1	Vacuum pump	Physical & Chemical for impeller, casing, shaft.	MA	Physical	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	TC	√	P	V	V	NOTE-5
		NDT of Impeller, casing, shaft, sleeve	MA	DPT	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	IR	√	P	V	V	NOTE-5
		Balancing of Rotating Parts	MA	Static & Dynamic Balancing	100%	100%	ISO 1940 Gr.6.3	ISO 1940 Gr.6.3	IR	√	P	V	V	NOTE-5
		NDT of Impeller & Shaft	MA	UT	100%	100%	ASTM A 388/ASME Sec.V	ASTM A 388/ASME Sec.V	IR	√	P	V	V	UT of shaft ≥ϕ 40mm NOTE-5

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		GIRIJESH PRASAD	Checked by:		ASHISH PANIGRAHI
Reviewed by:		RAJESH RANJAN	Reviewed by:		RK JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-491-571-A101	DATE:
		CUSTOMER : M/s NTPC LIMITED		QP NO.: -	DATE: APR-2023
		PROJECT: 2 X 500 MW NTPC SIPAT TPS, STAGE-II - FGD		PO NO.:	DATE:
		ITEM: GYPSUM DEWATERING EQUIPMENT	SYSTEM: FGD	SECTION:	SHEET 2 of 11

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/ N				D	M	C	N	
1.2	Speed reducer	Visual, dimensional, Run test including oil leakage, Temp. rise, Noise level and vibration	MA	Visual	100%	100%	Approved Drawing/ Data sheet	Approved Drawing/ Data sheet	IR	√	P	V	V	
1.3	AC Drive	Type, Make, Rating, Routine test.	MA	Visual	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	TC	√	P	V	V	Refer Electrical QP for details. NOTE-5
1.4	Belt	Visual & review of test certificate (Tensile, Elongation, Thickness)	MA	Visual	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	TC	√	P	V	V	
1.5	Filter Cloth	Physical Properties (Tensile,	MA	Physical	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	TC	√	P	V	V	

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	CUSTOMER : M/s NTPC LIMITED		QP NO.: -	DATE: APR-2023
	PROJECT: 2 X 500 MW NTPC SIPAT TPS, STAGE-II - FGD		PO NO.:	DATE:
	ITEM: GYPSUM DEWATERING EQUIPMENT	SYSTEM: FGD	SECTION:	SHEET 3 of 11

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/ N				D	M	C	N	
		Elongation, Thickness, air permeability test, etc.)												
1.6	Water Pump/ Slurry Pump	Chem. & Mech. Properties of Impeller, Casting, Shaft, Lining*	MA	Chemical Mechanical	100%	100%	Approved Drawing/Data sheet/Relevant Standard	Approved Drawing/Data sheet/Relevant Standard	TC	√	P	V	V	UT of shaft ≥ϕ 40mm *Lining if applicable
		Balancing of Rotating Parts	MA	Static & Dynamic Balancing	100%	100%	ISO 1940 Gr.6.3	ISO 1940 Gr.6.3	IR	√	P	V	V	
		Hydro test of casing	MA	Static pressure testing	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	IR	√	P	V	V	Hydrostatic testing of casings for 30min.at 1.5 times of shut-off head or 2 times pump rated head which ever higher.

BHEL					
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BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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	ITEM: GYPSUM DEWATERING EQUIPMENT	SYSTEM: FGD	SECTION:	SHEET 4 of 11

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/ N				D	M	C	N	
		NDT of Impeller, casing, shaft, sleeve	MA	DPT	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	IR	√	P	V	V	
		NDT of Impeller & Shaft	MA	UT	100%	100%	ASTM A 388/ASME sec.V	ASTM A 388/ASME sec.V	IR	√	P	V	V	UT of shaft ≥ϕ 40mm
1.7	Hydro cyclone	Visual & Dimension	MA	Visual & Measurement	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	IR	√	P	W	V	NOTE-5
1.8	Valves (Control valve & Butterfly Valve etc*)	Material certificate Hydrostatic test Seat leak test Function test DimensionS	MA	Visual	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	IR	√	P	V	V	*As applicable NOTE-5

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Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-491-571-A101	DATE:
	CUSTOMER : M/s NTPC LIMITED		QP NO.: -	DATE: APR-2023
	PROJECT: 2 X 500 MW NTPC SIPAT TPS, STAGE-II - FGD		PO NO.:	DATE:
	ITEM: GYPSUM DEWATERING EQUIPMENT	SYSTEM: FGD	SECTION:	SHEET 5 of 11

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/ N				D	M	C	N	
1.9(a)	Rubber Composition	Material content	MA	Chemical	1/Batch	1/Batch	Approved Drawing/Data sheet	Approved Drawing/Data sheet	COC	√	P	V	V	
1.9(b)	Rubber lining	Spark test at accessible area	MA	Inspection check	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	IR	√	P	W	V	Spark test 10-12.5KV min.
1.10	LT Motor	Make, Rating, Type, Routine Test, Paint	MA	Visual	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	IR	√	P	V	V	For Motor up to 30KW COC Will be submitted. NOTE-5
1.11	Junction Box	Type Test-Enclosure Protection Test	MA	Visual	One of Design	One of Design	IS:60529	IS:60529	IR	√	P	V	V	NOTE-5

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		GIRIJESH PRASAD	Checked by:		ASHISH PANIGRAHI
Reviewed by:		RAJESH RANJAN	Reviewed by:		RK JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-491-571-A101	DATE:
	CUSTOMER : M/s NTPC LIMITED		QP NO.: -	DATE: APR-2023
	PROJECT: 2 X 500 MW NTPC SIPAT TPS, STAGE-II - FGD		PO NO.:	DATE:
	ITEM: GYPSUM DEWATERING EQUIPMENT	SYSTEM: FGD	SECTION:	SHEET 6 of 11

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/ N				D	M	C	N	
1.12	Instruments (Transmitters, Switches, Gauges, RTD etc.)	COC/Functional Check	MA	Visual	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	TC	√	P	V	V	
2.0	**FINAL INSPECTION(Vacuum belt filter assembly)**													
2.1	Vacuum belt filter assembly	Dimensional	MA	Dimensional	100%	100%	Approved Drawing	Approved Drawing	IR	√	P	W	W	
		Run test(for 30 minutes)	MA	Visual, Measurement	100%	100%	Approved Drawing	Approved Drawing	IR	√	P	W	W	
2.2	All components required paints.	Paint Finish, Paint Thickness, High voltage porosity test	MA	Measurement	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	IR	√	P	W	V	

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-491-571-A101	DATE:
	CUSTOMER : M/s NTPC LIMITED		QP NO.: -	DATE: APR-2023
	PROJECT: 2 X 500 MW NTPC SIPAT TPS, STAGE-II - FGD		PO NO.:	DATE:
	ITEM: GYPSUM DEWATERING EQUIPMENT	SYSTEM: FGD	SECTION:	SHEET 7 of 11

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/ N				D	M	C	N	
2.3	Vacuum pump/ Water Pump/ Slurry Pump	Capacity, power, pressure, efficiency, noise, vibration, temperature rise	MA	Measurement	100%	100%	Approved Drawing/Data sheet	Approved Drawing/Data sheet	IR	√	P	W	V	NOTE-5
3	**VACCUM TANK (RAW MATRIAL INSPECTION)**													
3.1	Plates for shell and dished ends & structural	Chemical & Physical	MA	Chemical & Physical	1 /Heat	1 /Heat	Approved Data Sheet /Drawing	Approved Data Sheet /Drawing	TC	√	P	V	V	
4.0	**IN PROCESS CONTROLS**													
4.1	Welding (As applicable)	WPS,PQR,WPQ	CR	Visual	100%	100%	ASME Sec, IX/Relevant Standard	ASME Sec, IX/Relevant Standard	Report	√	P	V	V	

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Reviewed by:		RAJESH RANJAN	Reviewed by:		RK JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-491-571-A101	DATE:
	CUSTOMER : M/s NTPC LIMITED		QP NO.: -	DATE: APR-2023
	PROJECT: 2 X 500 MW NTPC SIPAT TPS, STAGE-II - FGD		PO NO.:	DATE:
	ITEM: GYPSUM DEWATERING EQUIPMENT	SYSTEM: FGD	SECTION:	SHEET 8 of 11

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/ N				D	M	C	N	
4.2	Stress Relieving	Physical	MA	Physical	100%	100%	Relevant Standard/Manufacturer standard	Relevant Standard/Manufacturer standard	HT chart	√	P	V	V	As applicable
4.3	All Weld	Weld Quality	MA	DPT	100%/ 10%	100%/ 10%	Relevant Standard /ASME Sec – VIII Div.1	Relevant Standard /ASME Sec – VIII Div.1	IR	√	P	W	V	100% DPT on root run of butt weld, nozzle welds and finished fillet welds
4.4	Weld quality of circumferential & longitudinal seams	Weld Defect	CR	RT- Review of documents	100%/ 10%	100%/ 10%	Relevant Standard /ASME Sec – VIII Div.1	Relevant Standard /ASME Sec – VIII Div.1	IR	√	P	V	V	Butt welds of dished ends shall be stress relieved and subjected to 100% RT. 10% RT (covering all 'T'/cross joints) of butt welds.

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Reviewed by:		RAJESH RANJAN	Reviewed by:		RK JAISWAL

BIDDER/ SUPPLIER	
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Seal	

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-491-571-A101	DATE:
	CUSTOMER : M/s NTPC LIMITED		QP NO.: -	DATE: APR-2023
	PROJECT: 2 X 500 MW NTPC SIPAT TPS, STAGE-II - FGD		PO NO.:	DATE:
	ITEM: GYPSUM DEWATERING EQUIPMENT	SYSTEM: FGD	SECTION:	SHEET 9 of 11

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/ N				D	M	C	N	
5.0	**FINAL INSPECTION (Complete System)**													
5.1	Complete System	Dimensional	MA	Dimension	100%	100%			Approved Drawing	√	P	W	V	NOTE-5
		Nozzle Orientation	CR	Dimension	100%	100%	Approved Drawing	Approved Drawing	IR	√	P	W	V	NOTE-5
		Hydro Test	CR	Hydro Test	100%	100%	2X working PR or 1.5x design PR Whichever is higher for 30 minutes	2X working PR or 1.5x design PR Whichever is higher for 30 minutes	IR	√	P	W	V	NOTE-5
		Pneumatic Test of RF pads for soundness /leakages	CR	Pneumatic Test	100%	100%	ASME SEC – VIII /appd. Drg/appd. Datasheet	ASME SEC – VIII /appd. Drg/appd. Datasheet	IR	√	P	W	V	*as applicable NOTE-5
5.2(a)	Rubber Lining of tank	Spark test	MA	Electrical	100%	100%	Technical Spec/ Relevant	Technical Spec/ Relevant	IR	√	P	V	V	Spark test 10-12.5KV min.

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	PROJECT: 2 X 500 MW NTPC SIPAT TPS, STAGE-II - FGD		PO NO.:	DATE:
	ITEM: GYPSUM DEWATERING EQUIPMENT	SYSTEM: FGD	SECTION:	SHEET 10 of 11

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/ N				D	M	C	N	
							standard	standard						
5.2(b)	Rubber Lining of tank	Hardness testing	MA	Physical	100%	100%	Technical Spec/ Relevant standard	Technical Spec/ Relevant standard	IR	√	P	W	V	Shore hardness value shall be within 60. NOTE-5
5.3	Junction Box	Insulation Resistance Test High Voltage Test	MA	Electrical	100 %	10%	Approved Drawing	Approved Drawing	IR	√	P	W	V	NOTE-5
5.4	Painting & Marking	Paint Finish, Thickness, HV porosity test	MA	Visual	100%	100%	Appd. Drg /Data Sheet	Appd. Drg /Data Sheet	IR	√	P	V	V	NOTE-5
5.5	Packing	Proper Packing	MA	Visual	100%	100%	Technical Spec	Technical Spec	Packing List	√	P	V	V	NOTE-2,5
5.6	Quality Dossier	Document	MA	Visual	100%	100%	Compilation of documents	Compilation of documents	Quality Dossier	√	P	V	V	

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	ITEM: GYPSUM DEWATERING EQUIPMENT	SYSTEM: FGD	SECTION:	SHEET 11 of 11

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/ N				D	M	C	N	

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
** M: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, C: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, N: CUSTOMER,
P: PERFORM, W: WITNESS, V: VERIFICATION, AS APPROPRIATE
MA: MAJOR, MI: MINOR, CR: CRITICAL
IR: INTERNAL REPORT D: DOCUMENTATION
RT: RADIOGRAPHY TEST UT: ULTRASONIC TEST DPT: DIE PENETRANT TEST

NOTE:

1. ORIGINAL TCS/ PHOTOCOPIES CERTIFIED IN ORIGINAL BY MILL SHALL BE FURNISHED FOR REVIEW.
2. PACKING PHOTO GRAPH IS TO BE SUBMITTED TO BHEL BEFORE DISPATCH.
3. BHEL RESERVES THE RIGHT FOR CONDUCTING REPEAT TEST, IF REQUIRED.
4. DURING TESTING ONLY CALIBRATED MEASURING AND TESTING INSTRUMENT IS TO BE USED AND. CALIBRATION CERTIFCATES ARE NEEDED TO BE FURNISHED DURING INSPECTION.
5. THESE TESTS/CHECKS ARE INDICATIVE ONLY. FURTHER TESTS MAY BE ADDED BASED ON END CUSTOMER REQUIREMENT AND WILL BE FINALISED DURING DETAILED ENGINEERING

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BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

ANNEXURE-IV

INPUT DRAWINGS/DOCUMENTS BY BHEL

Sl. No.	Drawing/Document Title	Drawing No.
1.	General Arrangement of Dewatering Building	9545-109-001-PEM-PVM-B-047
2.	P&ID - Primary & Secondary dewatering waste water discharge system	9545-109-RPT-PVM-F-020
2.1	P&ID - Legends & Notes	9545-109-RPT-PVM-F-020 (Sheet 1 & 2)
2.2	P&ID - Primary Hydrocyclone Feed Tank along with write-up.	9545-109-RPT-PVM-F-020 (Sheet 1 & 2 of 11)
2.3	P&ID of Vacuum Belt filter.	9545-109-RPT-PVM-F-020 (Sheet 5 & 6 of 11)
2.4	P&ID of Belt Filter washing Tanks & Cake washing Tanks along with write-up.	9545-109-RPT-PVM-F-020 (Sheet 7-10 of 11)
2.5	P&ID of Secondary Hydrocyclone Tank along with write-up.	9545-109-RPT-PVM-F-020 (Sheet 03-04 of 11)
2.6	P&ID Gypsum Dewatering Equipment- (Filtrate water tank)- sh 11 of 12	9545-109-RPT-PVM-F-020 (Sheet 11 of 11)
2.7	P&ID Gypsum Dewatering Equipment- (Waste water tank)	9545-109-RP-PVM-F046
3.	Plant Layout of FGD System	9545-109-109-001-PEM-PVM-B-047

एन टी पी सी लिमिटेड
(भारत सरकार का उद्यम)
NTPC Limited
(A Govt. of India Enterprise)
(Formerly National Thermal Power Corporation Ltd.)
(केंद्रीय कार्यालय नोएडा)
Corporate Center NOIDA

Reference : CC-ENGG-9545-109-109-001-RPT-PVM-F-020 **Date :** 22/02/2022

From : SUNNY MANAGER(PE-C&I)	**To :** BHARAT HEAVY ELECTRICALS LTD NEW DELHI 110049 IN **Cc :** sisodia@bhel.in

Subject : SIPAT2-FGD

Please find enclosed following drawings/ documents for necessary action at your end.

Vendor Drg. No.	:	RPT DWG
Orgn. Drg. No.	:	9545-109-109-001-RPT-PVM-F-020
Revision No.	:	00
Drg. Title	:	P&ID - PRIMARY & SECONDARY DEWATERING,WASTE WATER DISCHARGE SYSTEM
App. Category	:	CAT-II
Release Date	:	22/02/2022

Scan to verfiy

Comments : Comments marked

00	08.02.2022	Fresh Issue	MVR	PNR	ACR
REV	DATE	DESCRIPTION / NOTE	PRD	CHD	APD

REVISIONS

TITLE:

P&ID - Primary & secondary Dewatering, Waste Water Discharge System

OWNER/PROJECT: NTPC LIMITED

NTPC SIPAT SUPER THERMAL POWER STATION
STAGE-II, UNIT 4&5 (2x500 MW)
FGD SYSTEM PACKAGE

EPC CONTRACTOR:

BHARAT HEAVY ELECTRICALS LTD.
BOILER AUXILIARIES PLANT, RANIPET

COLLABORATOR

MITSUBISHI HITACHI POWER SYSTEMS, LTD
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

	BHEL	SIGN	
PREPARED BY	MVR	-sd-	STATUS : *FOR APPROVAL*
CHECKED BY	PNR	-sd-	BHEL CUST NO : G517 & G518
APPROVED BY	ACR	-sd-	BHEL DOC NO : 3-FW-000-07167
			REV NO :00

NTPC DRG./DOC NO. : 9545-109-RPT-PVM-F-020

THIRD ANGLE PROJECTION | No. REQ'D | A3 | DRAWING No.

LINE SYMBOLS

SYMBOLS	NAME
	PIPE LINE
	CAPILLARY TUBING
	ELECTRIC SIGNAL
	SOFTWARE LINK
	PRESSURE LEAD
	DUCT

PIPING VALVE SYMBOLS

SYMBOLS	NAME
	GATE VALVE (NOR.CLOSED)
	GLOBE VALVE (NOR.CLOSED)
	BALL VALVE (NOR.CLOSED)
	BUTTERFLY VALVE (NOR.CLOSED)
	DIAPHRAGM VALVE (NOR.CLOSED)
	PINCH VALVE (NOR.CLOSED)
	NEEDLE VALVE (NOR.CLOSED)
	CHECK VALVE
	CHECK VALVE (WAFER)
	PRESSURE RELIEF VALVE
	KNIFE EDGE GATE VALVE

INSTRUMENT VALVE SYMBOLS

SYMBOLS	NAME
	ACTUATED BY AIR
	ACTUATED BY MOTOR
	AIR CONTROL VALVE
	SOLENOID ACTUATOR
	SELF REGURATING VALVE
	SELF REGURATING VALVE

TRENCH SYMBOLS

SYMBOLS	NAME
	TO ABSORBER AREA DRAIN SUMP
	TO GYPSUM AREA DRAIN SUMP
	TO LIMESTONE AREA DRAIN SUMP

SYMBOLS FOR PIPING PARTS & INSTRUMENT PARTS

SYMBOLS	NAME
	STEAM TRAP
	AIR TRAP
	Y-STRAINER
	T-STRAINER
	TEMPORARY STRAINER
	REDUCER
	EXPANSION JOINT
	DUCT EXPANSION JOINT
	FLEXIBLE HOSE
	SPOOL PIECE
	VENT
	HOSE CONNECTION
	BLIND FLANGE
	REDUCING FLANGE
	CAP (BW)
	CAP (SCR)
	TRENCH
	SIGHT GLASS
	SILENCER
	ORIFICE
	DIAPHRAGM
	MAGNETIC FLOW METER
	VORTEX FLOW METER
	PH METER
	FILTER
M.H. M.H. M.H.	MANHOLE
	PITOT TUBE
	SAMPLING POT
	SAMPLING NOZZLE
	ROTOMETER TYPE FLOW METER

SYMBOLS FOR VALVE OPERATION

SYMBOLS	NAME
FO / FC	FAILURE OPEN (THE VALVE OPENS WHEN AIR OR ELECTRICITY FOR ACTUATOR FAILS.) FAILURE CLOSE (THE VALVE CLOSES WHEN AIR OR ELECTRICITY FOR ACTUATOR FAILS.)

INSULATION SYMBOLS

SYMBOLS	DESCRIPTION
H10	THERMAL INSULATION (100°C & LOWER)
H15	THERMAL INSULATION (101°C ~ 150°C)
H20	THERMAL INSULATION (151°C ~ 200°C)
H25	THERMAL INSULATION (201°C ~ 250°C)
H30	THERMAL INSULATION (251°C ~ 300°C)
H35	THERMAL INSULATION (301°C ~ 350°C)
HF	INSULATION FOR ANTI FREEZING
ET	ELECTRIC TRACE
ST	STEAM TRACE (LOW PRESSURE STEAM)
P10	PERSONAL PROTECTION (100°C & LOWER)
P15	PERSONAL PROTECTION (101°C ~ 150°C)
P20	PERSONAL PROTECTION (151°C ~ 200°C)
P25	PERSONAL PROTECTION (201°C ~ 250°C)
P30	PERSONAL PROTECTION (251°C ~ 300°C)
P35	PERSONAL PROTECTION (350°C ~ 400°C)

DELIVERY LIMITS

SYMBOLS	NAME
	BETWEEN NTPC AND CONTRACTOR
CONTRACTOR / XXX	BETWEEN SUB CONTRACTOR AND VENDOR

SYSTEM

NUMBER	NAME
1	FLUE GAS SYSTEM
2	SO_2 ABSORPTION OXIDATION SYSTEM
3	REHEATING SYSTEM
4	GYPSUM DEWATERING HANDLING SYSTEM
5	LIMESTONE PREPARATION SYSTEM
6	BLANK
7	SUMP SYSTEM
8	UTILITY SYSTEM

CONFIDENTIAL & PROPRIETARY INFORMATION

FLUID NAME

FLUID SYMBOL	FLUID NAME	FLUID SYMBOL	FLUID NAME
AC	COMPRESSED AIR	WCS	COOLING WATER SUPPLY
AF	FLUIDIZER AIR	WCR	COOLING WATER RETURN
AI	INSTRUMENT AIR	WD	DRINKING WATER
AO	OXIDATION AIR		
AS	SEAL AIR	WP	PROCESS WATER
DD	DUCT DRAIN	WR	RAW WATER
FS	FILTRATE SLURRY	WC	Ca(OH)2 WATER
GS	GYPSUM SLURRY	WW	WASTE WATER
LS	LIMESTONE SLURRY	VG	VACUUM PUMP VENT
		VBG	BELT FILTER VENT GAS
		LD	LIME/LIMESTONE DEDUSTING
		LOL	LUBE OIL (LOW PRESSURE)
		LOH	LUBE OIL (HIGH PRESSURE)
		CW	CLARIFIED WATER

SERVICE CLASS

SERVICE CLASS	MATERIAL	FLUID SYMBOL
AA40	NATURAL RUBBER LINED PIPING	LS, WP, WC
AA60	NATURAL RUBBER LINED PIPING	GS,FS,WW,DD
BA01	Gr.304 STAINLESS STEEL PIPING / GI PIPING	AI, LOL
BA02	Gr.304 STAINLESS STEEL PIPING / GI PIPING	LOH
BA03	Gr.316L STAINLESS STEEL PIPING	WP, AO
CA01	CARBON STEEL GENERAL PIPING	AS,AO,AC,AF,LD
CC01	CARBON STEEL PRESSURE PIPING	WP,WR,WCS,WCR, VG, AA, CW
DA60	FRP PIPING (PIPE DIA UPTO 250 NB)	GS,FS,WW,DD
DA40	FRP PIPING (PIPE DIA UPTO 250 NB)	LS, WP, WC

UNIT CODE

SYMBOLS	UNIT IDENTIFICATION
00	COMMON
10	UNIT-1 FGD SYSTEM AND AUXILIARIES
20	UNIT-2 FGD SYSTEM AND AUXILIARIES

EXPRESSION OF PIPING LINE

10 - 200 - GS - 2 00 1 - AA60 - HF

- 10 — UNIT CODE
- 200 — NOMINAL PIPE SIZE (mm)
- GS — FLUID SYMBOL
- 2 — SYSTEM
- 00 — SERIAL NUMBER
- 1 — SUFFIX NUMBER
- AA60 — PIPING SERVICE CLASS
- HF — INSULATION CLASS

CUSTOMER NOS: G517 & G518

CUSTOMER: NTPC LIMITED.

PROJECT: SIPAT STPS STAGE-II, Unit4&5 (2x500MW)

FGD SYSTEM PACKAGE

BHARAT HEAVY ELECTRICALS LIMITED, UNIT: BOILER AUXILIARIES PLANT, RANIPET:632 406.

DEPT CODE		NAME (BHEL)	DATE
M	DRN	M.VENKATARAMAN	01.02.22
	CHD	P.NAVEEN	01.02.22
	APPD	A.C.RAO	01.02.22

MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

TITLE: P & ID - LEGENDS AND NOTES

SCALE : NTS

NTPC DRG NO: ----

SH 01 of 02

BHEL DRG NO	FILE NO	REV NO
3-FW-000-00440	B240 - 00001	00

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INSTRUMENT ABBREVIATION

	FIRST–LETTER		SUCCEEDING–LETTERS		
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER, COMBUSTION		BLANK	BLANK	BLANK
C	BLANK			CONTROL	
D	BLANK	DIFFERENTIAL			
E	VOLTAGE		SENSOR (PRIMARY ELEMENT)		
F	FLOW RATE	RATIO (FRACTION)			
G	BLANK		GLASS, VIEWING DEVICE		
H	HAND				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW
M	BLANK	MOMENTARY			MIDDLE, INTERMEDIATE
N	BLANK		BLANK	BLANK	BLANK
O	BLANK		ORIFICE, RESTRICTION		
P	PRESSURE, VACUUM		POINT(TEST) CONNECTION		
Q	QUANTITY	INTEGRATE, TOTALIZE			
R	RADIATION		RECORD		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION, MECHANICAL ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL		
X	UNCLASSIFIED	X AXIS	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE OR PRESENCE	Y AXIS		RELAY, COMPUTE, CONVERT	
Z	POSITION, DIMENSION	Z AXIS		DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

INSTRUMENT SYMBOLS

SYMBOLS	NAME
	FIELD MOUNTED
	FOR CONTROL ROOM
	FOR LOCAL CONTROL PANEL
	FOR DCS
	INTERLOCK LOGIC

PNEUMATIC VALVE ACTUATOR

CODE NO.	ACTUATION
FLXXWA–D	DOUBLE SOLENOID NO LIMIT SWITCH
FLXXWA–DL	DOUBLE SOLENOID WITH LIMIT SWITCH
FLXXWA–S	SINGLE SOLENOID NO LIMIT SWITH
FLXXWA–SL	SINGLE SOLENOID WITH LIMIT SWITCH

MACHINARY SYMBOLS

SYMBOLS	NAME
	PUMP
	FAN / BLOWER
	AGITATOR (FLAT BLADE)
	AGITATOR (PROPELLOR)
	ROTARY VALVE
	CRUSHER
	BELT FEEDER
	BELT FILTER
	BALL MILL
	CYCLONE
	MIST ELIMINATOR

EQUIPMENT SYMBOLS

SYMBOLS	NAME
	BAG FILTER
	SILO
	SLIDE GATE
	TANDEM LOUVER DAMPER (MULTIVANE)
	SINGLE STAGE LOUVER DAMPER (MULTIVANE)
	LOUVER DAMPER (SINGLE VANE)
	DISTRIBUTION BOX (3WAY)
	DISTRIBUTION BOX (2WAY)
	SUMP
	HEAT EXCHANGER
	SHELL AND TUBE HEAT EXCHANGER
	AIR DRYER
	FILTER
	SPRAY NOZZLE

DRIVER SYMBOLS

SYMBOLS	NAME
A	AIR MOTOR
M	ELECTRIC MOTOR

OTHER SYMBOLS

SYMBOLS	NAME
	INSERT PIPE / LANCE
	CHUTE
	TRUCK

THIRD ANGLE PROJECTION

No. REQ'D

A3

DRAWING No.

CONFIDENTIAL & PROPRIETARY INFORMATION

CUSTOMER NOS: G517 & G518

CUSTOMER: NTPC LIMITED.

PROJECT: SIPAT STPS STAGE–II, Unit4&5 (2x500MW)

FGD SYSTEM PACKAGE

BHARAT HEAVY ELECTRICALS LIMITED, UNIT: BOILER AUXILIARIES PLANT, RANIPET:632 406.

DEPT CODE		NAME (BHEL)	DATE
M	DRN	M.VENKATARAMAN	01.02.22
	CHD	P.NAVEEN	01.02.22
	APPD	A.C.RAO	01.02.22

MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

TITLE: P & ID – LEGENDS AND NOTES

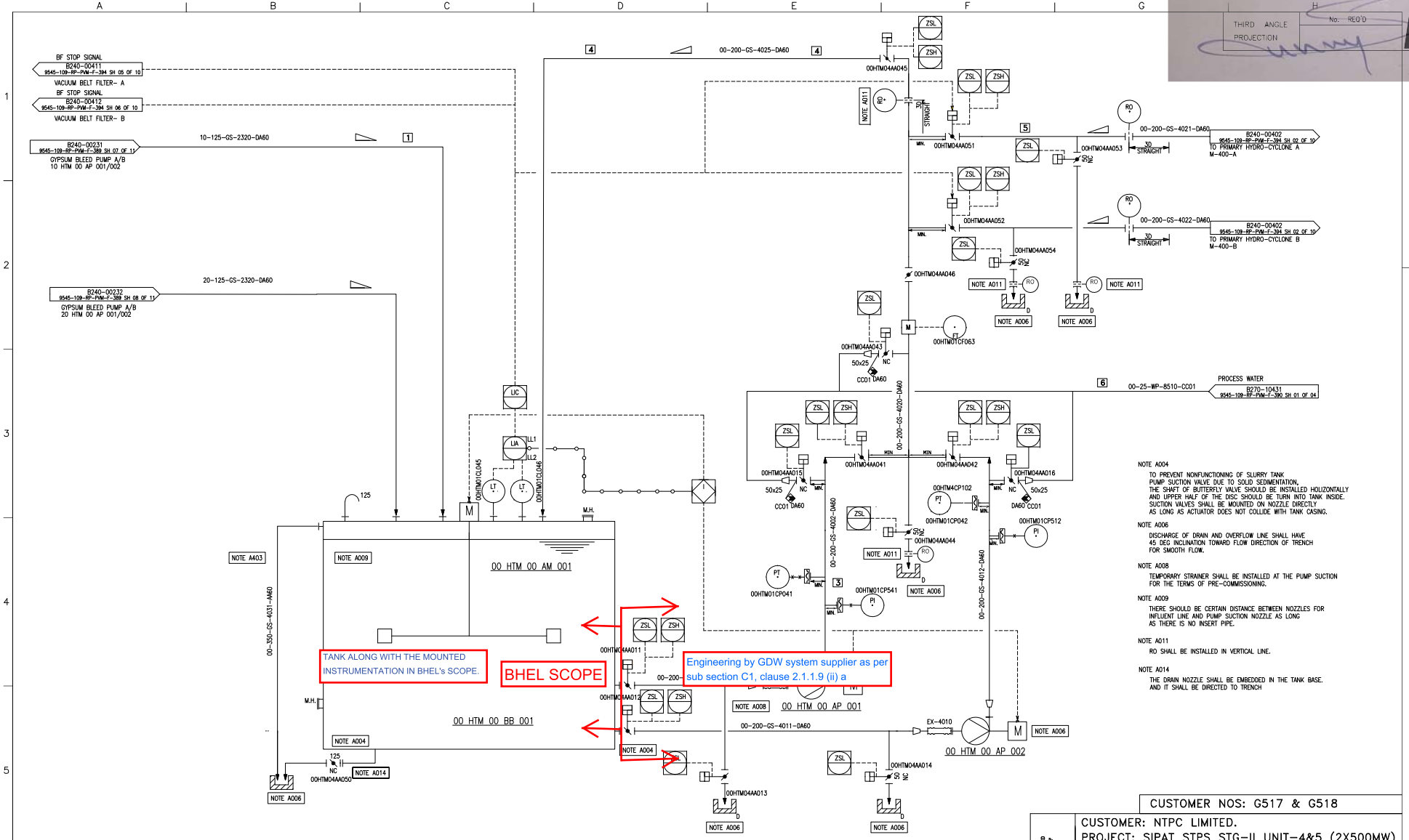
SCALE : NTS

NTPC DRG NO: ----

SH 02 of 02

BHEL DRG NO	FILE NO	REV NO
3–FW–000–00440	B240 – 00002	00

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S NO	SECTION	FLOW m^3/hr	TEMP (^0C)	DENSITY kg/m^3
1	Gypsum bleed from Gypsum bleed pump	56.6	61.5	1212
2	Primary hydrocyclone feed pump suction	230.0	61.5	1212
3	Primary hydrocyclone feed pump discharge	230.0	61.5	1212
4	Recirculation flow	116.8	61.5	1212
5	primary hydrocyclone flow	113.2	61.5	1212
6	process water flow for flushing	3	45.0	990

00 HTM 00 BB 001
PRIMARY HYDRO-CYCLONE FEED TANK

00 HTM 00 AM 001
PRIMARY HYDRO-CYCLONE FEED TANK AGITATOR

00 HTM 00 AP 001/002
PRIMARY HYDRO-CYCLONE FEED PUMP A/B

CUSTOMER NOS: G517 & G518

CUSTOMER: NTPC LIMITED.
PROJECT: SIPAT STPS STG-II UNIT-4&5 (2X500MW)
FGD SYSTEM PACKAGE

BHARAT HEAVY ELECTRICALS LIMITED, UNIT: BOILER AUXILIARIES PLANT, RANIPET-632 406.

DEPT CODE		NAME (BHEL)	DATE
M	DRN	M.VENKATARAMAN	08.02.22
	CHD	P.NAVEEN	08.02.22
	APPD	A.C.RAO	08.02.22

MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

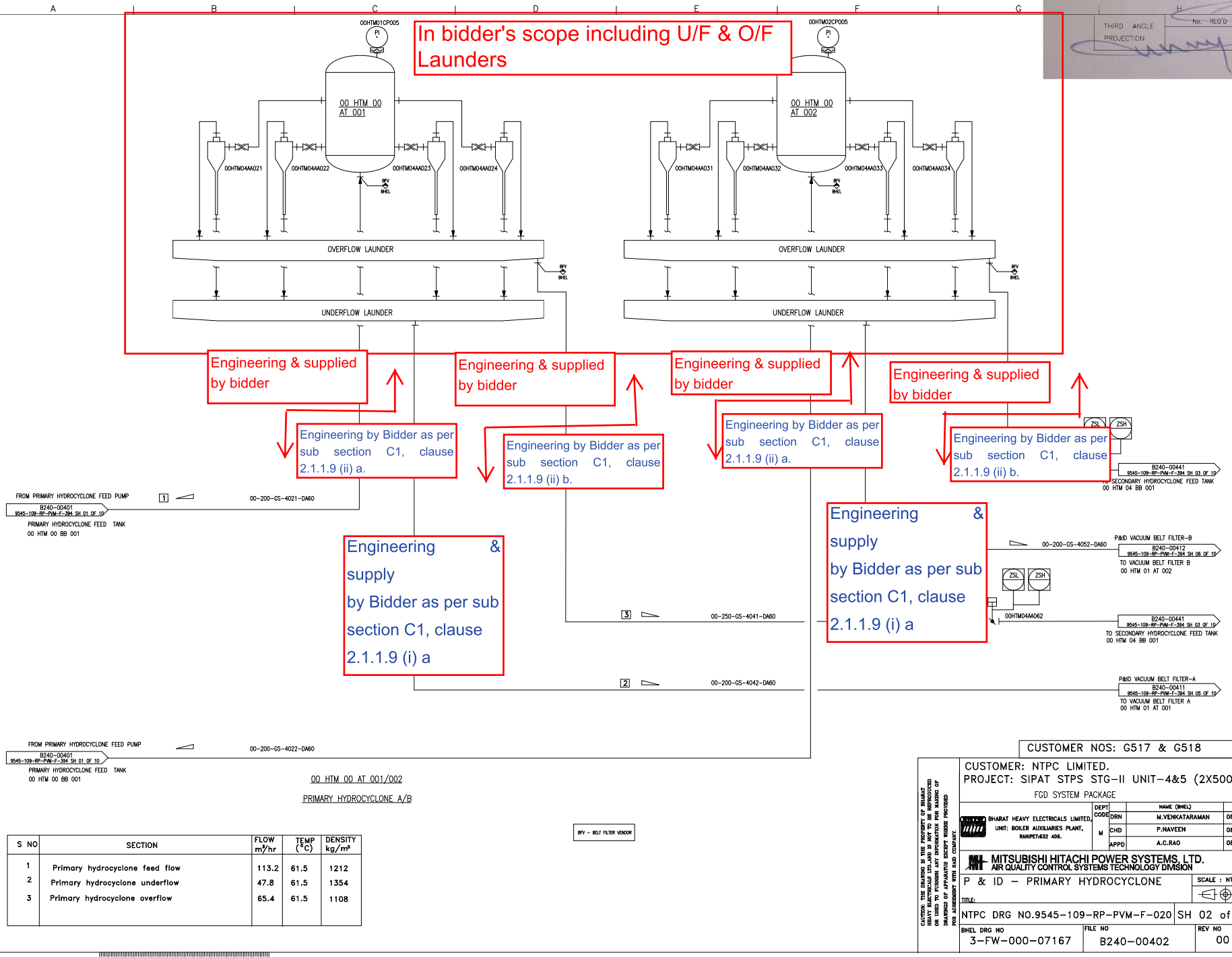
TITLE: P & ID – PRIMARY HYDROCYCLONE FEED TANK

SCALE : NTS

NTPC DRG NO.9545-109-RP-PVM-F-020 SH 01 of 11

BHEL DRG NO	FILE NO	REV NO
3-FW-000-07167	B240-00401	00

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S NO	SECTION	FLOW m³/hr	TEMP (°C)	DENSITY kg/m³
1	Primary hydrocyclone feed flow	113.2	61.5	1212
2	Primary hydrocyclone underflow	47.8	61.5	1354
3	Primary hydrocyclone overflow	65.4	61.5	1108

CUSTOMER NOS: G517 & G518

CUSTOMER: NTPC LIMITED.
PROJECT: SIPAT STPS STG-II UNIT-4&5 (2X500MW)
FGD SYSTEM PACKAGE

BHARAT HEAVY ELECTRICALS LIMITED, UNIT: BOILER AUXILIARIES PLANT, RANIPET-632 406.

DEPT CODE		NAME (BHEL)	DATE
M	DRN	M.VENKATARAMAN	08.02.22
	CHD	P.NAVEEN	08.02.22
	APPD	A.C.RAO	08.02.22

MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

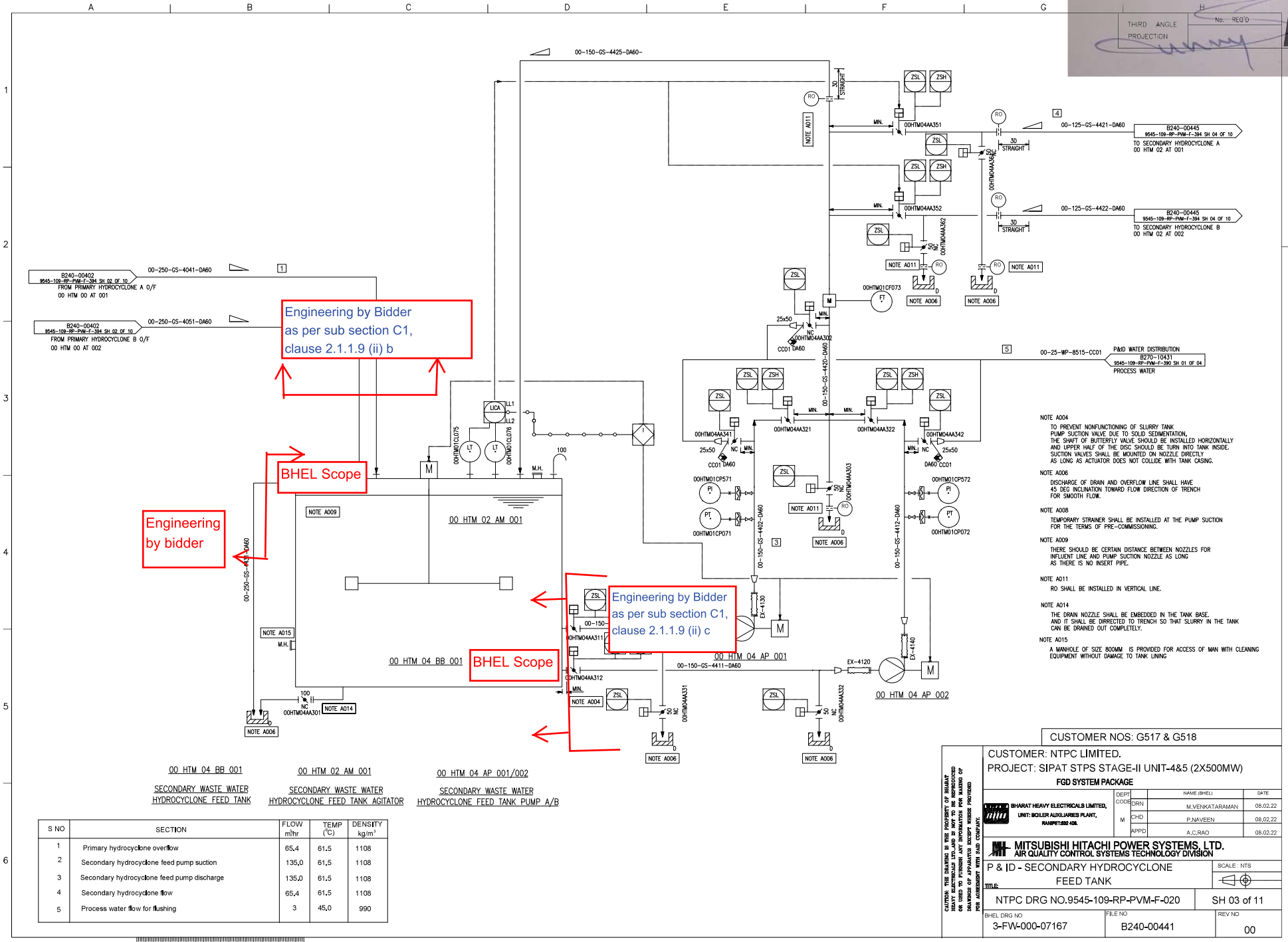
TITLE: P & ID - PRIMARY HYDROCYCLONE

SCALE : NTS

NTPC DRG NO.9545-109-RP-PVM-F-020 SH 02 of 11

BHEL DRG NO	FILE NO	REV NO
3-FW-000-07167	B240-00402	00

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00 HTM 04 BB 001
SECONDARY WASTE WATER HYDROCYCLONE FEED TANK

00 HTM 02 AM 001
SECONDARY WASTE WATER HYDROCYCLONE FEED TANK AGITATOR

00 HTM 04 AP 001/002
SECONDARY WASTE WATER HYDROCYCLONE FEED TANK PUMP A/B

S NO	SECTION	FLOW m³/hr	TEMP (°C)	DENSITY kg/m³
1	Primary hydrocyclone overflow	65.4	61.5	1108
2	Secondary hydrocyclone feed pump suction	135.0	61.5	1108
3	Secondary hydrocyclone feed pump discharge	135.0	61.5	1108
4	Secondary hydrocyclone flow	65.4	61.5	1108
5	Process water flow for flushing	3	45.0	990

CUSTOMER NOS: G517 & G518

CUSTOMER: NTPC LIMITED.
PROJECT: SIPAT STPS STAGE-II UNIT-4&5 (2X500MW)
FGD SYSTEM PACKAGE

BHARAT HEAVY ELECTRICALS LIMITED, UNIT: BOILER AUXILIARIES PLANT, RANIPET-632 406.

DEPT CODE		NAME (BHEL)	DATE
M	DRN	M.VENKATARAMAN	08.02.22
	CHD	P.NAVEEN	08.02.22
	APPD	A.C.RAO	08.02.22

MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

TITLE: P & ID - SECONDARY HYDROCYCLONE FEED TANK

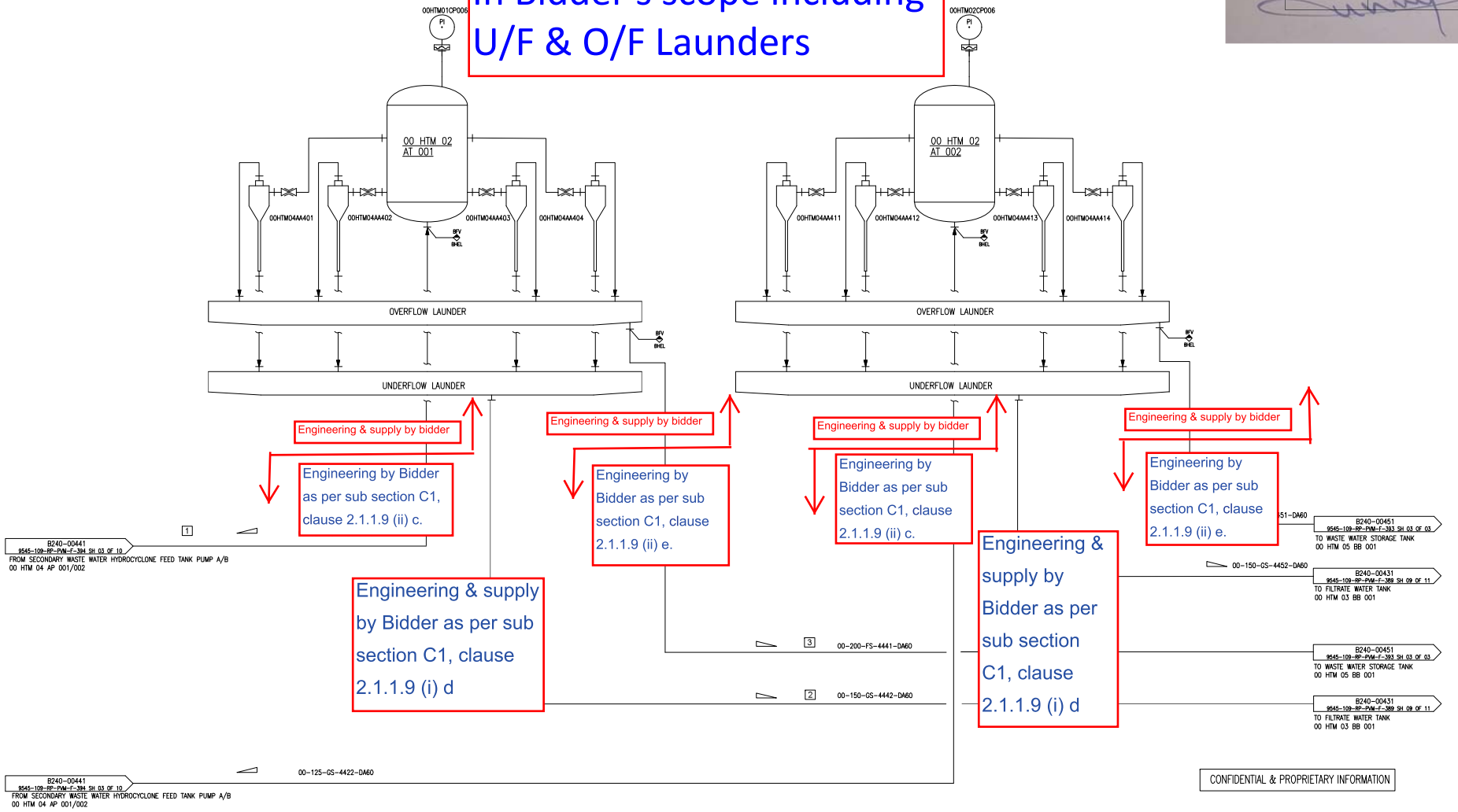
SCALE : NTS

NTPC DRG NO.9545-109-RP-PVM-F-020 SH 03 of 11

BHEL DRG NO 3-FW-000-07167 | FILE NO B240-00441 | REV NO 00

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In Bidder's scope including U/F & O/F Launders



00 HTM 02 AT 001/002

SECONDARY HYDROCYCLONE A/B

S NO	SECTION	FLOW m/hr	TEMP (°C)	DENSITY kg/m³
1	Secondary hydrocyclone feed flow	65.4	61.5	1108
2	Secondary hydrocyclone underflow	24.5	61.5	1256
3	Secondary hydrocyclone overflow	40.9	61.5	1020

CONFIDENTIAL & PROPRIETARY INFORMATION

CUSTOMER NOS: G517 & G518

CUSTOMER: NTPC LIMITED.
PROJECT: SIPAT STPS STAGE-II UNIT-4&5 (2X500MW)
FGD SYSTEM PACKAGE

BHARAT HEAVY ELECTRICALS LIMITED, UNIT: BOILER AUXILIARIES PLANT, RANIPET-632 406.

DEPT CODE		NAME (BHEL)	DATE
M	DRN	M.VENKATARAMAN	08.02.22
	CHD	P.NAVEEN	08.02.22
	APPD	A.C.RAO	08.02.22

MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

TITLE: P & ID - SECONDARY HYDROCYCLONE

SCALE : NTS

NTPC DRG NO.9545-109-RP-PVM-F-020 SH 04 of 11

BHEL DRG NO	FILE NO	REV NO
3-FW-000-07167	B240-00445	00

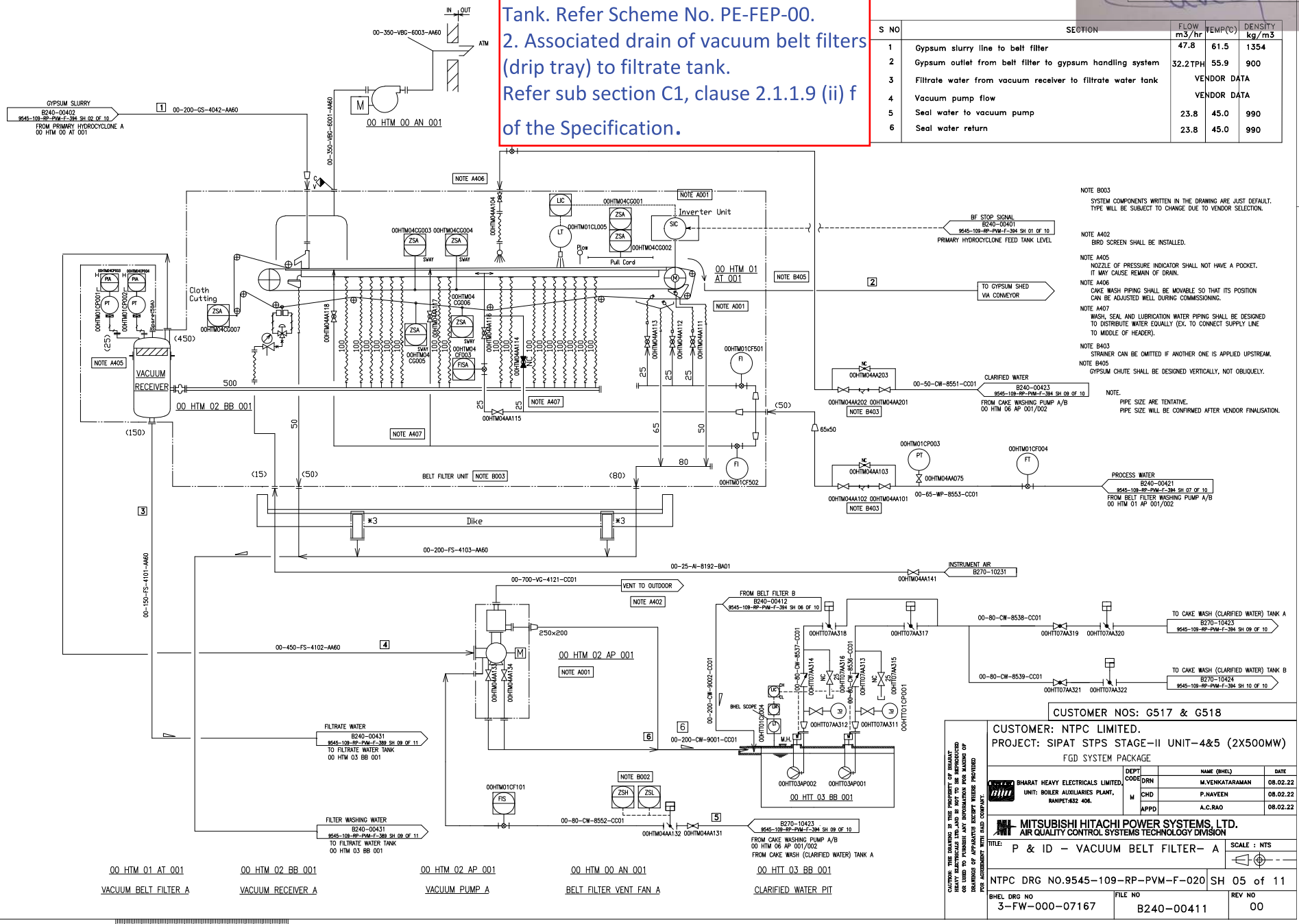
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Complete System in Bidder scope EXCEPT:

1. Piping with accessories from Vacuum Receiver Discharge to Filtrate Water Tank. Refer Scheme No. PE-FEP-00.
2. Associated drain of vacuum belt filters (drip tray) to filtrate tank.

Refer sub section C1, clause 2.1.1.9 (ii) f of the Specification.

S NO	SECTION	FLOW m3/hr	TEMP(°C)	DENSITY kg/m3
1	Gypsum slurry line to belt filter	47.8	61.5	1354
2	Gypsum outlet from belt filter to gypsum handling system	32.2 TPH	55.9	900
3	Filtrate water from vacuum receiver to filtrate water tank	VENDOR DATA		
4	Vacuum pump flow	VENDOR DATA		
5	Seal water to vacuum pump	23.8	45.0	990
6	Seal water return	23.8	45.0	990



CUSTOMER NOS: G517 & G518

CUSTOMER: NTPC LIMITED.
PROJECT: SIPAT STPS STAGE-II UNIT-4&5 (2X500MW)
FGD SYSTEM PACKAGE

BHARAT HEAVY ELECTRICALS LIMITED, UNIT: BOILER AUXILIARIES PLANT, RANIPET:632 406.

DEPT CODE		NAME (BHEL)	DATE
M	DRN	M.VENKATARAMAN	08.02.22
	CHD	P.NAVEEN	08.02.22
	APPD	A.C.RAO	08.02.22

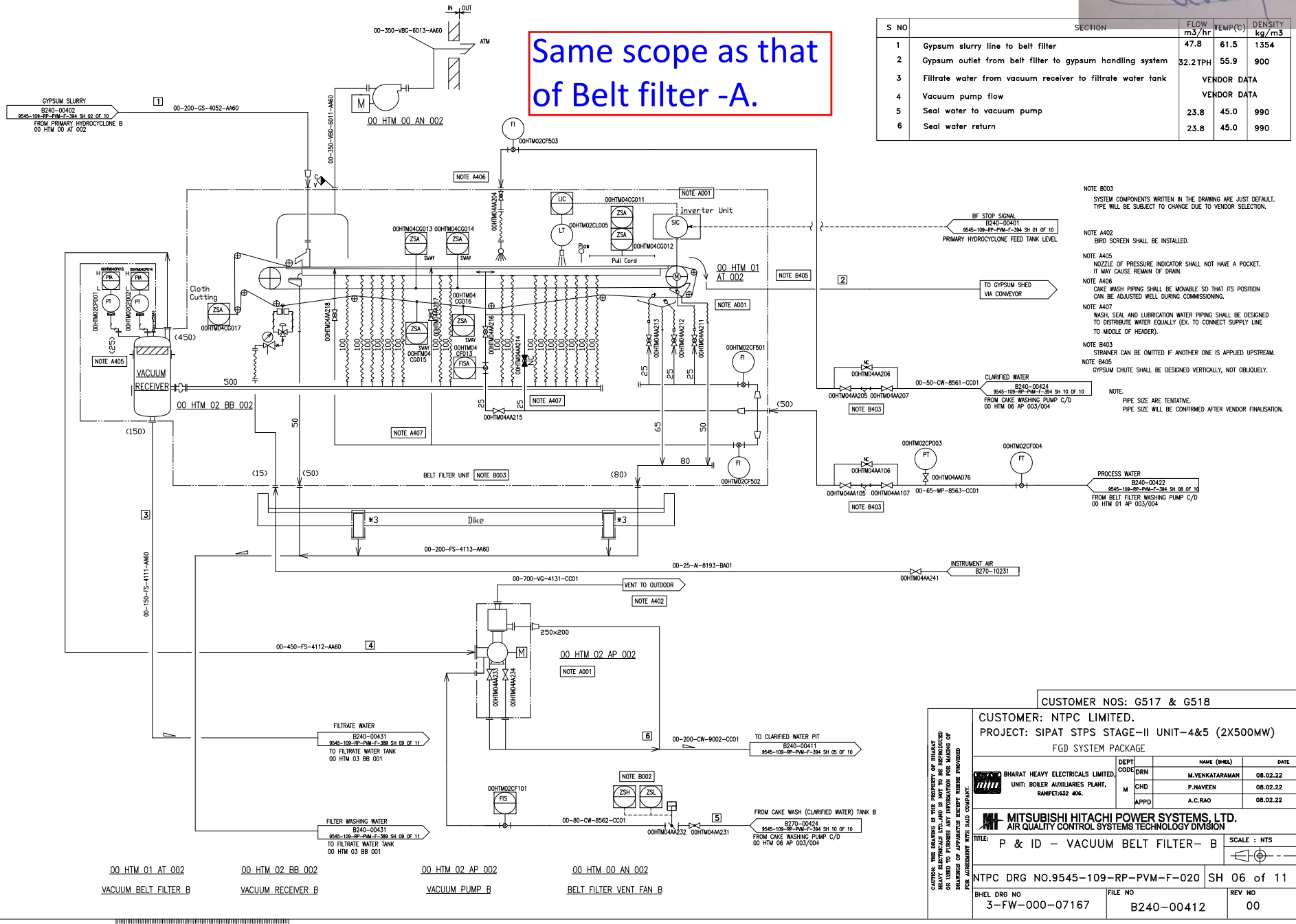
MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

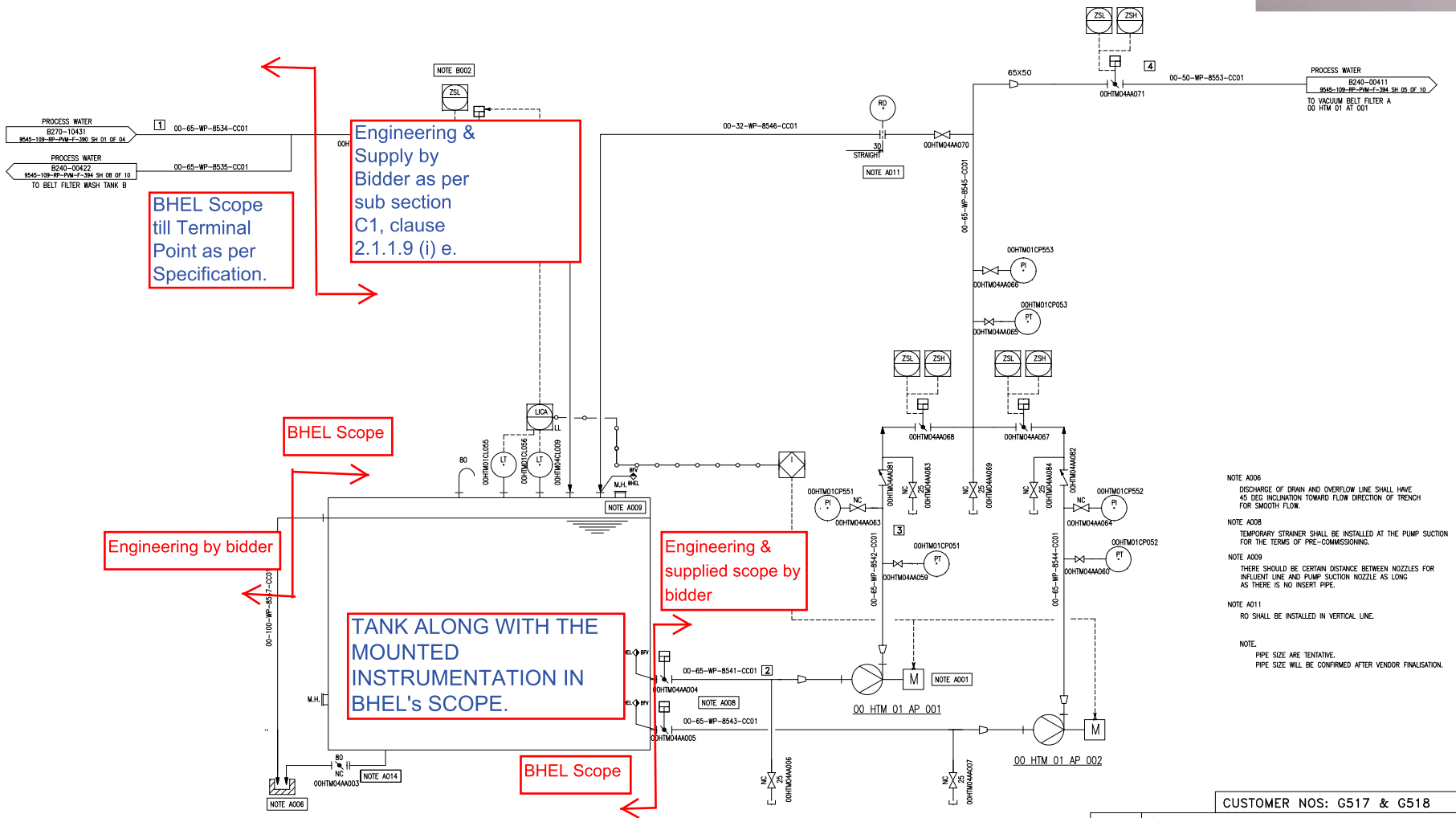
TITLE: P & ID – VACUUM BELT FILTER– A
SCALE : NTS

NTPC DRG NO.9545-109-RP-PVM-F-020 SH 05 of 11

BHEL DRG NO	FILE NO	REV NO
3-FW-000-07167	B240-00411	00

CAUTION THIS DRAWING IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LTD.,AND IS NOT TO BE REPRODUCED OR USED OR FURNISH ANY INFORMATION FOR MAKING OF ITEM AGREEMENT WITH SAID COMPANY.


Same scope as that of Belt filter -A.
S NO | SECTION | FLOW m3/hr | TEMP(C) | DENSITY kg/m3
1 | Gypsum slurry line to belt filter | 47.8 | 61.5 | 1354
2 | Gypsum outlet from belt filter to gypsum handling system | 32.2TPH | 55.9 | 900
3 | Filtrate water from vacuum receiver to filtrate water tank | VENDOR DATA
4 | Vacuum pump flow | VENDOR DATA
5 | Seal water to vacuum pump | 23.8 | 45.0 | 990
6 | Seal water return | 23.8 | 45.0 | 990
GYPSUM SLURRY B240-00402 FROM PRIMARY HYDROCYCLONE B 00 HTM 00 AT 002
00-200-GS-4052-AA60
00-350-VBG-6011-AA60
00-350-VBG-6013-AA60
00 HTM 00 AN 002
Inverter Unit
00 HTM 01 AT 002
00 HTM 02 BB 002
VACUUM RECEIVER
VACUUM BELT FILTER
Cloth Cutting
Pull Cord
BELT FILTER UNIT NOTE B003
Dike
00 HTM 02 AP 002
00-200-FS-4113-AA60
00-150-FS-4111-AA60
00-450-FS-4112-AA60
00-25-AI-8193-BA01
INSTRUMENT AIR B270-10231
00-700-VG-4131-CC01
VENT TO OUTDOOR
NOTE A402
250x200
00-200-CW-9002-CC01
TO CLARIFIED WATER PIT B240-00411
FILTRATE WATER B240-00431 TO FILTRATE WATER TANK 00 HTM 03 BB 001
FILTER WASHING WATER B240-00431 TO FILTRATE WATER TANK 00 HTM 03 BB 001
00-80-CW-8562-CC01
FROM CAKE WASH (CLARIFIED WATER) TANK B B270-00424 FROM CAKE WASHING PUMP C/D 00 HTM 06 AP 003/004
BF STOP SIGNAL B240-00401 PRIMARY HYDROCYCLONE FEED TANK LEVEL
TO GYPSUM SHED VIA CONVEYOR
00-50-CW-8561-CC01
CLARIFIED WATER B240-00424 FROM CAKE WASHING PUMP C/D 00 HTM 06 AP 003/004
00-65-WP-8563-CC01
PROCESS WATER B240-00422 FROM BELT FILTER WASHING PUMP C/D 00 HTM 01 AP 003/004
NOTE B003 SYSTEM COMPONENTS WRITTEN IN THE DRAWING ARE JUST DEFAULT. TYPE WILL BE SUBJECT TO CHANGE DUE TO VENDOR SELECTION.
NOTE A402 BIRD SCREEN SHALL BE INSTALLED.
NOTE A405 NOZZLE OF PRESSURE INDICATOR SHALL NOT HAVE A POCKET. IT MAY CAUSE REMAIN OF DRAIN.
NOTE A406 CAKE WASH PIPING SHALL BE MOVABLE SO THAT ITS POSITION CAN BE ADJUSTED WELL DURING COMMISSIONING.
NOTE A407 WASH, SEAL AND LUBRICATION WATER PIPING SHALL BE DESIGNED TO DISTRIBUTE WATER EQUALLY (EX. TO CONNECT SUPPLY LINE TO MIDDLE OF HEADER).
NOTE B403 STRAINER CAN BE OMITTED IF ANOTHER ONE IS APPLIED UPSTREAM.
NOTE B405 GYPSUM CHUTE SHALL BE DESIGNED VERTICALLY, NOT OBLIQUELY.
NOTE. PIPE SIZE ARE TENTATIVE. PIPE SIZE WILL BE CONFIRMED AFTER VENDOR FINALISATION.
00 HTM 01 AT 002 VACUUM BELT FILTER B
00 HTM 02 BB 002 VACUUM RECEIVER B
00 HTM 02 AP 002 VACUUM PUMP B
00 HTM 00 AN 002 BELT FILTER VENT FAN B
CUSTOMER NOS: G517 & G518
CUSTOMER: NTPC LIMITED.
PROJECT: SIPAT STPS STAGE-II UNIT-4&5 (2X500MW)
FGD SYSTEM PACKAGE
BHARAT HEAVY ELECTRICALS LIMITED, UNIT: BOILER AUXILIARIES PLANT, RANIPET:632 406.
DEPT CODE M DRN M.VENKATARAMAN 08.02.22 CHD P.NAVEEN 08.02.22 APPD A.C.RAO 08.02.22
MITSUBISHI HITACHI POWER SYSTEMS, LTD. AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION
TITLE: P & ID – VACUUM BELT FILTER– B
SCALE : NTS
NTPC DRG NO.9545-109-RP-PVM-F-020 SH 06 of 11
BHEL DRG NO 3-FW-000-07167
FILE NO B240-00412
REV NO 00
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00 HTM 01 BB 001

BELT FILTER WASH TANK A

00 HTM 01 AP 001/002

BELT FILTER WASHING PUMP A/B

BFV - BELT FILTER VENDOR

S NO	SECTION	FLOW m3/hr	TEMP(C)	DENSITY kg/m3
1	Process water to belt filter wash tank	11.9	45.0	990
2	At the suction of belt filter wash pump	15.0	45.0	990
3	At the discharge of belt filter wash pump	15.0	45.0	990
4	Wash water to belt filter	11.9	45.0	990

CUSTOMER NOS: G517 & G518

CUSTOMER: NTPC LIMITED.

PROJECT: SIPAT STPS STAGE-II UNIT-4&5 (2X500MW)

FGD SYSTEM PACKAGE

BHARAT HEAVY ELECTRICALS LIMITED, UNIT: BOILER AUXILIARIES PLANT, RANIPET:632 406.

DEPT CODE		NAME (BHEL)	DATE
M	DRN	M.VENKATARAMAN	08.02.22
	CHD	P.NAVEEN	08.02.22
	APPD	A.C.RAO	08.02.22

MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

TITLE: P & ID - VACUUM BELT FILTER (BELT FILTER WASH TANK A)

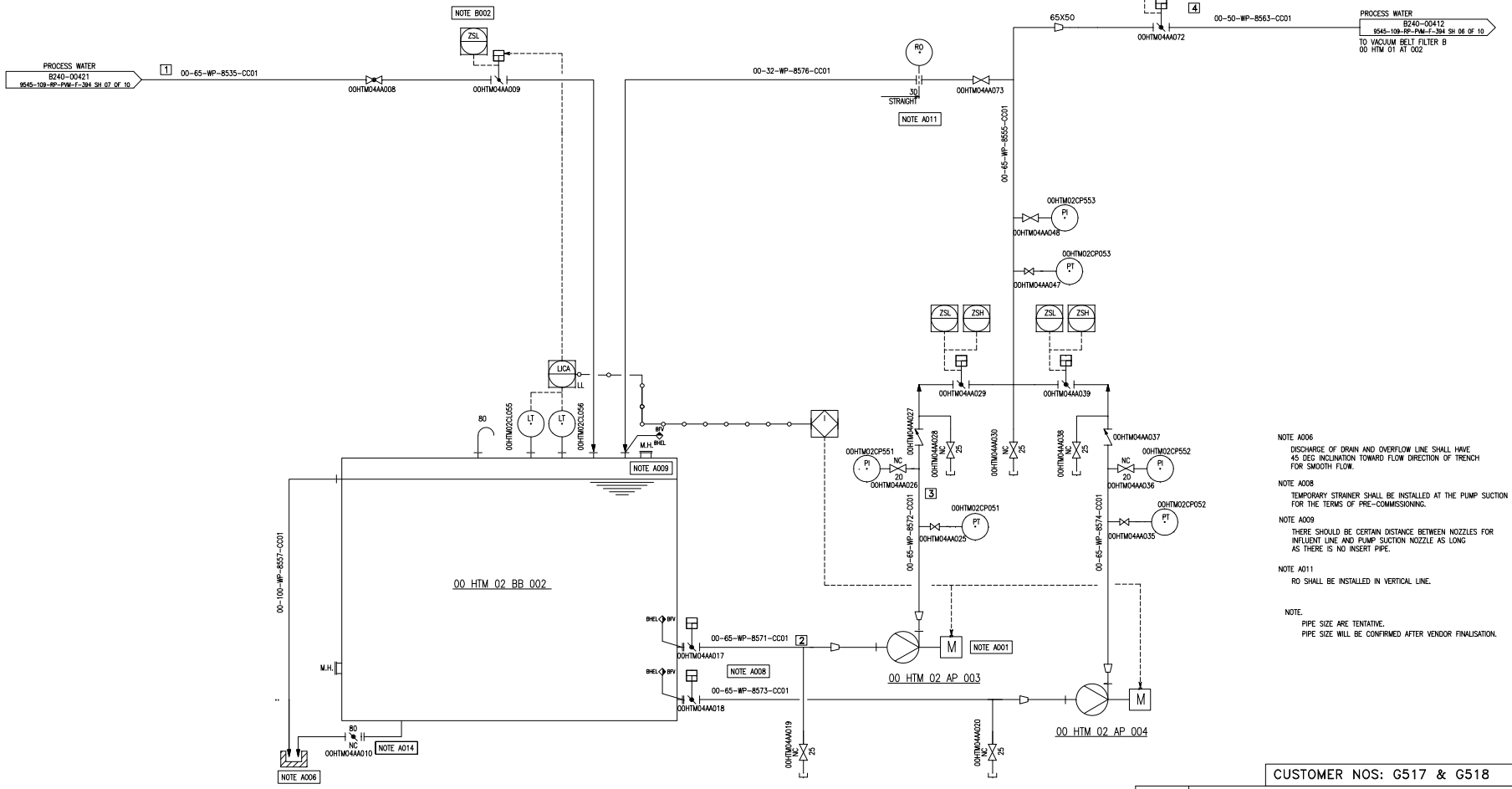
SCALE : NTS

NTPC DRG NO.9545-109-RP-PVM-F-020 SH 07 of 11

BHEL DRG NO 3-FW-000-07167 | FILE NO B240-00421 | REV NO 00

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Same scope as that of
Belt filter Wash Tank - A



NOTE A006
DISCHARGE OF DRAIN AND OVERFLOW LINE SHALL HAVE 45 DEG INCLINATION TOWARD FLOW DIRECTION OF TRENCH FOR SMOOTH FLOW.

NOTE A008
TEMPORARY STRAINER SHALL BE INSTALLED AT THE PUMP SUCTION FOR THE TERMS OF PRE-COMMISSIONING.

NOTE A009
THERE SHOULD BE CERTAIN DISTANCE BETWEEN NOZZLES FOR INFLUENT LINE AND PUMP SUCTION NOZZLE AS LONG AS THERE IS NO INSERT PIPE.

NOTE A011
RO SHALL BE INSTALLED IN VERTICAL LINE.

NOTE.
PIPE SIZE ARE TENTATIVE.
PIPE SIZE WILL BE CONFIRMED AFTER VENDOR FINALISATION.

00 HTM 02 BB 002
BELT FILTER WASH TANK B

00 HTM 02 AP 003/004
BELT FILTER WASHING PUMP C/D

S NO	SECTION	FLOW m3/hr	TEMP(℃)	DENSITY kg/m3
1	Process water to belt filter wash tank	11.9	45.0	990
2	At the suction of belt filter wash pump	15.0	45.0	990
3	At the discharge of belt filter wash pump	15.0	45.0	990
4	Wash water to belt filter	11.9	45.0	990

BFV - BELT FILTER VENDOR

CUSTOMER NOS: G517 & G518

CUSTOMER: NTPC LIMITED.
PROJECT: SIPAT STPS STAGE-II UNIT-4&5 (2X500MW)
FGD SYSTEM PACKAGE

BHARAT HEAVY ELECTRICALS LIMITED.
UNIT: BOILER AUXILIARIES PLANT,
RANIPET:632 406.

DEPT CODE		NAME (BHEL)	DATE
M	DRN	M.VENKATARAMAN	08.02.22
	CHD	P.NAVEEN	08.02.22
	APPD	A.C.RAO	08.02.22

MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

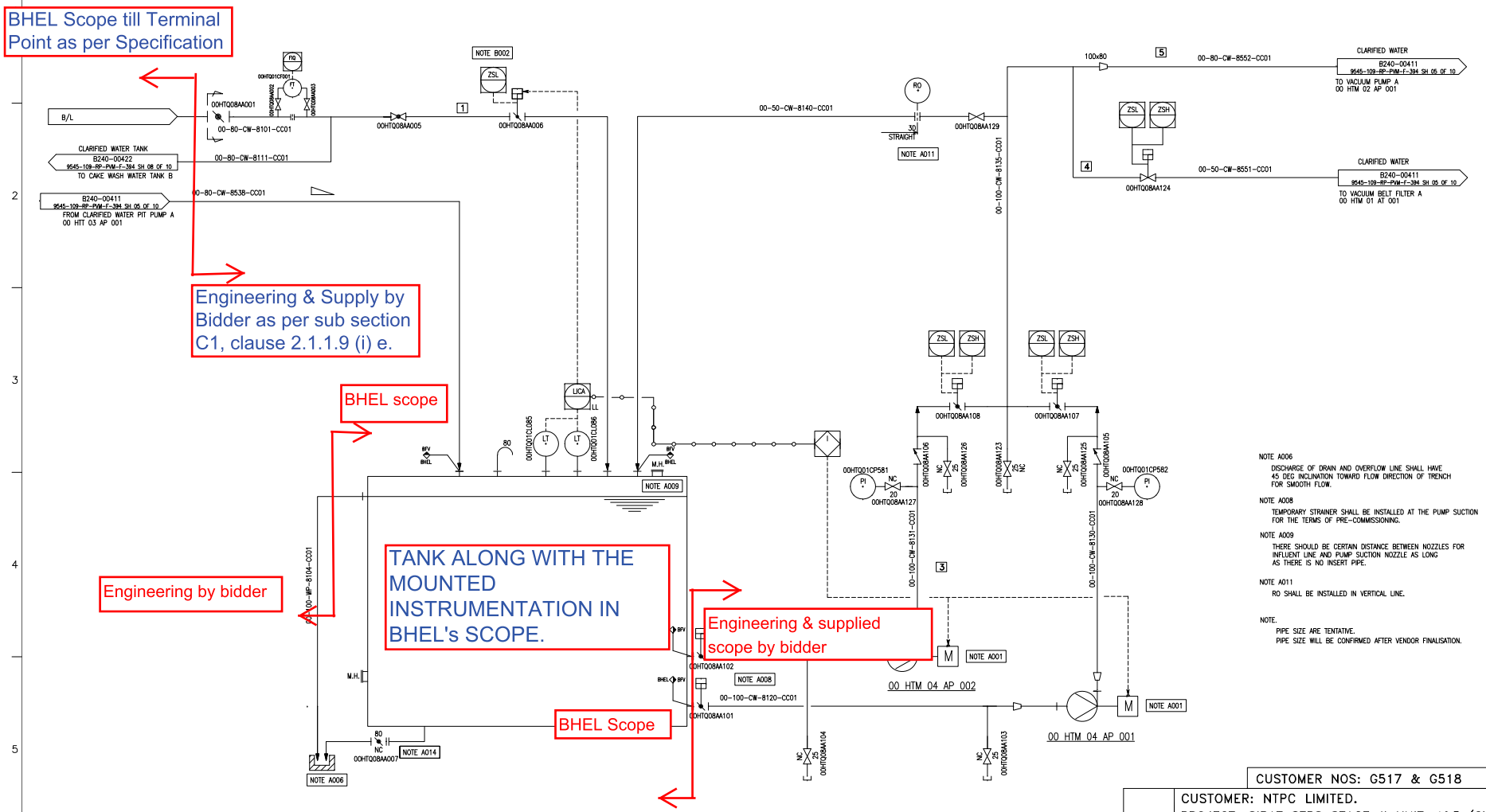
TITLE: P & ID – VACUUM BELT FILTER (BELT FILTER WASH TANK B)

SCALE : NTS

NTPC DRG NO.9545-109-RP-PVM-F-020 SH 08 of 11

BHEL DRG NO 3-FW-000-07167 | FILE NO B240-00422 | REV NO 00

CAUTION: THIS DRAWING IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LTD.,AND IS NOT TO BE REPRODUCED OR USED TO FURNISH ANY INFORMATION FOR MAKING OF DRAWINGS OF APPARATUS EXCEPT WHERE PROVIDED FOR, AGREEMENT WITH SAID COMPANY.



NOTE A006
DISCHARGE OF DRAIN AND OVERFLOW LINE SHALL HAVE 45 DEG INCLINATION TOWARD FLOW DIRECTION OF TRENCH FOR SMOOTH FLOW.

NOTE A008
TEMPORARY STRAINER SHALL BE INSTALLED AT THE PUMP SUCTION FOR THE TERMS OF PRE-COMMISSIONING.

NOTE A009
THERE SHOULD BE CERTAIN DISTANCE BETWEEN NOZZLES FOR INFLUENT LINE AND PUMP SUCTION NOZZLE AS LONG AS THERE IS NO INSERT PIPE.

NOTE A011
RO SHALL BE INSTALLED IN VERTICAL LINE.

NOTE.
PIPE SIZE ARE TENTATIVE.
PIPE SIZE WILL BE CONFIRMED AFTER VENDOR FINALISATION.

S NO	SECTION	FLOW m3/hr	TEMP(℃)	DENSITY kg/m3
1	Clarified water to clarified wash tank	11.9	45.0	990
2	At the suction of clarified wash pump	45.0	45.0	990
3	At the discharge of clarified wash pump	45.0	45.0	990
4	Clarified Wash water to belt filter	11.9	45.0	990
5	Vacuum pump seal water	23.8	45.0	990

00 HTQ 01 BB 001
CAKE WASH (CLARIFIED WATER) TANK A

00 HTQ 04 AP 001/002
CAKE WASHING PUMP A/B

BFV - BELT FILTER VENDOR

CUSTOMER NOS: G517 & G518

CUSTOMER: NTPC LIMITED.
PROJECT: SIPAT STPS STAGE-II UNIT-4&5 (2X500MW)
FGD SYSTEM PACKAGE

	DEPT CODE	NAME (BHEL)	DATE
BHARAT HEAVY ELECTRICALS LIMITED, UNIT: BOILER AUXILIARIES PLANT, RANIPET:632 406.	M	DRN M.VENKATARAMAN	08.02.22
		CHD P.NAVEEN	08.02.22
		APPD A.C.RAO	08.02.22

MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

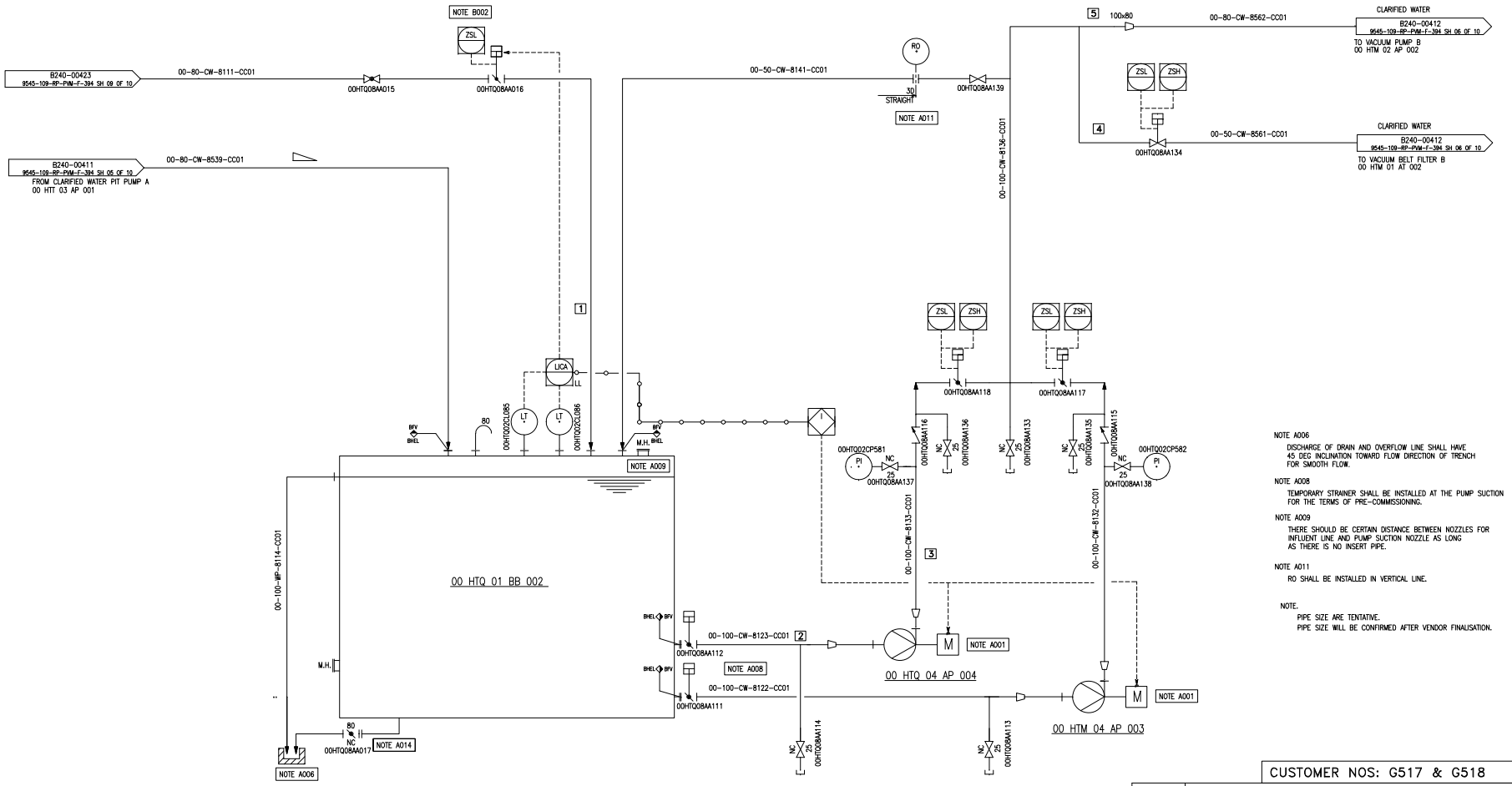
TITLE: P & ID - VACUUM BELT FILTER CAKE WASH (CLARIFIED WATER) TANK A
SCALE : NTS

NTPC DRG NO.9545-109-RP-PVM-F-020 SH 09 of 11

BHEL DRG NO 3-FW-000-07167 | FILE NO B240-00423 | REV NO 00

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Same scope as that of Belt filter Wash Tank - A



NOTE A006
DISCHARGE OF DRAIN AND OVERFLOW LINE SHALL HAVE 45 DEG INCLINATION TOWARD FLOW DIRECTION OF TRENCH FOR SMOOTH FLOW.

NOTE A008
TEMPORARY STRAINER SHALL BE INSTALLED AT THE PUMP SUCTION FOR THE TERMS OF PRE-COMMISSIONING.

NOTE A009
THERE SHOULD BE CERTAIN DISTANCE BETWEEN NOZZLES FOR INFLUENT LINE AND PUMP SUCTION NOZZLE AS LONG AS THERE IS NO INSERT PIPE.

NOTE A011
RO SHALL BE INSTALLED IN VERTICAL LINE.

NOTE.
PIPE SIZE ARE TENTATIVE.
PIPE SIZE WILL BE CONFIRMED AFTER VENDOR FINALISATION.

00 HTQ 01 BB 002
CAKE WASH (CLARIFIED WATER) TANK B

00 HTQ 04 AP 003/004
CAKE WASHING PUMP C/D

S NO	SECTION	FLOW m3/hr	TEMP(C)	DENSITY kg/m3
1	Clarified water to clarified wash tank	11.9	45.0	990
2	At the suction of clarified wash pump	45.0	45.0	990
3	At the discharge of clarified wash pump	45.0	45.0	990
4	Clarified Wash water to belt filter	11.9	45.0	990
5	Vacuum pump seal water	23.8	45.0	990

BFV - BELT FILTER VENDOR

CUSTOMER NOS: G517 & G518

CUSTOMER: NTPC LIMITED.
PROJECT: SIPAT STPS STAGE-II UNIT-4&5 (2X500MW)
FGD SYSTEM PACKAGE

	DEPT CODE	NAME (BHEL)	DATE
BHARAT HEAVY ELECTRICALS LIMITED, UNIT: BOILER AUXILIARIES PLANT, RANIPET:632 406.	M	DRN M.VENKATARAMAN	08.02.22
		CHD P.NAVEEN	08.02.22
		APPD A.C.RAO	08.02.22

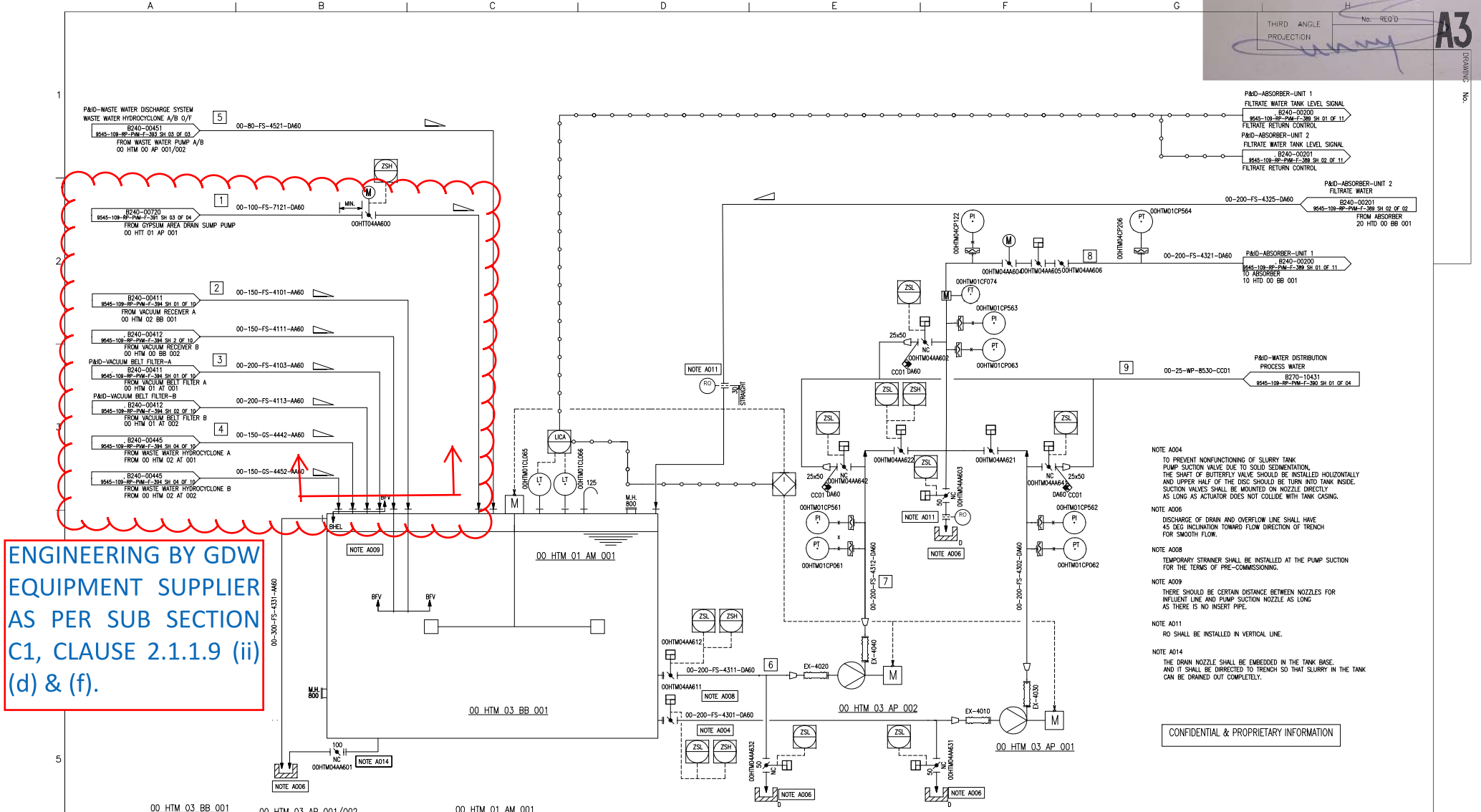
MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

TITLE: P & ID – VACUUM BELT FILTER CAKE WASH (CLARIFIED WATER) TANK B
SCALE : NTS

NTPC DRG NO.9545-109-RP-PVM-F-020 SH 10 of 11

BHEL DRG NO 3-FW-000-07167 | FILE NO B240-00424 | REV NO 00

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S NO	SECTION	FLOW m³/hr	TEMP(°C)	DENSITY(kg/m)
1	Gypsum slurry from gypsum area drain sump pump	50	61.5	1212
2	Filtrate water from vacuum receiver		VENDOR DATA	
3	Wash Water from vacuum belt filter		VENDOR DATA	
4	Underflow from sec waste water hydrocyclone	24.5	61.5	1256
5	Waste water slurry from waste water tank	21.3	61.5	1020
6	Suction line of filtrate tank pump	205	58.0	1066
7	Discharge line from filtrate pump	205	58.0	1066
8	Common discharge line to absorber	205	58.0	1066
9	Process water for flushing	3.0	45.0	990

NOTE A004
TO PREVENT NONFUNCTIONING OF SLURRY TANK PUMP SUCTION VALVE DUE TO SOLID SEDIMENTATION, THE SHAFT OF BUTTERFLY VALVE SHOULD BE INSTALLED HOLIZONTALLY AND UPPER HALF OF THE DISC SHOULD BE TURN INTO TANK INSIDE. SUCTION VALVES SHALL BE MOUNTED ON NOZZLE DIRECTLY AS LONG AS ACTUATOR DOES NOT COLLIDE WITH TANK CASING.

NOTE A006
DISCHARGE OF DRAIN AND OVERFLOW LINE SHALL HAVE 45 DEG INCLINATION TOWARD FLOW DIRECTION OF TRENCH FOR SMOOTH FLOW.

NOTE A008
TEMPORARY STRAINER SHALL BE INSTALLED AT THE PUMP SUCTION FOR THE TERMS OF PRE-COMMISSIONING.

NOTE A009
THERE SHOULD BE CERTAIN DISTANCE BETWEEN NOZZLES FOR INFLUENT LINE AND PUMP SUCTION NOZZLE AS LONG AS THERE IS NO INSERT PIPE.

NOTE A011
RO SHALL BE INSTALLED IN VERTICAL LINE.

NOTE A014
THE DRAIN NOZZLE SHALL BE EMBEDDED IN THE TANK BASE. AND IT SHALL BE DIRRECTED TO TRENCH SO THAT SLURRY IN THE TANK CAN BE DRAINED OUT COMPLETELY.

CUSTOMER NOS: G517 & G518

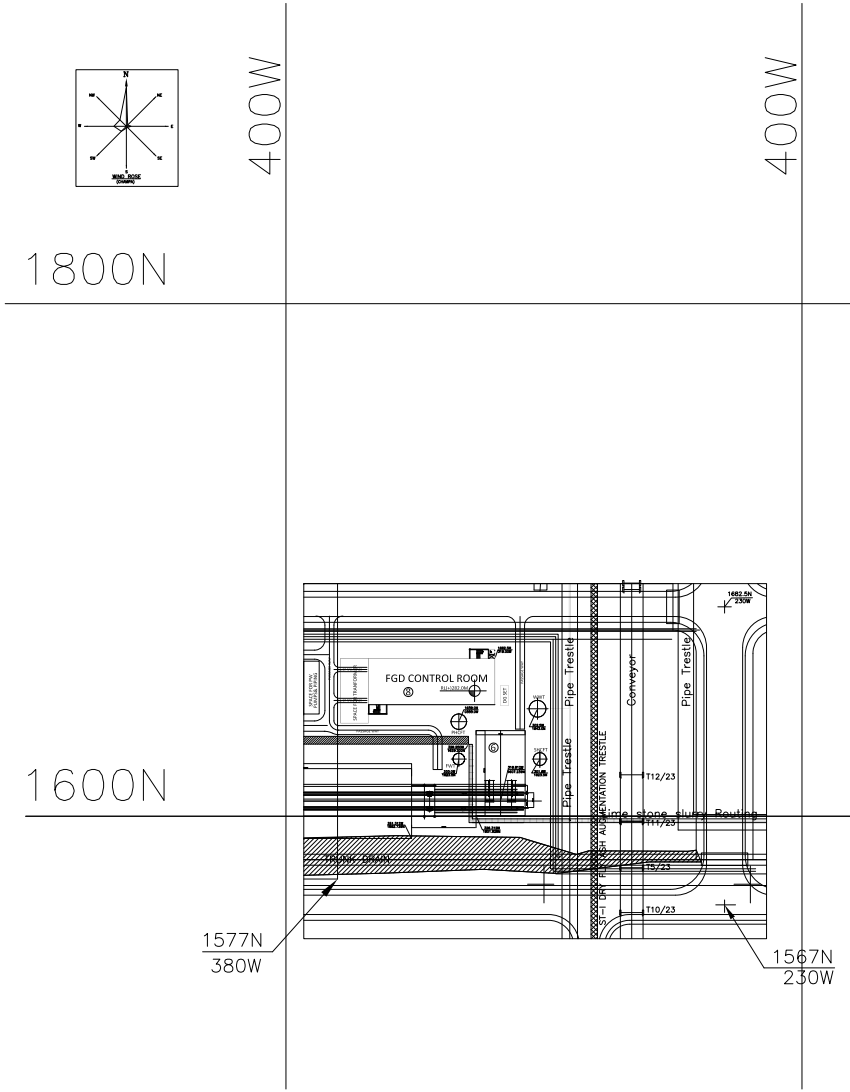
CUSTOMER: NTPC LIMITED.
PROJECT: SIPAT STPS STAGE-II UNIT-4&5 (2X500MW)
FGD SYSTEM PACKAGE

	DEPT CODE	NAME (BHEL)	DATE
BHARAT HEAVY ELECTRICALS LIMITED, UNIT: BOILER AUXILIARIES PLANT, RANIPET-632 406.	DRN	M.VENKATARAMAN	08.02.22
	M CHD	P.NAVEEN	08.02.22
	APPD	A.C.RAO	08.02.22

MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

TITLE: P & ID –FILTRATE WATER TANK
SCALE : NTS
NTPC DRG NO: 9545-109-RP-PVM-F-020
SH 11 of 11
BHEL DRG NO 3-FW-000-07167
FILE NO B240-00431
REV NO 00

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NOTES:

1. ALL DIMENSIONS AND LEVELS ARE IN MM.
2. FORMATION LEVEL OF VARIOUS BLOCKS SHALL BE AS INDICATED IN THE DRAWING.
3. EL(±)0.00M CORRESPONDS TO RL(+)282.50M.
4. EXISTING PIPE/CABLE TRESTLES PASSING THROUGH THE PROPOSED FGD AREA SHALL BE RETAINED, AND FGD LAYOUT SHALL BE PREPARED ACCORDINGLY.
5. DIMENSIONS OF ALL BUILDINGS/FACILITIES SHOWN IN THE GLP ARE INDICATIVE AND ARE SUBJECT TO DETAILED EQUIPMENT LAYOUT DRG.
6. THE AREA IDENTIFIED FOR FGD PURPOSE IN GLP SHALL BE LEVELLED AND FREE FROM OBSTRUCTION LIKE SHEDS, TREES ETC. AND SHALL BE OWNER'S SCOPE.
7. PASSAGES SHALL BE PROVIDED INSIDE THE FGD AREA CONNECTING TO THE OUTER PERIPHERY ROAD TO HAVE ACCESS TO THE VARIOUS FACILITIES / BUILDING
8. TOP OF STEEL/STRUCTURE/FACILITY IN THE TRANSMISSION LINE CORRIDOR SHALL BE RESTRICTED TO 16M FROM GROUND.

LEGEND:

1. ROAD
2. BOUNDARY WALL
3. FENCING
4. RAILWAY LINE
5. LAND ACQUISITION LINE
6. FACILITIES/BUILDINGS/STRUCTURES
7. FORMATION LEVEL — RL(+) 282.0M
8. TOWNSHIP BOUNDARY WALL
9. SPACE FOR FGD PACKAGE (FOR LOT-2)
10. SPACE FOR FGD PACKAGE (FOR LOT-5)

EQUIPMENT/ STRUCTURE NO.	DESCRIPTION
01	NEW WET STACK
02	WET LIMESTONE BASED ABSORBER
03	BC PUMPS AND OXIDATION BLOWER HOUSE
04	BOOST UP FANS
05	AUXILIARY ABSORBENT TANK AND PUMP
06	GYPSUM DEWATERING BUILDING
07	ACW AND DACW PUMP SHED
08	FGD CONTROL ROOM
09	ELEVATOR FOR ABSORBER
10	COMPRESSOR HOUSE
11	LIMESTONE SLURRY STORAGE TANKS AND PUMP
12	MCWH BRIDGE FOR LIMESTONE/GYPSUM HANDLING SYS

REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD
3	18.01.23	IKU	SK	BKA	2	05.11.22	IKU	SK	BKA	1	10.06.22	IKU	SK	BKA
1	Drawing updated as per latest input and comments				1	Drawing updated as per latest input and comments				1	Drawing updated as per latest input and comments			

JOB NO.	491
STATUS	CONTRACT
DISTRIBUTION	

NTPC DRG No.	9545-109-109-001-PEM-PVM-F-044 03
CUSTOMER	NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION
PROJECT	SIPAT SUPER THERMAL POWER PROJECT
	BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR PROJECT ENGINEERING MANAGEMENT,NOIDA

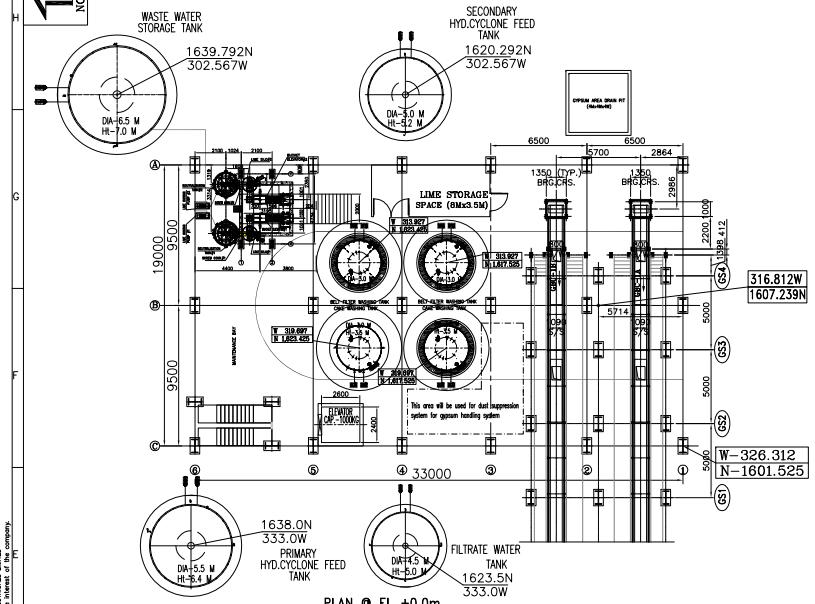
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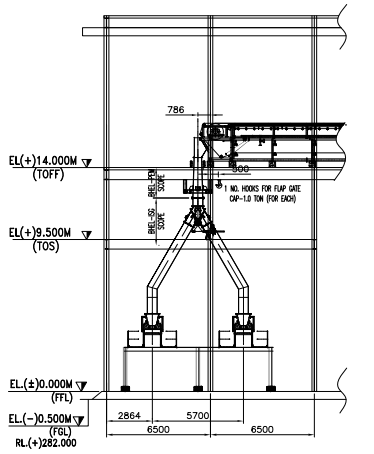
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	DESN	IKU		28.01.2022
	CHD	SK		28.01.2022
	APPD	BKA		28.01.2022

GENERAL PLANT LAYOUT OF FGD SYSTEM

DEPT.	SCALE: 4000	DRAWING NO.
SIGN		PE-DG-491-100-M001
		SHEET 1 OF 1 REV. 03

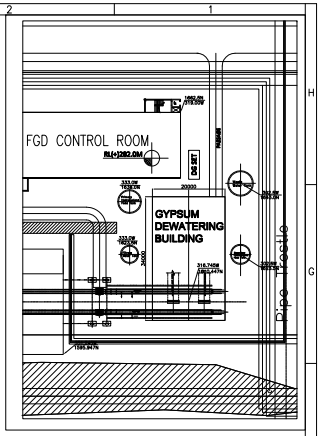
May 08, 2023 - 2:32pm SIZE-A0





LIST OF REFERENCE DRAWINGS			
SL. NO	DRAWING NO.	DRAWING TITLE	AGENCY
1	–	LAYOUT OF FGD SYSTEM	PEM/BAP
2	–	LAYOUT OF LIME FEEDING/ DOSING SYSTEM (LDS)	PEM/VENDOR
3	–	PAVING DETAILS OF GYPSUM AREA	PEM
4	–	FLOW DIAGRAM OF LIME STONE AND GYPSUM HANDLING PLAN	ISG
5	9545-109-109-001-ISG-PVM-Y-511	GA & LOAD DATA OF GYPSUM CONVEYOR GBC-1A/1B	ISG/VENDOR
6	–	GA DRAWING OF PRIMARY HYDRO CYCLONE FEED TANK	PEM/VENDOR
7	–	GA DRAWING OF FILTERATE WATER TANK	PEM/VENDOR
8	–	GA DRAWING OF SECONDARY HYDRO CYCLONE FEED TANK	PEM/VENDOR
9	–	GA DRAWING OF WASTE WATER TANK	PEM/VENDOR
10	–	GA DRAWING OF BELT FILTER WASH TANKS	PEM/VENDOR
11	–	GA DRAWING OF CAKE WASH (CLARIFIED WATER) TANK	PEM/VENDOR

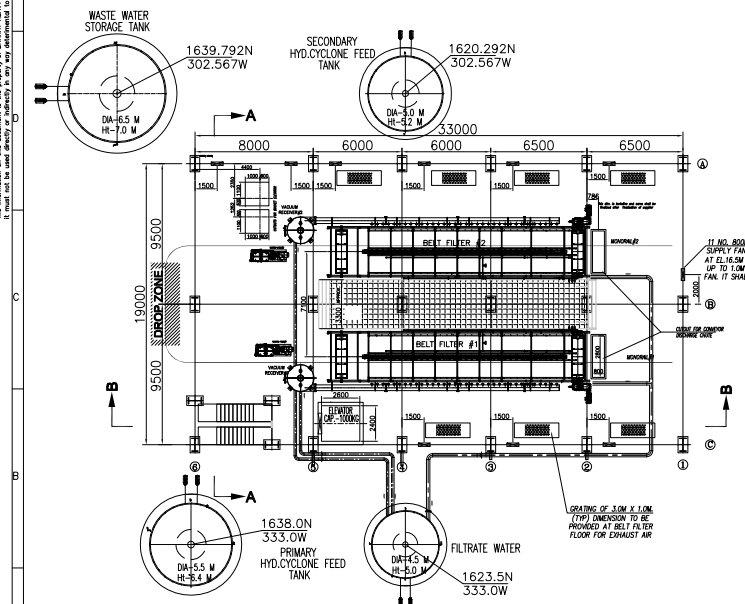
WIND ROSE



KEY PLAN

Notes:

1. All Dimensions are in millimeters and elevations in meters, unless otherwise specified.
2. EL(±)0.00m corresponds to RL(+)282.50m.
3. Floor openings, pipe crossings shall be finalized during detailed engineering.
4. This Drawings is tentative considering not-to-exceed loads. Civil drawing shall be prepared accordingly.
5. Seal pit dimension (*) shall be finalized as furnished by the Gypsum Dewatering Equipment Supplier.
6. Gypsum Dewatering Equipment Supplier shall confirm the capacity and layout for handling equipments.
7. Building shall be ventilated suitably.
8. Details of staircase, suitable doors, windows etc. shall be considered by Civil Designer.



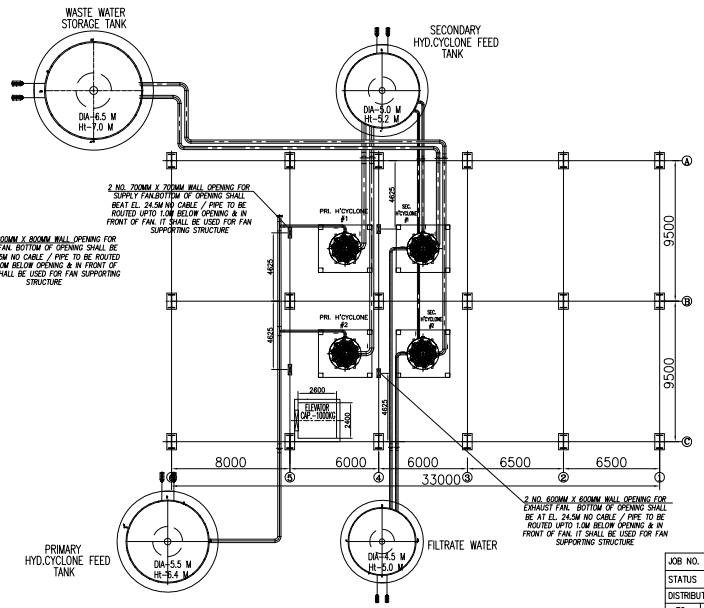


TABLE OF EQUIPMENTS					
EQPT NO	QTY.	DESCRIPTIONS	APPX WEIGHT OF EACH EQPT UNDER OPRATION	LOCATION IN GDW BUILDING	REMARKS
1	02	VACUUM BELT FILTER	60 MT	ON FIRST FLOOR EL(+)14.00	THE EQUIPMENT COLUMNS WILL BE SUPPORTED ON THE FLOOR
2	02	SECONDARY HYDRO CYCLONE – (SET)	3 MT (INCLUDING SUPPORTING PLATFORMS)	ON FIRST FLOOR EL(+)14.00	THE EQUIPMENT HAS 4 COLUMNS WHICH WILL BE SUPPORTED ON THE FLOOR
3	02	NEUTRALISATION (LIME DOSING) TANK WITH AGITATOR	5.5 MT	GROUND FLOOR @ EL(+)0.00	SEPARATE FOUNDATION OR FLOOR MOUNTED AS PER CIVIL DESIGN
4	02	LIME FEED SCREW CONVEYER	1.5 MT	ABOVE NEUTRALISATION (LIME DOSING) TANK	THE SCREW CONVEYER WILL BE MOUNTED BELOW LIME SILO/HOPPER
5	02	LIME DOSING SILO/HOPPER, MANUAL GATE, MOTORISED GATE, ROTARY FEEDER & SUPPORT STRUCTURE	12 MT (COMBINED WEIGHT INCLUDING SUPPORTS)	ABOVE NEUTRALISATION (LIME DOSING) TANK	LIME SILO WILL BE SUPPORTED ON PLATFORM OR SUPPORTING STRUCTURE
6	02	PRIMARY HYDROCYCLONE	4MT (INCLUDING SUPPORTING PLATFORMS)	ON SECOND FLOOR EL(+)22.00	PRIMARY HYDRO CYCLONE WILL BE SUITABLY SUPPORTED ON FLOOR
7	02	VACUUM PUMP & MOTOR	20 MT	ON FIRST FLOOR EL(+)14.00	FOUNDATION TO BE PROVIDED AS PER CIVIL DESIGN
8	02	VACUUM RECEIVER	8MT	FIRST FLOOR @ EL(+)14.00	FLOOR MOUNTED
9	02	CAKE WASH TANK	–	GROUND FLOOR @ EL(+)0.00	SEPARATE FOUNDATION OR FLOOR MOUNTED AS PER CIVIL DESIGN
10	02	BELT FILTER(CLOTH) TANK	–	GROUND FLOOR @ EL(+)0.00	SEPARATE FOUNDATION OR FLOOR MOUNTED AS PER CIVIL DESIGN
11	02	BUCKET ELEVATOR ASSY. (WITH SURGE HOPPER & VIBRATING FEEDER) FOR LIME FEED	13.5 T	FROM GROUND FLOOR TO LIME STORAGE SILO TOP	THE BUCKET ELEVATOR IS MOUNTED ON PIT FLOOR AND WILL REACH TO LIME SILO TOP THROUGH SUPPORT STRUCTURE.
12	02	BAG FILTER WITH BLOWERS	1 T	ON LIME STORAGE SILO PLATFORM	BAG FILTER WILL BE SUPPORTED ON LIME SILO / PLATFORM WHICH WILL BE SUPPORTED ON FLOOR
13	02	LIME DOSING PUMPS	0.2 T	GROUND FLOOR @ EL(+)0.00	FOUNDATION TO BE PROVIDED AS PER CIVIL DESIGN
14	01	PRIMARY HYDROCYCLONE FEED TANK & PUMPS WITH MOTORS	–	OUTSIDE GDW BUILDING	SEPARATE FOUNDATION OR FLOOR MOUNTED AS PER CIVIL DESIGN
15	01	FILTRATE WATER TANK & PUMPS WITH MOTORS	–	OUTSIDE GDW BUILDING	FOUNDATION TO BE PROVIDED AS PER CIVIL DESIGN
16	01	SECONDARY HYDROCYCLONE FEED TANK & PUMPS WITH MOTORS	–	OUTSIDE GDW BUILDING	SEPARATE FOUNDATION OR FLOOR MOUNTED AS PER CIVIL DESIGN
17	01	WASTE WATER STORAGE TANK & PUMPS WITH MOTORS	–	OUTSIDE GDW BUILDING	FOUNDATION TO BE PROVIDED AS PER CIVIL DESIGN
18	02	CAKE WASH PUMPS & MOTORS	0.5 T	GROUND FLOOR @ EL(+)0.00	FOUNDATION TO BE PROVIDED AS PER CIVIL DESIGN
19	02	BELT/CLOTH WASH PUMPS & MOTORS	0.3 T	GROUND FLOOR @ EL(+)0.00	FOUNDATION TO BE PROVIDED AS PER CIVIL DESIGN
20	–	PLATFORMS FOR VBF & HYDROCYCLONES	15 T	AS SHOWN	FOUNDATION TO BE PROVIDED AS PER CIVIL DESIGN
21	02	DISCHARGE CHUTE	–	VBF DISCHARGE Φ14.0M TO CONVEYOR	FOUNDATION TO BE PROVIDED AS PER CIVIL DESIGN
22					

REV.	DATE	ALTD	CHD	APPD

REV.	DATE	ALTD	CHD	APPD

JOB NO. 491
STATUS CONTRACT
DISTRIBUTION
TO
No. OF

NTPC DRG No. 9545-109-109-001-PEM-PVM-B-047

CUSTOMER NTPC

NTPC Limited
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT SIPAT SUPER THERMAL POWER PROJECT (STAGE-II) FGD

DEVELOPED BY BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR
PROJECT ENGINEERING MANAGEMENT,NOIDA

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	DESN	GP	–SD–	10.06.2022
	CHD	RR	–SD–	10.06.2022
	APPD	SKB	–SD–	10.06.2022

GENERAL ARRANGEMENT & LAYOUT OF GDW BUILDING.

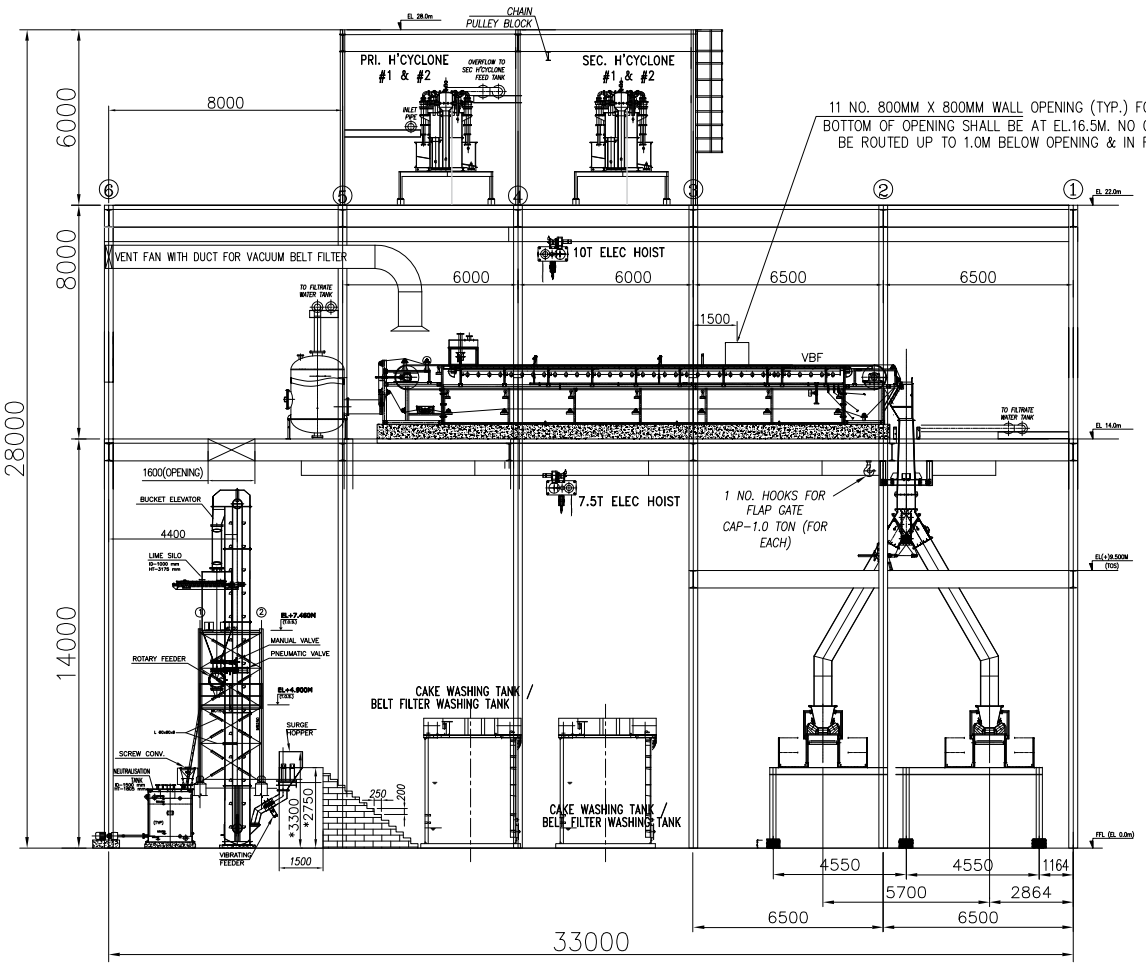
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					SIGN		
					DATE		SHEET 01 OF 02 REV. 00

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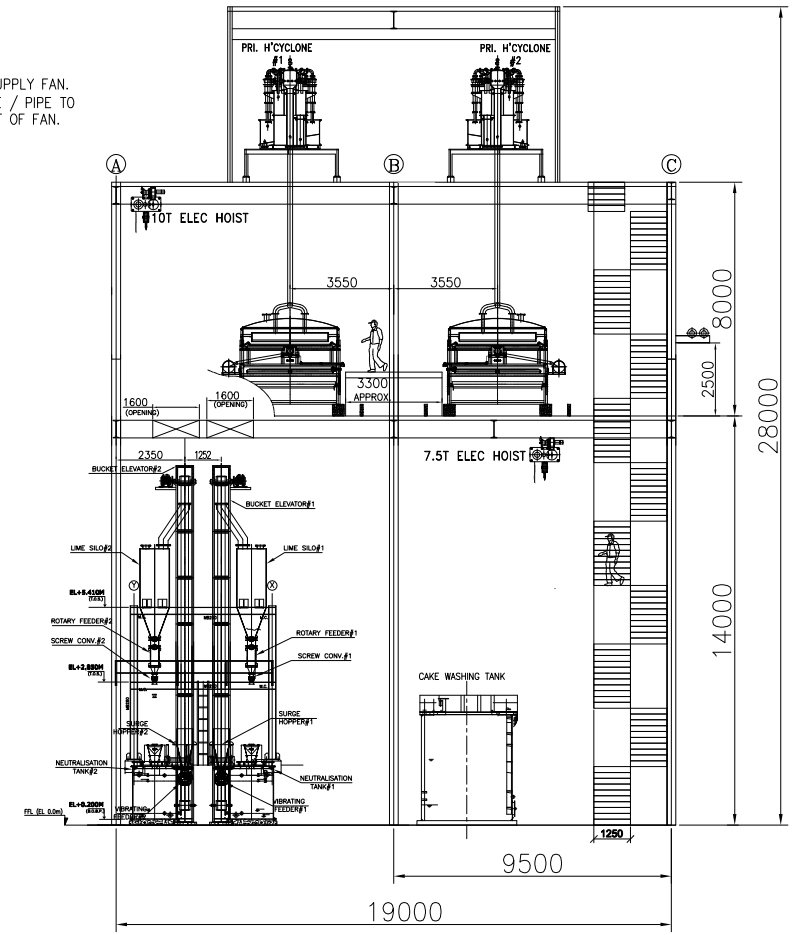
FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

DRAWING NO. PE-DG-491-571-A001



SECTION – BB



SECTION – AA

JOB NO.	491
STATUS	CONTRACT
DISTRIBUTION TO	
No. OF	

REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD

NTPC DRG No.	9545-109-109-001-PEM-PVM-B-047
CUSTOMER	NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION
PROJECT	SIPAT SUPER THERMAL POWER PROJECT (STAGE-II) FGD
DRAWN BY	BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR PROJECT ENGINEERING MANAGEMENT,NOIDA

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	DESN	GP	–SD–	10.04.2022
	CHD	RR	–SD–	10.04.2022
	APPD	SKB	–SD–	10.04.2022

GENERAL ARRANGEMENT & LAYOUT OF GDW BUILDING.

MPL	ELEC	C&I	MSE	MAX	DEPT.	SCALE 1:100	DRAWING NO. PE-DG-491-571-A001
					SIGN		
					DATE		SHEET 02 OF 02 REV. 00

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BHEL REV.–OB, 26.12.2022 FORMAT SIZE A0

SECTION-I

SUB-SECTION-D

ANNEXURE-V

MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION

Drawings/Drawings to be submitted by the Bidder:

SN	Doc / Drawing No.	Drawing Title	Remarks		No. of weeks from LOI
			Type*		
1	PE-V0-491-571-A901	MQP for Vacuum Belt Filter along with Sub-Vendor List of Components for GDE.	Primary	Basic Engineering drawings/ Documents (Primary drawings/ documents)	4
2	PE-V0-491-571-A902	P&I Diagram with Bill of quantity (BOQ) of GDE.	Primary		3
3	PE-V0-491-571-A903	Control Philosophy of GDE.	Primary		6
4	PE-V0-491-571-A904	Design Philosophy & Sizing Calculation for Gypsum Dewatering Equipment: (a) VBF, (b) Vacuum Receiver, (c) Vacuum Pump, (d) Belt Wash Pump, (e) Cake wash Pumps, (f) Drives and (g) other Accessories for GDE..	Primary		3
5	PE-V0-491-571-A905	GENERAL ARRANGEMENT & LAYOUT OF GDW BUILDING (Showing layout & Foundation details of all the equipments of GDE)	Primary		6
6	PE-V0-491-571-A906	Data Sheet (vacuum belt filter & all accessories of GDE) & General Arrangement Drawings of VBF including cross-sectional details, foundation plan and load details	Primary		6
7	PE-V0-491-571-A907	Piping Layout (Integral-Vendor Scope) with supports & fixing arrangement with BOQ for GDE.	Primary		10
8	PE-V0-491-571-A908	General Arrangement Drawings of (a) Vacuum Pump, (b) Vacuum Receiver, (c) Hydro cyclones (Primary & Secondary), (d) Belt Wash Pump, (e) Cake Wash Pump & (f) Vent Fan, along with cross sectional details, foundation plan and loading details.	Primary		8
9	PE-V0-491-571-A909	Piping Layout (Non-Integral - BHEL Scope) with supports & fixing arrangement with BOQ for GDE.	Primary		10
10	PE-V0-491-571-A910	Instrument schedule along with GA & Data sheet for GDE.	Secondary		
11	PE-V0-491-571-A911	Data Sheet of Instruments of GDE	Secondary		

12	PE-V0-491-571-A912	Valve schedule for GDE.	Secondary		
13	PE-V0-491-571-A913	GA & Data sheet of Valves for GDE.	Secondary		
14	PE-V0-491-571-A914	Piping Isometric (Integral-Vendor Scope) with supports & fixing arrangement with BOQ for GDE.	Secondary		
15	PE-V0-491-571-A915	Piping Isometric (Non-Integral - BHEL Scope) with supports & fixing arrangement with BOQ for GDE.	Secondary		
16	PE-V0-491-571-A916	Block logic diagram & Inter-Connection drawing of GDE.	Secondary		
17	PE-V0-491-571-A917	Cable Schedule of GDE.	Secondary		
18	PE-V0-491-571-A918	Electrical load List for GDE.	Secondary		
19	PE-V0-491-571-A919	Local Panel Control Circuit Diagram of GDE.	Secondary		
20	PE-V0-491-571-A920	General Arrangement Drawing & Data sheet of Motors for GDE.	Secondary		
21	PE-V0-491-571-A921	T-S & Performance curves of Vacuum Pump for GDE.	Secondary		
22	PE-V0-491-571-A922	I/O List (Drives & Instruments) of GDE.	Secondary		
23	PE-V0-491-571-A923	Utility Consumption of GDE.	Secondary		
24	PE-V0-491-571-A924	Schedule for Lubrication and other Consumables of GDE.	Secondary		
25	PE-V0-491-571-A925	Painting Schedule of GDE	Secondary		
26	PE-V0-491-571-A926	Mandatory Spare List & BBU of GDE	Secondary		
27	PE-V0-491-571-A927	Platform Drawing of GDE with detailed BOQ	Secondary		
28	PE-V0-491-571-A928	Erection & Commissioning Manual of GDE including- i). Installation and assembly procedure of complete GDE ii). Pre-Commissioning Check List of GDE	Secondary		
29	PE-V0-491-571-A929	Operation & Maintenance (O&M) Manual of GDE including Transportation and Storage Specification for GDE Components	Secondary		
30	PE-V0-491-571-A930	Schedule of Start-up & Commissioning Spares for GDE	Secondary		

31	PE-V0-491-571-A931	List of Special tools & Tackles for GDE	Secondary		
32	PE-V0-491-571-A932	Performance Test Procedure of GDE	Secondary		

List of Documents for BHEL Ref / info.

1	PE-V0-491-571-A933	Bill of Material (BOM) of complete GDE for Main Supply	Information to BHEL
2	PE-V0-491-571-A934	Overall space and headroom requirement with details of handling during Erection, operation & maintenance of the equipments of GDE	Information to BHEL
3	PE-V0-491-571-A935	Monthly Progress Report for GDE	Information to BHEL
4	PE-V0-491-571-A936	Packing & Forwarding Details	Information to BHEL
5	PE-V0-491-571-A937	Packing List of complete GDE	Information to BHEL

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.
2. Drawings shall be prepared in Auto-Cad / 3D Modelling software latest edition, as applicable. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
3. Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
4. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:

   a) All drawings and documents shall indicate the list of all reference drawings including General Arrangement.

   b) All drawings shall include / show plan, elevation, side view, cross-section, skin section, blow-up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.

   c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names and equivalent.

d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.

e) Drawings/ documents to be submitted for purchaser's review/ approval shall be under Revision A, B, C… etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 …. etc.

f) Drawings and documents not covered above but required to check safety of machines/ equipment/ system, shall be submitted during detailed engineering stage without any commercial implication.

g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.

h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No. Documents marked for submission to BHEL's Customer shall also bear BHEL's Customer's drawing No.

i) 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.

j) Bidder to follow the following the drawing submission schedule:

- 1st submission of drawings from date of PO as per the submission schedule.
- Every revised submission incorporating comments – within 7 days.

k) Supply time period specified in the NIT under the title "Delivery Schedule" shall be reduced by the time period equivalent to the delay attributable in submission/Re-submission of drawing/documents beyond stipulated time frame.

l) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

SECTION-I

SUB-SECTION-D

ANNEXURE-VI

PACKING PROCEDURE

1.0	PACKING AND FORWARDING
1.	Proper packing to be ensured for the Gypsum Dewatering Equipment & its components. Indigenous Supply: Shall be wrapped in polythene bags & packed in a strong rigid wooden crate. Rain water should not enter into the pump internals during storage in the outer yard of power plant. Imported Supply: All imported supply should be packed as per Sea worthy packing standards Annexure-VII of this sub-section. All imported items should have Sea worthy packing. Liberal packing materials and struts shall be provided to arrest rolling and to protect from transit damages.
2.	Equipment and process materials shall be packed and semi-knocked down, to the extent possible, to facilitate handling and storage and to protect bearings and other machine surfaces from oxidation. Each container, box, crate or bundle shall be reinforced with steel strapping in such a manner that breaking of one strap will not cause complete failure of packaging. The packing shall be of best standard to withstand rough handling and to provide suitable protection from tropical weather while in transit and while awaiting erection at the site.
3.	Equipment and materials in wooden cases or crates shall be properly cushioned to withstand the abuse of handling, transportation and storage. Packing shall include preservatives suitable to tropical conditions. All machine surfaces and bearings shall be coated with oxidation preventive compounds. All parts subject to damage when in contact with water shall be coated with suitable grease and wrapped in heavy asphalt or tar impregnated paper.
4.	The entire equipment/ system has to be supplied in containers and it should be suitable for storing in the outer yard of the plant for a minimum period of 12 months. Crates and packing material used for shipping will become the property of owner.
5.	Packaging or shipping units shall be designed within the limitations of the unloading facilities of the receiving ports and the ship will be used. It shall be the bidder's responsibility to investigate these limitations and to provide suitable packaging and shipping to permit transportation to site.
6.	Packing (tare) shall be part of the equipment cost and shall not be subject to return. The packing should ensure integrity and cohesiveness of each delivery batch of equipment during transportation. In case of equipment assemblies and unit's delivery in the packing of glass, plastics or paper the specification of packing with the material and weight characteristics are to be indicated.
7.	Each package should have the following inscriptions and signs stenciled with an indelible ink legibly and clearly: a. Destination b. Package Number c. Gross and Net Weight d. Dimensions e. Lifting places f. Handling marks and the following delivery marking

8.	Each package or shipping units shall be clearly marked or stenciled on at least two sides with the **DETAILED SHIPPING ADDRESS –TO BE PROVIDED LATER.** In addition, each package or shipping unit shall have the symbol painted in red on at least two sides of the package, covering one fourth of the area of the side.
9.	Each part of the equipment which is to be shipped as a separate piece or smaller parts packed within the same case shall be legibly marked to show the unit of which it is part, and match marked to show its relative position in the unit, to facilitate assembly in the field. Unit marks and match marks shall be made with steel stamps and with paint.
10.	Each case shall contain a packing list showing the detailed contents of the package. When any technical documents are supplied together with the shipment of materials no single package shall contain more than one set of such documents. Shipping papers shall clearly indicate in which packages the technical documents are contained.
11.	The case number shall be written in the form of a fraction, the numerator of which is the serial number of the case and the denominator the total number of case in which a complete unit of equipment is packed.
12.	Wherever necessary besides usual inscriptions the cases shall bear special indication such as “Top”, “Do not turn over”, “Care” , “Keep Dry” etc. as well as indication of the center of gravity (with red vertical lines) and places for attaching slings (with chain marks).
13.	Marking for Safe handling: To ensure safe handling, packing case shall be marked to show the following: a. Upright position b. Sling position and center of Gravity position c. Storage category d. Fragile components (to be marked properly with a clear warning for safe handli
14.	Each crate or package is to contain a packing list in a waterproof envelope. All items are to be clearly marked for easy identification against the packing List. All cases, packages etc. are to be clearly marked on the outside to indicate the total weight where the weight is bearing and the correct position of the slings are to bear an identification mark relating them to the appropriate shipping documents. All stencil marks on the outside of cases are either to be made in waterproof material or protected by shellac or varnish to prevent obliteration in transit.
15.	**The packing slip shall contain the following information: -** Customer name, Name of the equipment, Purchase Order number with Date, Address of the delivery site, Name and Address of the Sender, Serial Number of pump & accessories, BHEL item Code, Gross Weight and Net weight of Supplied items.
16.	Prior to transport from manufacturer’s work to destination, components of the unit shall be completely cleaned to remove any foreign particles. Flange faces and other machined surfaces shall be protected by an easily removable rust preventive coating followed by suitable wrapping.
17.	All necessary painting, corrosion protection & preservation measures shall be taken as specified in painting schedule. Supplier shall consider the coastal environment zone which is defined as “very severe” during final finishing/shipping.

18	Successful bidder shall furnish the detail packing /shipment box details with information like packing box size, type of packing, weight of each consignment, sequence no. of dispatch, no. of consignment for each deliverable item against each billing break up units/ billable blocks. Without these details the BBU shall not be approved during detail engineering. Also, complete billing break-up with above mentioned details shall be submitted to Purchaser within 10 days of placement of the LOI.
19	All items/equipment shall be dispatched in properly packed condition (i.e. no item shall be dispatched in loose condition such that it becomes difficult to store/identify its location at site at a later stage).
20	Cases which cannot be marked as above shall have metal tags with the necessary markings on them. The metal tags shall be securely attached to the packages with strong steel binding wire. Each piece, Skid, Case or package shipped separately shall be labelled or tagged properly.

BIDDER TO REFER SUB-SECTION C2-A FOR CUSTOMER SPECIFICATION IN THIS REGARD.

SPECIFICATION No: PE-TS-491-571-A101 **SECTION : I** **SUB-SECTION : D** **REV 00** **Annexure VII -** SEA-WORTHY PACKING PROCEDURE (53 Pages)

VOLUME IIB

TECHNICAL SPECIFICATION
FOR
SEAWORTHY PACKING FOR EXPORT JOBS

SPECIFICATION NO. PE-TS-888-100-A001

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI, INDIA

1.0 Purpose

The purpose of this specification is to describe minimum packing requirements for the different items/equipment for all export Project and also to define marking and shipping requirements during transportation by ship, road and air for all export jobs.

2.0 **SCOPE**

For export jobs, sea worthy packing capable of performing all necessary functions like prevention of damage to the contents, sufficient to support frequent handling and lengthy period of outdoor storage in adverse weather conditions are required. Workmanship and materials used shall be of high standard meeting the technical requirements and in accordance with best commercial export packing practices. Vendor shall be responsible for sea worthy export packing, however it shall meet the minimum requirements specified herein. Equivalent or better packing methods may be deployed subject to approval of the BHEL/Purchaser. Vendor shall submit the packing procedure for its equivalent for purchaser's approval during detailed engineering.

The scope this specification is to define VENDOR's responsibilities in terms of:

- Preservation of the GOODS/items/equipments before packing.
- Packing of the GOODS for road, rail, sea and/or air transportation to desired destination i.e. project site
- Making cases/crates
- Chemical Treatment/Fumigation before packing to prevent fungus, damage due to termite, borer, rats, etc.
- Marking of cases/crates.
- Other Services required.

3.0 Application

This specification is applicable to all the goods to be transported to project site and requires to be in transit for longer duration. *However, for "Misc cable erection items", "Fire sealing system" & "Exothermic welding material", the packing requirements shall be as per the procurement specification.*

4.0 Definitions

"BHEL" : Main EPC vendor

"OWNER" : Customer for a particular export project.

"VENDOR" : Company(ies)/VENDOR(s) to whom the BHEL has placed Purchase Order for GOODS/ items/system/package.

"GOODS": means all or part of the articles, material, equipment supplies including technical documentation, as described in the Purchase Order, to be supplied by VENDOR.

"PACKER": Packaging Company to whom VENDOR intends to sub-contract the packing in case they do not have own packing capability/facilities .

"FREIGHT FORWARDER" : Means the Company responsible for performing freight forwarding activities.

5. General Information

The following requirements are intended as minimum requirements, and compliance to these requirements in no way absolves or relieves VENDOR of any responsibility or obligation outlined in the Purchase Order. In all circumstances, the packing will be designed and constructed in order to support GOODS during transportation as well as to prevent the Goods from damage due to impact, extreme climatic conditions, sun and rain. It must be ensured that the delivery of the GOODS to the jobsite by sea, road or air, in good condition.

GOODS shall be export packed in compliance with the best-established practices for international projects, in accordance with the following instructions. In the event of any conflict between these specified requirement and the established practices, specification requirement shall govern.

Due to climatic conditions and the complex transport operation(s), it is essential that protection and packing is of the highest standard. Packing means to efficiently protect the GOODS during the total transport operation; from the moment they leave the factory until they are delivered to the jobsite, including handling operations (loading/unloading) and storage.

When VENDOR do not have packing capabilities/facilities of their own and therefore intends to sub-contract, VENDOR have to inform BHEL/Purchaser of the name and address of proposed PACKER(s) for approval.

6.0 Criteria for Selection of Packaging

Packages are to be made according to categories, described in articles 8.1 to 8.5, depending on the type of materials, their fragility and size.

These categories have been established for the protection of equipment and material during multi-mode transports, i.e.: combination of overland and sea transport; containerization, air transportation.

In a general manner, the GOODS have to be packed in such a way that crates, bundles, pallets can be stored into General Purpose containers, wherever possible.

If VENDOR has any doubt about the correct method of protection or packing, he should contact BHEL/Purchaser in order to mutually agree on the adequate type of packing to be used.

Materials can be classified in following categories

- Hazardous Material
- Non-Hazardous Material
-

Further to above categorisation, non-hazardous materials can be sub- categorised for selection of packing.

6.1 Hazardous Materials

Though handling of hazardous material may is not applicable in the scope of this specification. All hazardous material must be packed in adherence to the detailed requirement relating to packing, marking and labelling set out in the most recent report of the Board's Standard Advisory Committee on the Carriage of Dangerous Goods in Ships for sea freight, and the Restricted Articles Regulations, laid down by the International Air Transport Association for airfreight.

6.2 Non-Hazardous GOODS

The scope of this specification is to provide necessary guidelines for packing for power plant equipment, components, Pipings & Valves, Fittings, other structural items, electrical items, spare parts and erection materials. The procedure is defined in subsequent paragraphs in details in clause no. 8.0.

7. 0 Marking Instructions & Despatch details, Storage Code

7.1 Marking Instructions & despatch details

Packages and crates will be marked with indelible black paint, resistant to seawater. Marking must be perfectly legible.

The shipping marks, which will be as per fig-13, shall be stencilled on two sides and one end in clear characters at least 5 centimetres high (where crate size permits, otherwise use optimum size for each package dimension).

When the GOODS are to be shipped in containers then marking may be stencilled on one end only. However, packages must be stowed in a manner that shows these marks.

Crates containing fragile articles must be packed with special precaution against risk of breakage and must be stencilled on all sides "FRAGILE - HANDLE WITH CARE". Where crates are not to be overturned, VENDOR must show on the crates, clear and readily visible identification as per fig-12, to ensure they are kept in the correct position.

Packages/equipment of 2,000 kg or more must be marked with slinging points on all sides, in addition to the centre of gravity marks.

Number packages consecutively i.e. 1 of 10, 2 of 10, etc. Do not duplicate package numbers. VENDOR is responsible for any loss or damage caused by incorrect marking.

All cases/crates shall also be marked with the appropriate international standard graphic symbols for handling as shown in Fig 12.

As a minimum, all cases/crates are to be marked clearly on all four sides with:

- "HANDLE WITH CARE"
- "RIGHT SIDE UP"
- **"KEEP DRY"**

In the case of packages with a single gross weight totalling 2,000 kg and/or a height of more than 1m, the centre of gravity shall be clearly marked with the symbol on two adjoining sides. For all items of equipment with an eccentric centre of gravity this symbol shall be marked at the bottom, side and top of the package.

The slinging and lashing points shall be marked with a chain symbol.

When packing in cases/crates, these packages shall also have metal corners at the slinging points. (Fig-11)

External front and rear sides of the boxes to be planed for writing instructions.

Dispatch details such as consigner/consignee address, contract and case details, country of origin, port of delivery, stacking instructions shall be written on one side of the boxes. An anodized aluminum plate as per details and specifications given in fig-13 shall be provided on one side of the boxes.

One copy of packing slip wrapped in polyethylene bag covered with aluminum packing slip holder to be nailed on the external surface of the box. One more copy of the packing slip wrapped in polyethylene bag is to be kept inside the box at the pertinent place.

7.2 Storage Code

The type of storage required is required to be specified, it will be shown on each packaging in **RED colour.**

X Crates or packages to be stored outdoor without covers
XX Crates or packages to be stored under tarpaulin
XXX Crates or packages to be stored in covered or enclosed premises
XXXX Crates or packages which must be stored in air-conditioned premises

8.0 GUIDELINES FOR PACKING GOODS

8.1 In the subsequent paragraphs details of different types of packings for different types of GOODS are defined. Vendor shall make packing details/procedure based on the guidelines and submit for approval.

8.1.1 Packing for Pipe, Fittings, Flanges and Valves, Structural Steel

Particular attention should be brought to pipe, fittings, flanges, valves and structural steel. Packing categories for piping and fittings will differ according to the diameter and wall thickness of these products. VENDOR shall comply with the following established practice.

IMPORTANT NOTE:
Depending on the project schedule and availability of ocean vessels, the piping and structural steel may be shipped in containers. In this event, VENDOR has to arrange the packages in such a way it allows the stuffing into Open Top in gauge containers.

8.1.2 Pipe

Where practicable, pipe lengths shall be limited to 11.8 meters.
All pipes **2"** included and below shall be packed in crates. All pipes to be capped and ends sealed with waterproof tape.

Pipes over 2" up to 6", shall be bundled and banded in bundles of uniform length. Bundling is carried out with U-IRON or traversal planks, joined with threaded connecting rods with locknuts. Quantities and strapping positions depend on the lengths, with a 120 cm spacing to prevent distortion. Bundle weight shall not exceed 2,000 kg. All pipes are to be capped and ends sealed with waterproof tape (tape is not necessary if end caps are of the pre-shrunk or self-sealing type).

Pipes larger than 6" shall be shipped as single lengths with the ends capped. End caps are to be of the recessed type to enable the use of soft faced hooks, but still completely sealing the end and also protecting the weld.
All stainless steel piping must be packed separately in wooden crates. Any banding of bundles is to be with the same material.

8.1.3 Pipe Fittings, Flanges and Valves

All pipe fittings, flanges and valves up to 6", are to be packed in cases/crates. For items over 6", these may be fixed securely to a pallet base and enclosed in a crate, for protection. Where valves have actuators attached, rigidity must be ensured for the valve and actuator. The vulnerable parts of the actuator are to be completely protected within a wooden crate.

All stainless steel fittings, flanges and valves of all sizes, must be packed separately in wooden crates. Any strapping is to be with the same material.

8.1.4 Structural Steel

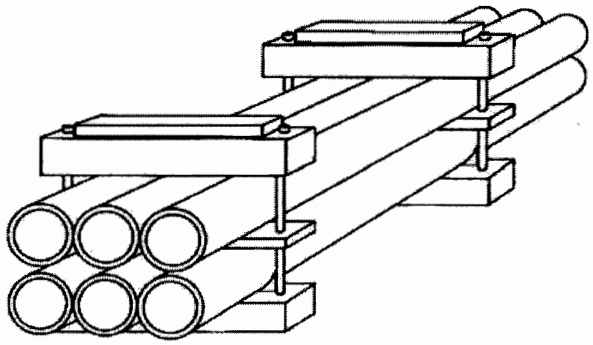
Structural Steel, reinforcing rods, bars, etc., should be packed in bundles of uniform length. Refer to articles 8.1.2, for strapping requirements. Bundle weight not normally to exceed 2,000 kg. Fabricated structures and structural steelwork, etc, should be bundled and packed using wooden beams and long bolting to secure the load.

8.2 Bundling – Packing Category I

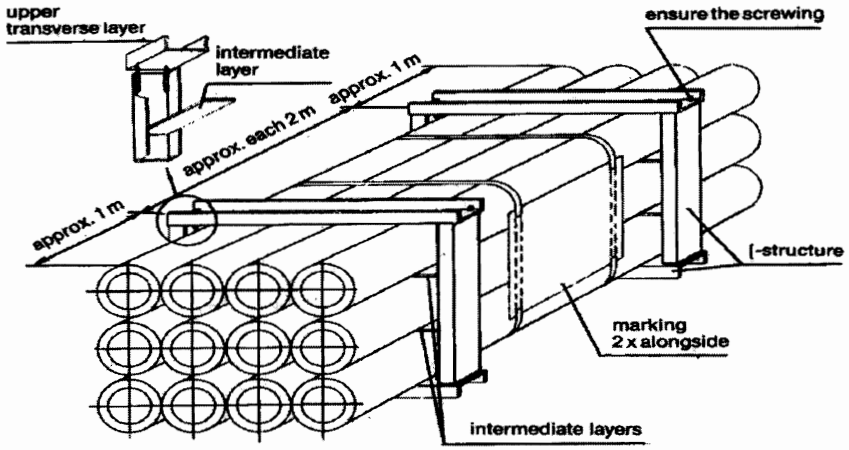
8.2.1 Type of Equipment

Equipment which is not subject to damage by corrosion or mechanical effect, i.e. pipes, piping, structural steel.

Packing category I



Bundling by U-shaped iron – packing category I A



8.2.2 Type of Construction

Bundling has to be effected

- By squared timber and threaded rods.
- With an intermediate layer (threaded on tightening bolts) according to the weight of the package.
- Wedge-shaped timbers must be added at the outer points of lower layer.
- Between the bolts a spacer must be nailed.
- The bolts must be secured (e.g. by locking nut).
- If single parts could protrude, an appropriate protection must be installed (flat iron or plates).
- Bundling with steel straps or PVC straps is not accepted.

8.3 Skids, Square Timber Constructions, Casings – Packing (Category II)

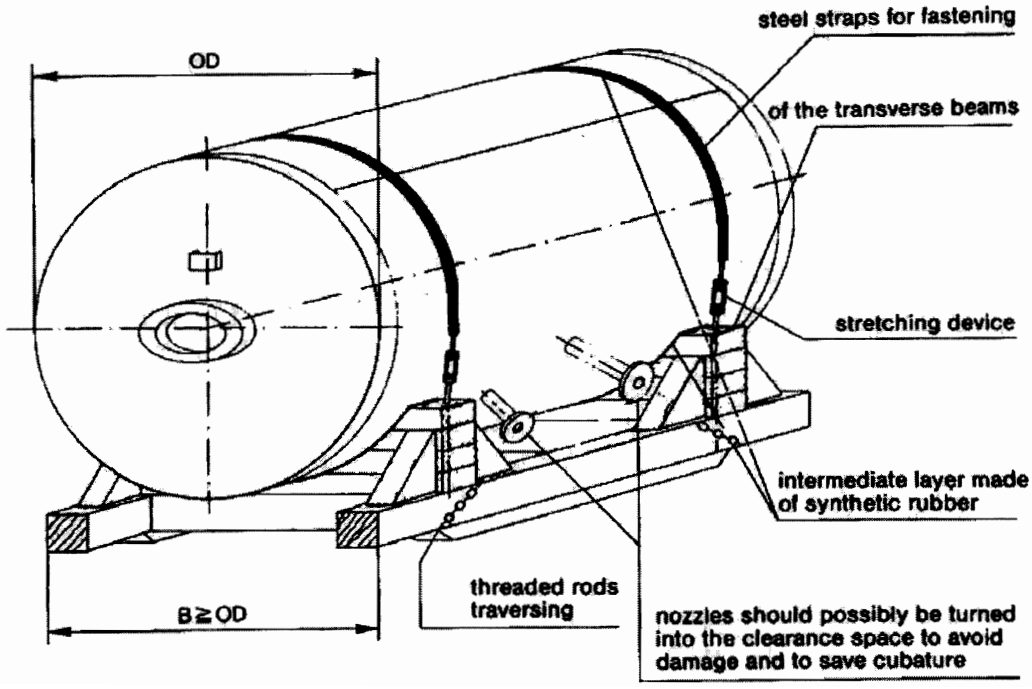
8.3.1 Type of Equipment

Voluminous apparatus, tanks and/or heavy pieces those are not vulnerable to mechanical or corrosive effects.

8.3.2 Type of Construction

- The construction skid can be made of wood or of metal.
- The fastening of the packages on the skid will be made by steel straps (flat iron) which have to be elastically lined, non-slip and securely bolted onto the skids.
- Flange openings have to be closed with gaskets and blind flanges or, if necessary, provided with cover.
- Skid constructions may not be less than the dimensions of the package in length or in width.
- Tanks and apparatus with their own support cradles must be supplied with an anti-slip lining.

PACKING CATEGORY-II



Bundling has to be effected

- By squared timber and threaded rods.
- With an intermediate layer (threaded on tightening bolts) according to the weight of the package.
- Wedge-shaped timbers must be added at the outer points of lower layer.
- Between the bolts a spacer must be nailed.
- The bolts must be secured (e.g. by locking nut).
- If single parts could protrude, an appropriate protection must be installed (flat iron or plates).
- Bundling with steel straps or PVC straps is not accepted.

8.3 Skids, Square Timber Constructions, Casings – Packing (Category II)

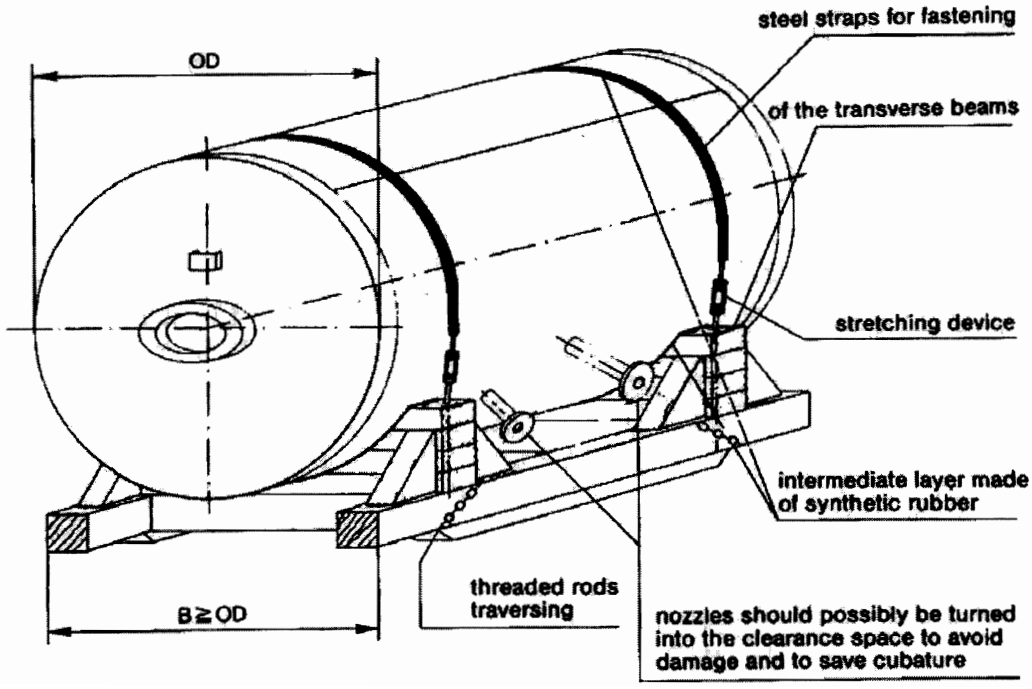
8.3.1 Type of Equipment

Voluminous apparatus, tanks and/or heavy pieces those are not vulnerable to mechanical or corrosive effects.

8.3.2 Type of Construction

- The construction skid can be made of wood or of metal.
- The fastening of the packages on the skid will be made by steel straps (flat iron) which have to be elastically lined, non-slip and securely bolted onto the skids.
- Flange openings have to be closed with gaskets and blind flanges or, if necessary, provided with cover.
- Skid constructions may not be less than the dimensions of the package in length or in width.
- Tanks and apparatus with their own support cradles must be supplied with an anti-slip lining.

PACKING CATEGORY-II



8.4 Packing of GOODS in Wooden Crates/Cases/Boxes

The construction of wooden crate/cases/boxes shall be as per the details indicated in clause 9.0 & Fig 1 to 11. Details indicated in the sketches for different categories Packing crates/boxes are only for a typical equipment considered for illustration.

8.4.1 Packing Category III

8.4.1.1 Type of Equipment

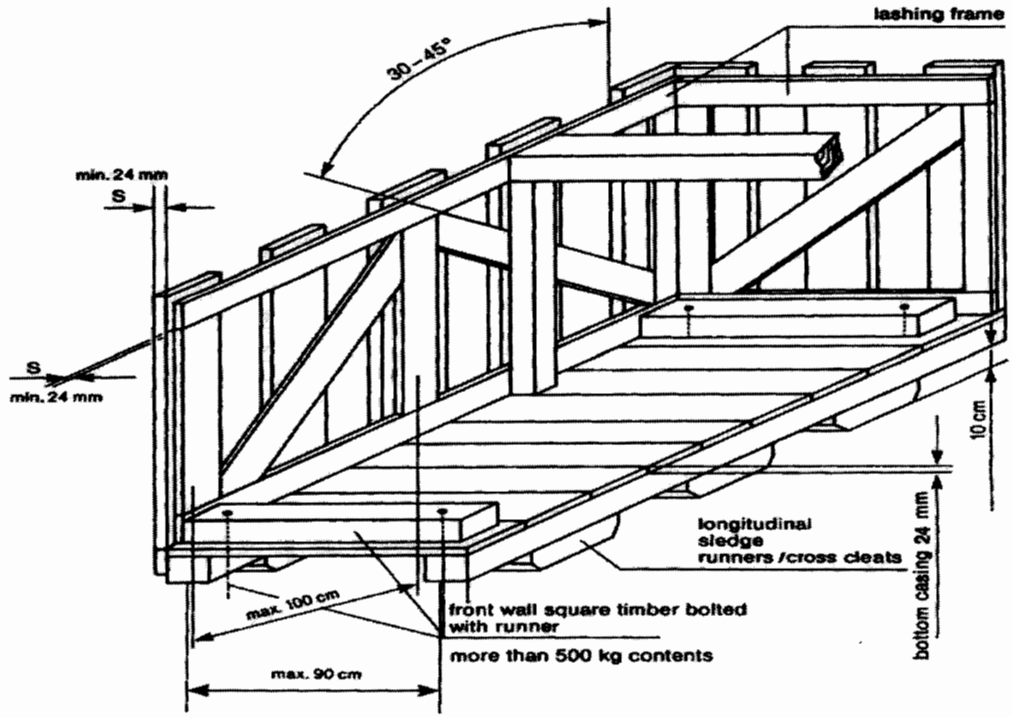
Fabricated equipment, which cannot be transported on cradles; frame-works, prefabricated piping and fittings, mechanical and electrical assemblies. *This type of packing is recommended where many parts of the equipment/component/assembly are not protruding out.*

8.4.1.2 Type of Construction

The equipment must be safely fastened to the bottom with bolts, possibly by the runners or to be spread in such a manner that no protruding parts are possible. For parts, sensitive to rainwater and/or debris, a protection has to be made by a foil cap.

If it is possible that single part could protrude through the front/back side wall, they shall be closed completely. The marking of the package shall be done on plywood plates at the prescribed sides.

Packing Category III



8.4.2 Cases with Lining – Packing Category IV

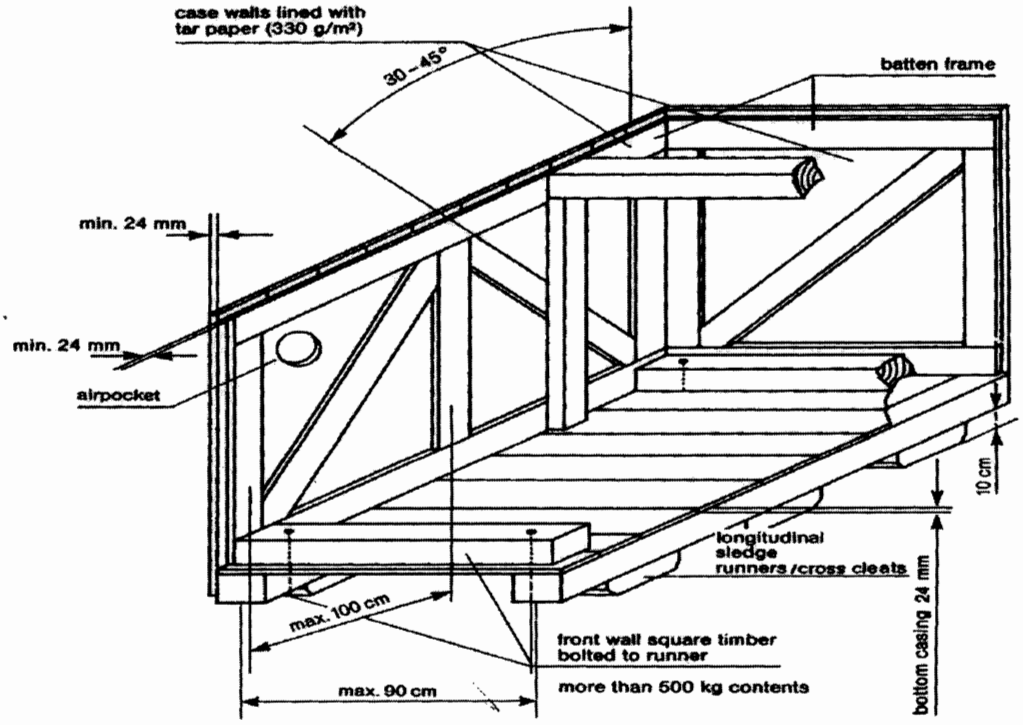
8.4.2.1 Type of Equipment

Recommended for equipment and mechanical parts Equipment sensitive to mechanical damage or parts and components that are particularly at risk of theft or loss; pumps, elbows, flanges, fittings, tools, erection materials, etc.

8.4.2.2 Type of Construction

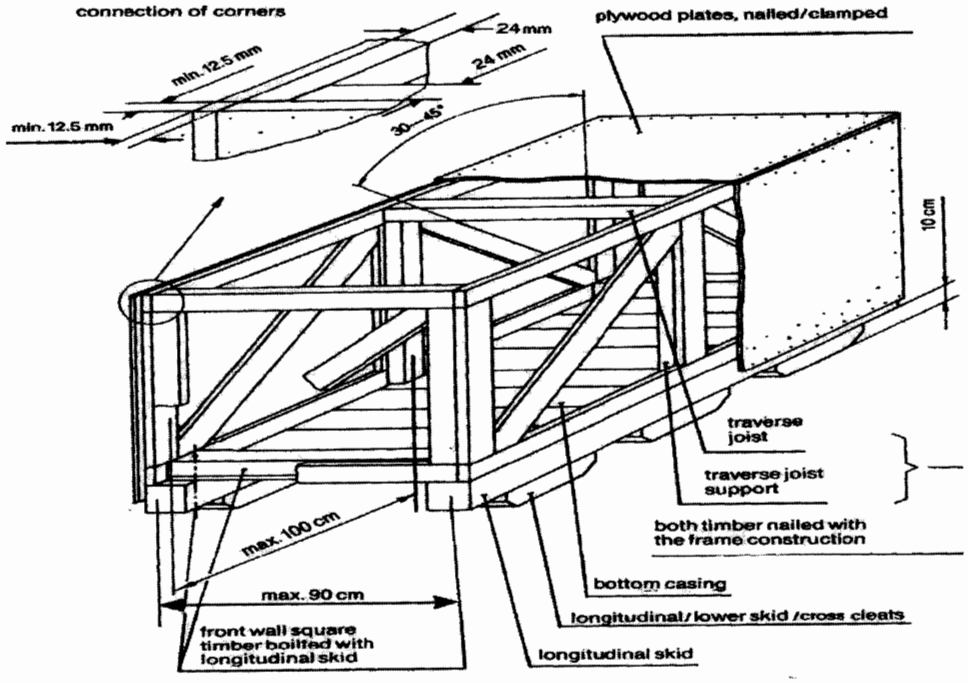
The same type of construction as article 8.4.1.2, but with all sides completely boarded without space between the boards. Sides to be provided with waterproof lining; fabric-reinforced waterproof tar paper or polyethylene-foils resistant to ultraviolet rays can be used. Polyethylene-foil shall be fixed under the lid cover to avoid penetration of water. At weights of more than 500 kg the longitudinal runner must be bolted to the front all square timber. For ventilation inside the case, an opening in the waterproof lining must be placed between the diagonal battens and diagonal joists.

Packing Category IV



8.4.3 Cases with Alternative Surface Materials

8.4.3.1 Plywood Box – Packing Category IV A



Case constructed of 5 layers of watertight, glued plywood with a total thickness of 12.5 mm. The frame must be constructed from minimum 24 mm timber or as per guide lines given above against clause 8.0, Fig 1 to 11 and must be suitable for the weight and nature of the parts to be packed. Planed square timber must be bolted with longitudinal skid and covered with diagonal joists. If applicable, construction of the cover and sides is to include diagonal bracing. Covers consisting of several layers of plywood are to be sealed with durable elastic putty or additional water-resistant sheets to be fixed.

8.4.4 Case with Barrier Material – Polyethylene Foil – Packing Category V

8.4.4.1 Type of Equipment

Sensitive equipment, simple electrical equipment, insulation materials, fire-resistant materials, with non-corrosion- guarantee for a period up to twelve (12) months.

8.4.4.2 Type of Construction

Preservation by welding in polyethylene-foil with addition of desiccants and if necessary, application of non-corrosive contact agents, otherwise, type of construction as indicated in article 8.4.2.2.
Additional marking:

- Case with desiccants.

8.4.5 Case with Barrier Material – Aluminium Compound Foil – Packing Category VI

8.4.5.1 Type of Equipment

Electrical equipment such as, switchboards, electric motors, sensitive equipment, with non-corrosion guarantee, for a period up to twelve (12) months.

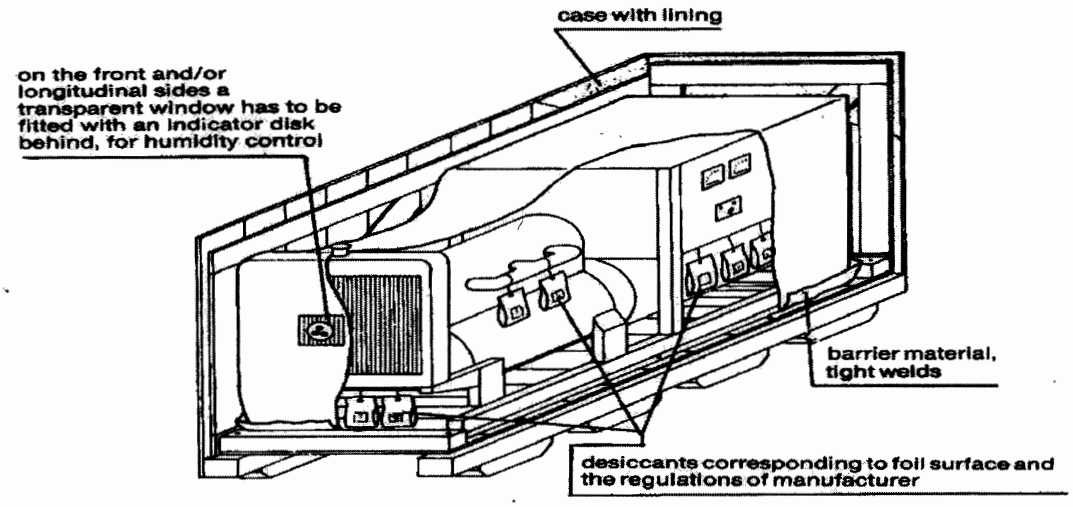
8.4.5.2 Type of Construction

Type of construction as indicated in article 8.4.2.2. Preservation by sealing an aluminium compound foil, with the addition of desiccants. Humidity indicators, if required and installed in the barrier wrapping, shall allow easy control from the outside.

Additional marking:

- Case with desiccants.

Packing Category V/VI



8.4.6 Double Case – Packing Category VII

8.4.6.1 Type of Equipment

GOODS which are of high sensitivity to shock, impact and vibration, for instance, special electrical equipment like computers, switchboards, laboratory instruments

8.4.6.2 Type of Construction

Case construction as indicated in article 8.4.2.2, with additional floating inner packing (case-in-case principle), padding corresponding to weight and sensitiveness. Preservation by sealing in aluminium compound foil with the addition of desiccants. The inner case has to be made of plywood or equivalent material with a thickness of 8-12 mm, depending on the weight of the GOODS to be packed. The inner buckles and/or frame borders have to be dimensioned so that the full stability of the inside case will be reached and no twisting is possible. The inner sides of the inside case will be lined with bituminous kraft paper on all sides (except bottom).

8.4.7 Cable Drum – Packing Category VIII

8.4.7.1 Type of Equipment

All type of cables, wires, ropes, hoses.

8.4.7.2 Type of Construction

For all type of cables refer clause no. 11.1. For other items (wires, ropes, hoses) new or practically new drums are to be used. Planking of the e drums by use of boards, thickness minimum 20 mm, with additional double steel strapping, nailed, and carefully preserved/ protected cable ends prior to packing.

8.4.8 Hazardous Materials – Packing Category IX

8.4.8.1 Type of Equipment

Hazardous materials according to the law are explosives, compressed gases, liquefied gases dissolved under pressure or deeply refrigerated, flammable liquids, flammable solids: substances liable to spontaneous combustion; substances which, on contact with water, emit flammable gases, oxidizing substances, organic peroxides, poisonous (toxic) and infectious substances; radioactive materials, corrosives, miscellaneous dangerous goods.

8.4.8.2 Type of Construction

Hazardous materials shall always be packed and documented separately from any other material. Selection of packaging materials, execution of packing and marking as well as documentation shall always be in compliance with the applicable laws and regulations. Any certificates required for transportation or for authorities to be supplied before shipment of the GOODS.

8.4.9 Wooden Floor as a Transport Support – Packing Category X

8.4.9.1 Type of Equipment

Any materials to be stuffed in containers or on flat racks and that are not stowed on standard pallets or otherwise suitably packed

8.4.9.2 Type of Construction

- Longitudinal internal square timbers bolted to the front wall runners, longitudinal skid.
- Maximum distance between longitudinal runners 90 cm (middle to middle of the runner).
- Full boarding of the floor.
- Attaching of lifting lugs and/or iron ropes for lifting/pulling the units off the transport equipment.
- If applicable, preservation of the equipment by sealing in polyethylene-foil or aluminium compound foil and the addition of desiccants.

8.5 Air Transport Packing

8.5.1 General

Certain types of material may have to be shipped by air from their country of origin. This means of transport will be exceptional, and will be used only:

- For GOODS, which are highly sensitive to shock or vibrations, such as computers, electronic instruments, or those of small dimensions and weight.
- For GOODS urgently required at the module yard(s) and/or jobsite.

8.5.2 Type of Packing

Depending on the goods to be packed, VENDOR may use one of the following types:

- A triple-corrugated cardboard container made with waterproofed glue and a barrier layer of polyethylene on the outsides to keep out humidity.
- Wooden/cardboard packing cases: the wood being used for the framework and base of the cases, waterproofed triple-corrugated cardboard being used for the sides and top. These cases are of the "Bell" type, and used for material of small or medium dimensions.
- For larger dimensions, plywood cases are acceptable. The timber characteristics, cross-sections and thickness will be systematically determined by the nature of the loads to be packed.

8.5.3 Dimensions

In order to optimize the existing transport facilities (passenger or cargo aircraft), the dimensions of:

- Triple-corrugated containers.
- Wooden/cardboard packing cases.
- Plywood cases.

Are to be adapted to pallets used for air transportation.

9.0 <u>Detailed specification for Wooden Crates/Boxes/Cases and other packing materials</u>

9.1 **Technical specification for wood**

The wood shall be Fir, Chir, Silver Oak (Gravillea Robusta), chemically treated mango and Pinewood with moisture content not exceeding 50%. The wood shall have flexural and compressive strength, stiffness, shock absorption and nail retention properties. The wood shall be free from common defects such as warp, bone, twist, knot, crakes, splits, end splits, bend, visible sign of infection and any kind of decay caused by insects or fungus, etc. Surface cracks with maximum depth of 3mm are permissible. A continuous crack of any depth all along the length is not allowed.

9.2 **Chemical Treatment of Wood**:

The wood shall be chemically treated to provide protection against deterioration due to fungi and attack by termites, borers, marine organism and any other kind of infection. It shall be treated only after final processing like cutting, planning, joint grooving, etc.

9.3 **TYPE, DESIGN & DIMENSION OF WOODEN PACKING CASES**:

9.3.1 **PACKING OF EQUIPMENTS**

Various mechanical, electrical and C&I equipment e.g. Pumps, motors, equipment skids, heat exchangers, control panels, switch gears, transformers, etc. shall be wrapped in weather proof packing and then secured in wooden packing cases. The construction of wooden packing cases/crates shall be as per details given below and also given in figure 1 to 11.

9.3.1.1 **Bottom Frame**

The construction of bottom frame shall be as per Fig-2. The No. of slides/runners for bottom frames shall be selected depending upon the weight and overall dimensions of the load to be carried. The equipment shall be secured by fixing their base frame/plate with the help of bolt and nuts etc. to bottom frame of the wooden packing cases/crates. The equipment not provided with base frame/plate like cylindrical vessels, etc to be secured to the bottom frame of the wooden cases with "C" clamps fabricated from steel channels/ angle iron.

9.3.1.2 **TOP FRAME**

The construction of top frame shall be as per fig-3.

9.3.1.3 **END PANELS**

The dimension of the end and lateral panels shall be calculated according to overall dimensions of the items to be packed. Diagonal braces shall be used for packing cases having height exceeding 500mm. Details of bracings shall be as per fig 5 to 9.

9.3.1.4 **Sling Plate**

To facilitate lifting of cases, longitudinal under slide boards shall be fixed. To avoid damage to the box while lifting sling plates shall be provided. Refer fig-11.

9.3.1.5 **Angle Iron Cleats**

Angle iron cleats shall be used for strengthening the joints as indicated in fig-10

9.3.1.6 **Other Requirements**

- The thickness of planks for top, bottom, side and end panels shall be at least 25mm. Planks used for this purpose shall be joined with each other by tongue and groove joint. The groove dimension shall be such that tongue fits tightly into groove to make the joint.
- Runners/slides, traverse bars, etc shall be of single length I.e. without any joint. Planks for sheathing, diagonal bracing etc shall also be of single length up to 2400mm, proper jointing is permitted for planks for sheathing and diagonal bracings.
- Each equipment to be individually covered with double polyethylene petticoat. Sheet thickness of polythene sheet shall not be less than 0.175 mm (175 microns). The sealing shall be such so as not to allow moisture inside.
- The inner surface of 4 sides of shooks shall be nailed with bituminized water proof craft paper. Wherever 2 pieces of kraft paper are used, joint shall have an overlap of minimum 20 mm.
- All the inner sides of the box shall be nailed with bitumen coated HESSIAN POLYTHYLENE KRAFT PAPER. For top frame it shall project on all sides by 100mm and shall be nailed on sides. Wherever 2 pieces of kraft paper are used, joint shall have an overlap of minimum 20 mm.
- For delicate equipment like control panels and switchgears, lighting panels and lighting transformers, suitable cushioning material like rubberised coir (min. 50 mm thick and 100 mm wide) shall be provided on their bottom support and the gap between the panel and casing

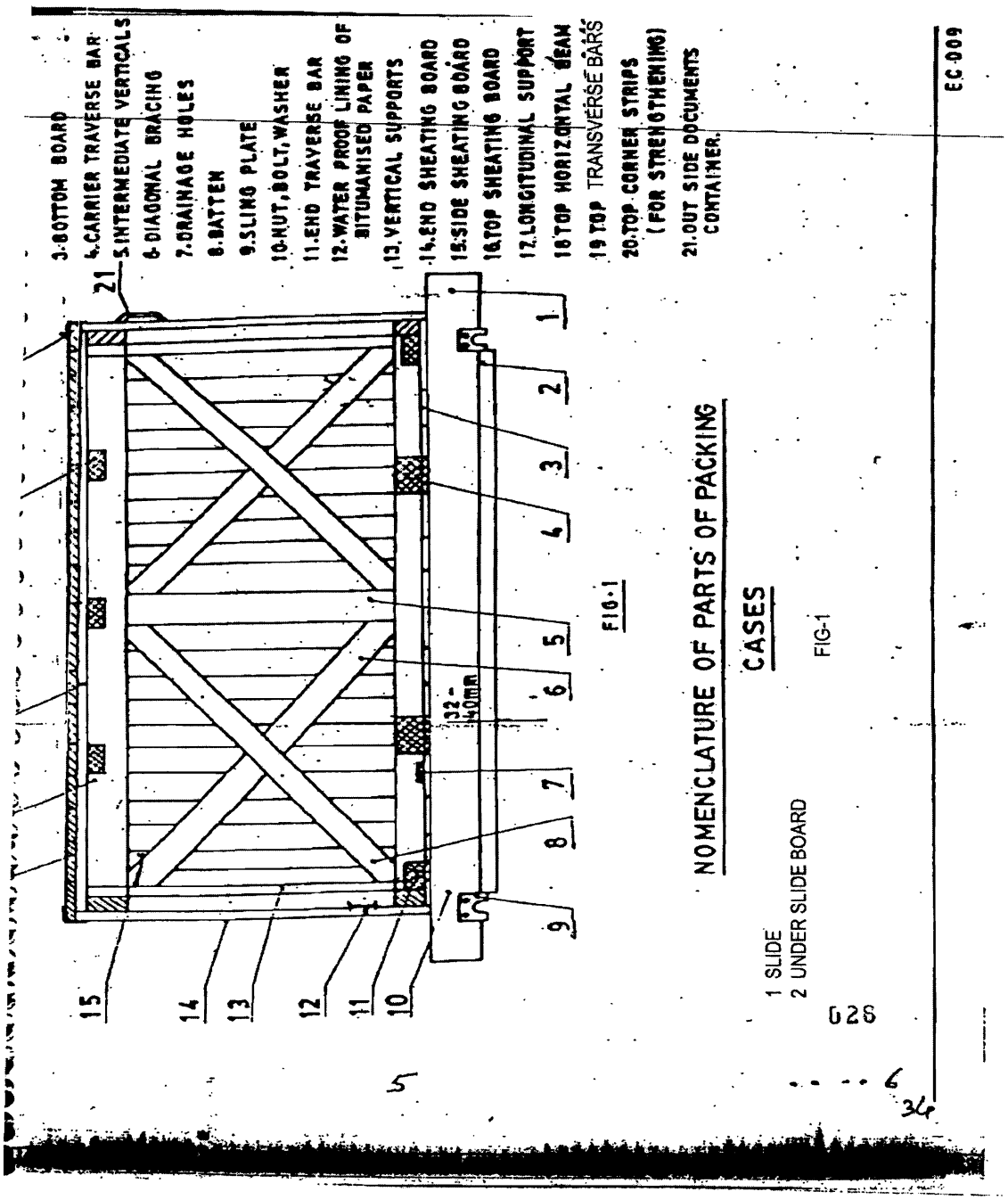
shall be filled with rubberized coir with distance between consecutive supports less than 500 mm (ref fig15). For other equipment suitable support from sides of the casing shall be provided.

- Switchgear cubicles, control panels and control desks shall be packed and shipped in separate convenient sections. The components e.g. circuit breakers relays and instruments etc. which are removed from panels for shipping purpose and shall be separately packed and shipped as per packing instructions in clause 10.4.

- Packing case for control panels and switchgear panels shall be finally covered with GI sheet of minimum thickness of 0.4mm.

- Packing cases shall be bound at edges by nailing MS clamps/brackets at sufficient intervals. Further heavier boxes shall be strapped with C clamps (ref fig-4) fabricated from steel channels/angles and lighter boxes shall be strapped with hoop iron strips.

- Silica gel is used for this purpose to protect contents over sufficiently long time from corrosion. Silica gel shall be indicating type confirming to IS-304 (1979) packed in cotton bags placed at different positions inside the packing for absorbing moisture and shall not come into directly contact with equipment/material inside the package. The quantity of silica gel shall be adequate for storage period of one year, however it shall not be less than 4 gm. per ltr. Volume of case subject to minimum 400 gm. Per case.


3.BOTTOM BOARD
4.CARRIER TRAVERSE BAR
5.INTERMEDIATE VERTICALS
6.DIAGONAL BRACING
7.DRAINAGE HOLES
8.BATTEN
9.SLING PLATE
10.NUT,BOLT,WASHER
11.END TRAVERSE BAR
12.WATER PROOF LINING OF BITUMANISED PAPER
13.VERTICAL SUPPORTS
14.END SHEATING BOARD
15.SIDE SHEATING BOARD
16.TOP SHEATING BOARD
17.LONGITUDINAL SUPPORT
18 TOP HORIZONTAL BEAM
19 TOP TRANSVERSE BARS
20.TOP CORNER STRIPS (FOR STRENGTHENING)
21.OUT SIDE DOCUMENTS CONTAINER.
EC-009
32-40mm
F10-1
NOMENCLATURE OF PARTS OF PACKING
CASES
FIG-1
1 SLIDE
2 UNDER SLIDE BOARD
026

BOTTOM FRAME ARRANGEMENTS

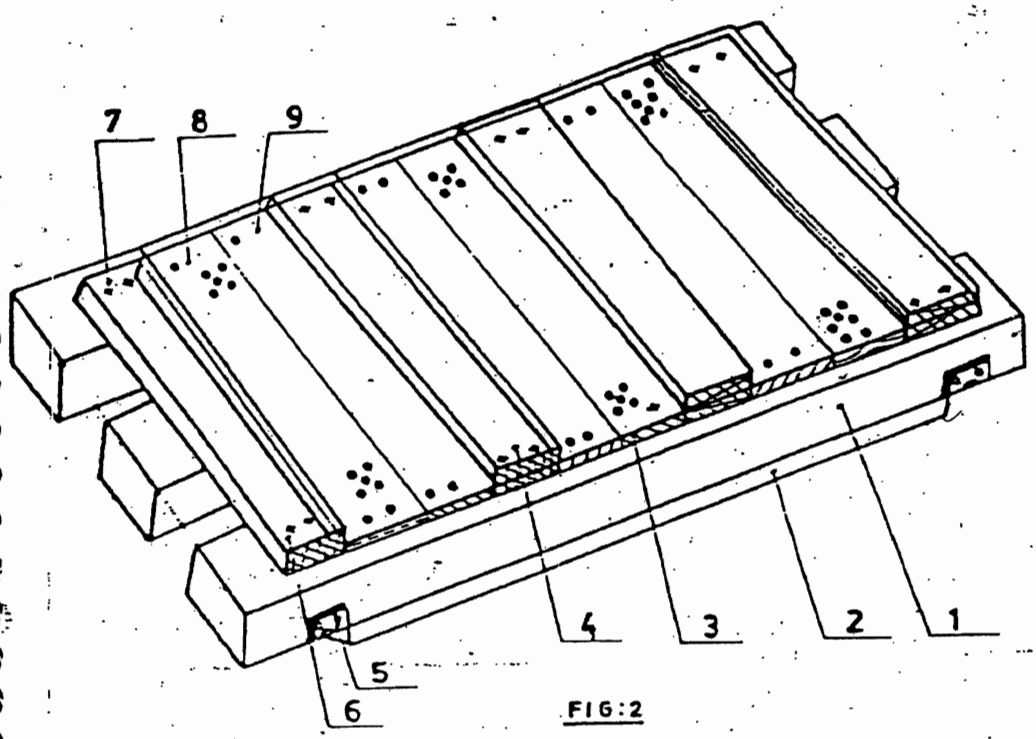


FIG:2

Nos. of slides : Minimum 2 Nos.
For length more than 1800 mm or load more than 1000kg, Nos. of slides shall be minimum 3 Nos.
For dimensions of slides, refer Table 1
Cross section of end traverse bar; 100 X 100 mm (minimum)

1. SLIDE
2. UNDER SLIDE BOARD
3. BOTTOM BOARD
4. CARRIER TAVERSE BAR
5. SLING PLATE
6. END TRAVERSE BAR
7. BOLT, NUT & WASHER
8. DRAINAGE HOLES
9. NAILS

027

6

TOP FRAME ARRANGEMENT

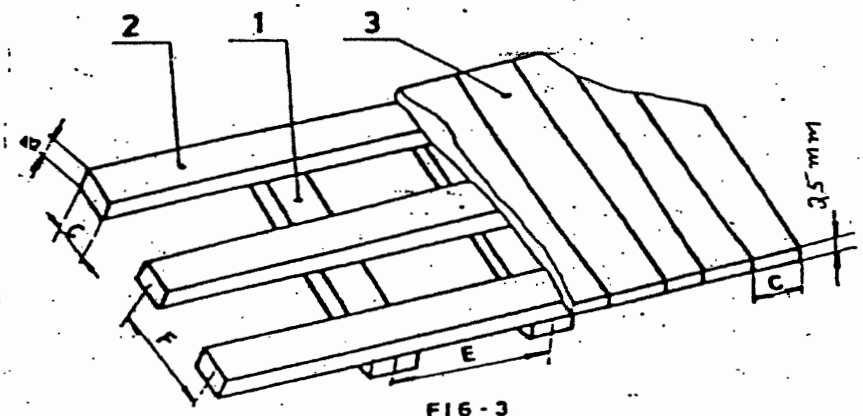
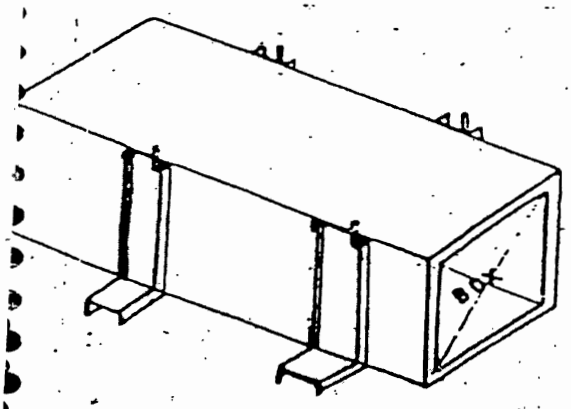


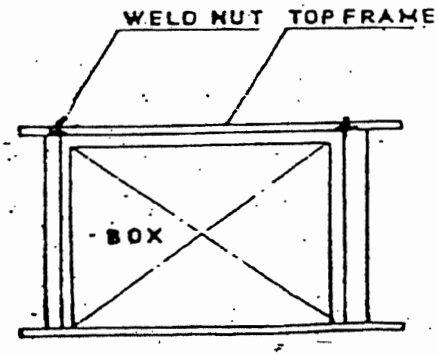
FIG-3

F : 700 t 1000 mm
E : 500 t 900 mm
: 30×100 mm.

1 - Treverse Bers
2 - Horizontal Beans
3 - Top Board

ARRANGEMENT OF C-CLAMPS AROUND CASES





028

ARRANGEMENT OF DIAGONAL BRACING AND HORIZONTAL SUPPORT

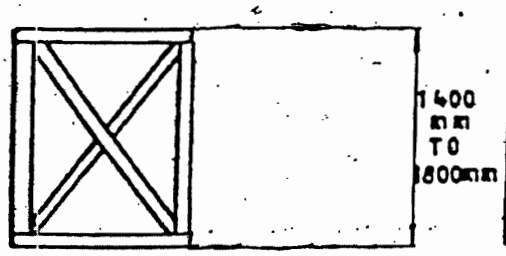


FIG:6

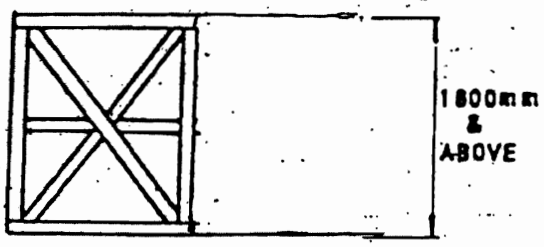


FIG:8

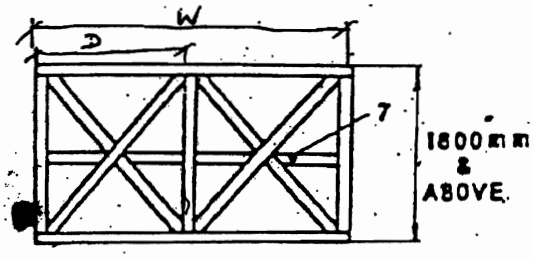


FIG:9

7- Middle Horizontal Support

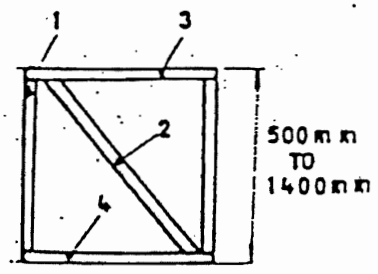


FIG:5.

1- Vertical Support

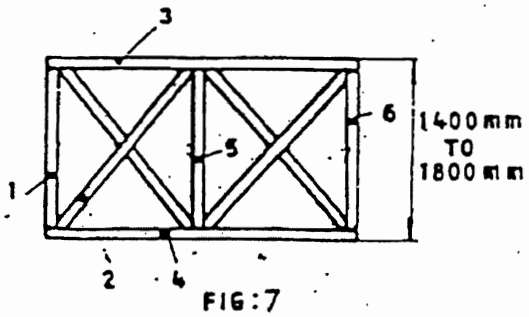
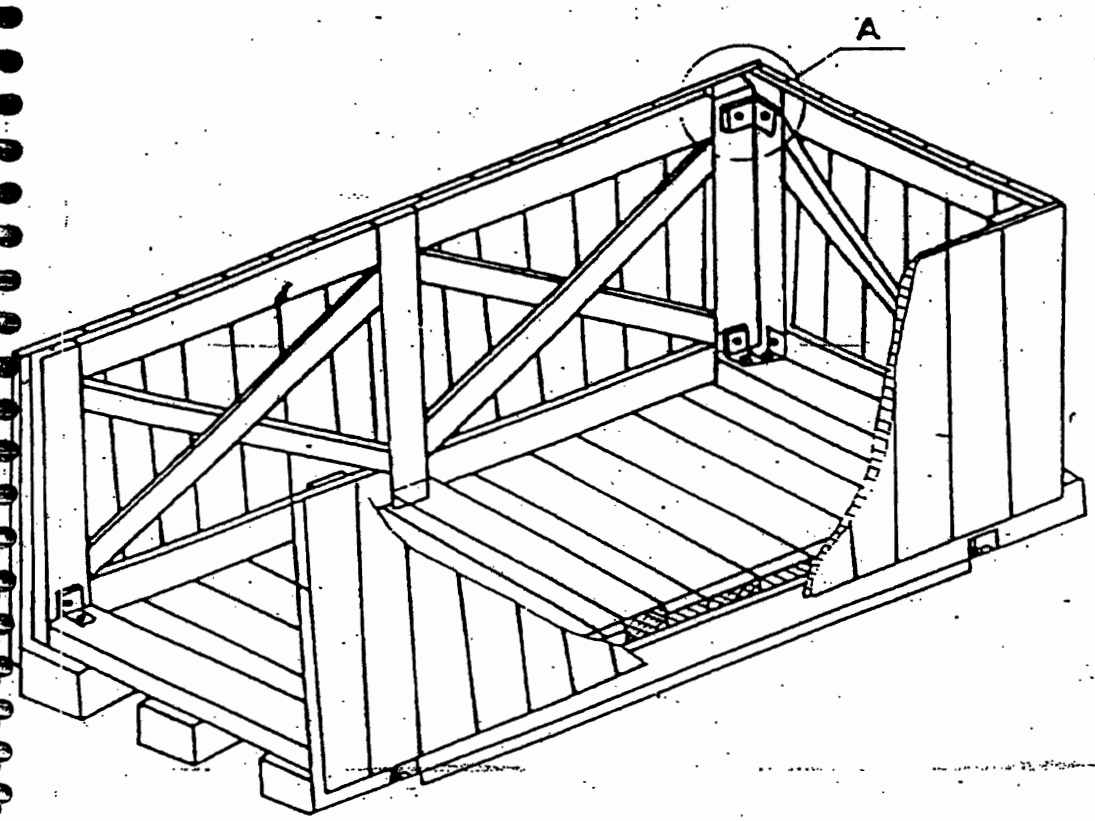


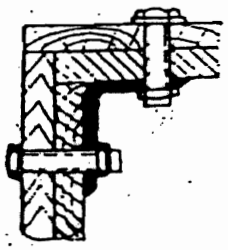
FIG:7

1, 5, 6 - Vertical Support

029

ARRANGEMENT OF PACKING CASE





DETAIL-A

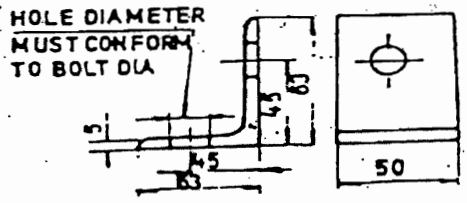


FIG:10

030

ARRANGEMENT OF SLING PLATE ON CASES

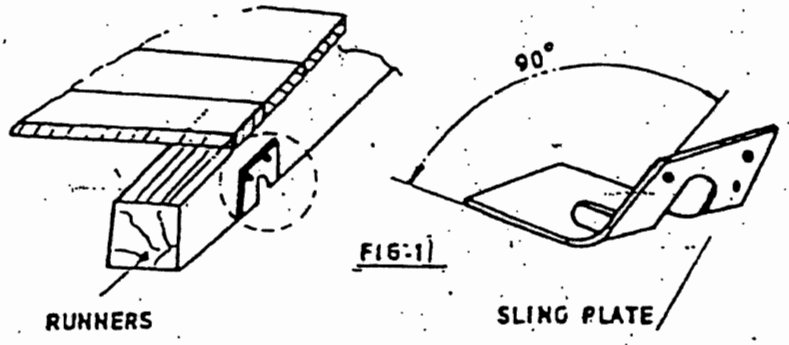


FIG:1

031

TABLE-1

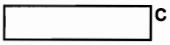
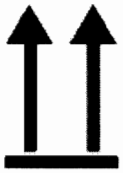
LOADS	LENGTHS OF SLIDES						
	600	800	1000	1200	1300	1500	2000
	Cross section b x c						
500	50 X 100	50 X 100	50 X 100	50 X 100	75 X 100	75 X 100	100 X 100
800	50 X 100	50 X 100	75 X 100	75 X 100	75 X 100	75 X 100	100 X 100
1000	75 X 100	75 X 100	75 X 100	100 X 100	100 X 100	100 X 110	100 X 150
1500	75 X 100	75 X 100	100 X 100	100 X 100	100 X 100	100 X 150	100 X 150
2000	75 X 100	100 X 100	100 X 100	100 X 150	100 X 150	100 X 150	150 X 150
2500	75 X 100	100 X 100	100 X 150	100 X 150	100 X 150	150 X 150	150 X 150
3000	100 X 100	100 X 150	150 X 150	150 X 150	150 X 150	150 X 150	150 X 150

Table-2

End and side panels	Width of the panel "W"	Distance between longitudinal support (Dimension "D")						
		600	800	1000	1200	1400	1600	1800
		Cross section b x c				Item 1 to 7		
Fig- 5 to Fig-9	600 to 1200	30 X 100	30 X 100	30 X 100	30 X 130	30 X 130	30 X 130	30 X 130
	1201 to 1600	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130
	1601 to 2000	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130
	2001 to 3000	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130	30 X 130	40 X 150
	3001 to 4000	40 X 150	40 X 150	40 X 150	40 X 150	40 X 150	40 X 150	40 X 150

INDICATION MARKS ON CASES/BOXES/CRATES

Designation	Symbol	Explanation
Fragile, Handle with care		The symbol should be applied to easily broken cargoes. Cargoes marked with this symbol should be handled carefully and should never be tipped over or slung.
Use no hooks		Any other kind of point load should also be avoided with cargoes marked with this symbol. The symbol does not automatically prohibit the use of the plate hooks used for handling bagged cargo.
Top		The package must always be transported, handled and stored in such a way that the arrows always point upwards. Rolling, swinging, severe tipping or tumbling or other such handling must be avoided.
Keep away from heat (solar radiation)		Compliance with the symbol is best achieved if the cargo is kept under the coolest possible conditions. In any event, it must be kept away from additional sources of heat. It may be appropriate to enquire whether prevailing or anticipated temperatures may be harmful.
Protect from heat and radioactive sources		Stowage as for the preceding symbol. The cargo must additionally be protected from radioactivity.
Sling here		The symbol indicates merely where the cargo should be slung, but not the method of lifting. If the symbols are applied equidistant from the middle or center of gravity, the package will hang level if the slings are of identical length. If this is not the case, the slinging equipment must be shortened on one side.
Keep dry		Cargo bearing this symbol must be protected from excessive humidity and must accordingly be stored under cover. If particularly large or bulky packages cannot be stored in warehouses or sheds, they must be carefully covered with tarpaulins.

Center of gravity		This symbol is intended to provide a clear indication of the position of the center of gravity. To be meaningful, this symbol should only be used where the center of gravity is not central. The meaning is unambiguous if the symbol is applied onto two upright surfaces at right angles to each other.
No hand truck here		The absence of this symbol on packages amounts to permission to use a hand truck on them.
Stacking limitation		The maximum stacking load must be stated as "... kg max.". Since such marking is sensible only on packages with little loading capacity, cargo bearing this symbol should be stowed in the uppermost layer.
Clamp here		Stating that the package may be clamped at the indicated point is logically equivalent to a prohibition of clamping anywhere else.
Temperature limitations		According to regulations, the symbol should either be provided with the suffix "...°C" for a specific temperature or, in the case of a temperature range, with an upper ("...°C max.") and lower ("...°C min.") temperature limit. The corresponding temperatures or temperature limits should also be noted on the consignment note.
Do not use forklift truck here		This symbol should only be applied to the sides where the forklift truck cannot be used. Absence of the symbol on other sides of the package amounts to permission to use forklift trucks on these sides.
Electrostatic sensitive device		Contact with packages bearing this symbol should be avoided at low levels of relative humidity, especially if insulating footwear is being worn or the ground/floor is nonconductive. Low levels of relative humidity must in particular be expected on hot, dry summer days and very cold winter days.

Do not destroy barrier		A barrier layer which is (virtually) impermeable to water vapor and contains desiccants for corrosion protection is located beneath the outer packaging. This protection will be ineffective if the barrier layer is damaged. Since the symbol has not yet been approved by the ISO, puncturing of the outer shell must in particular be avoided for any packages bearing the words "Packed with desiccants".
Tear off here		This symbol is intended only for the receiver.

FIG-12

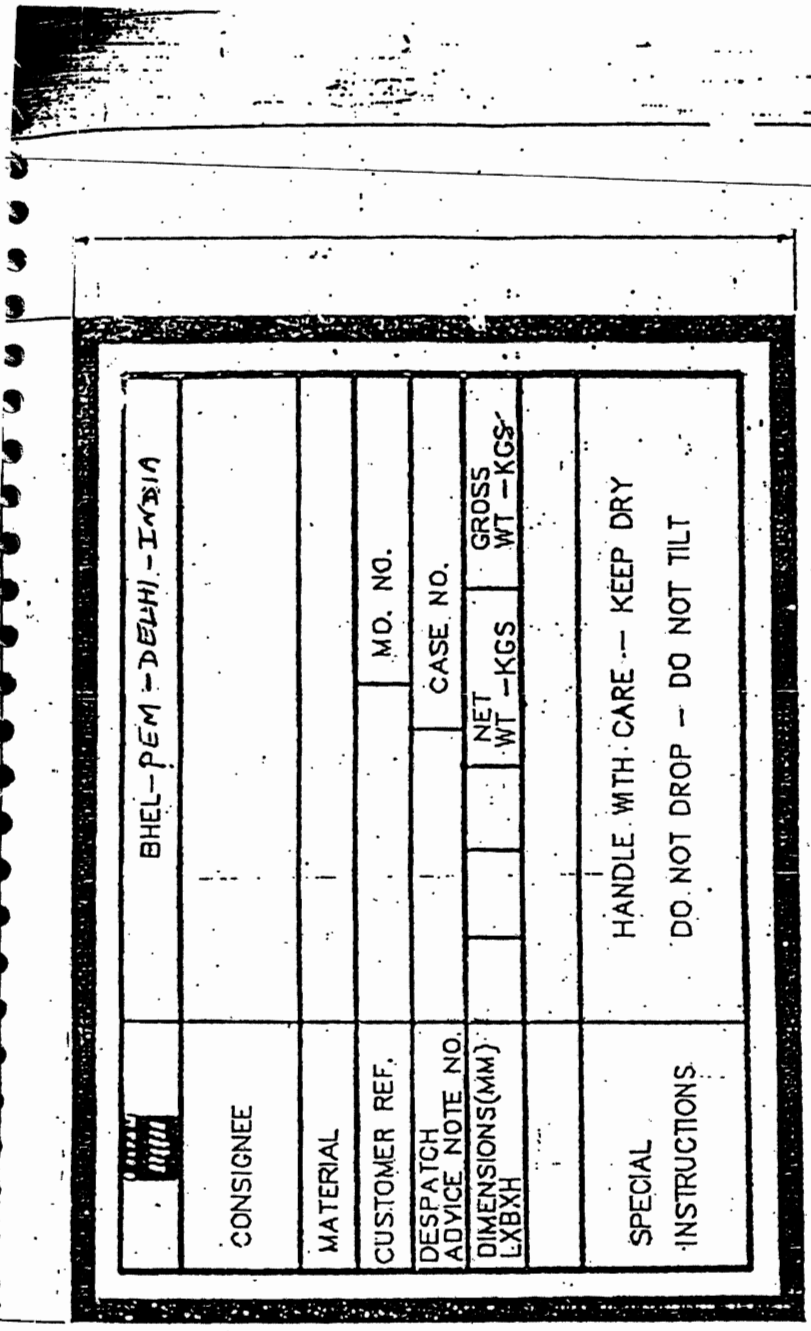
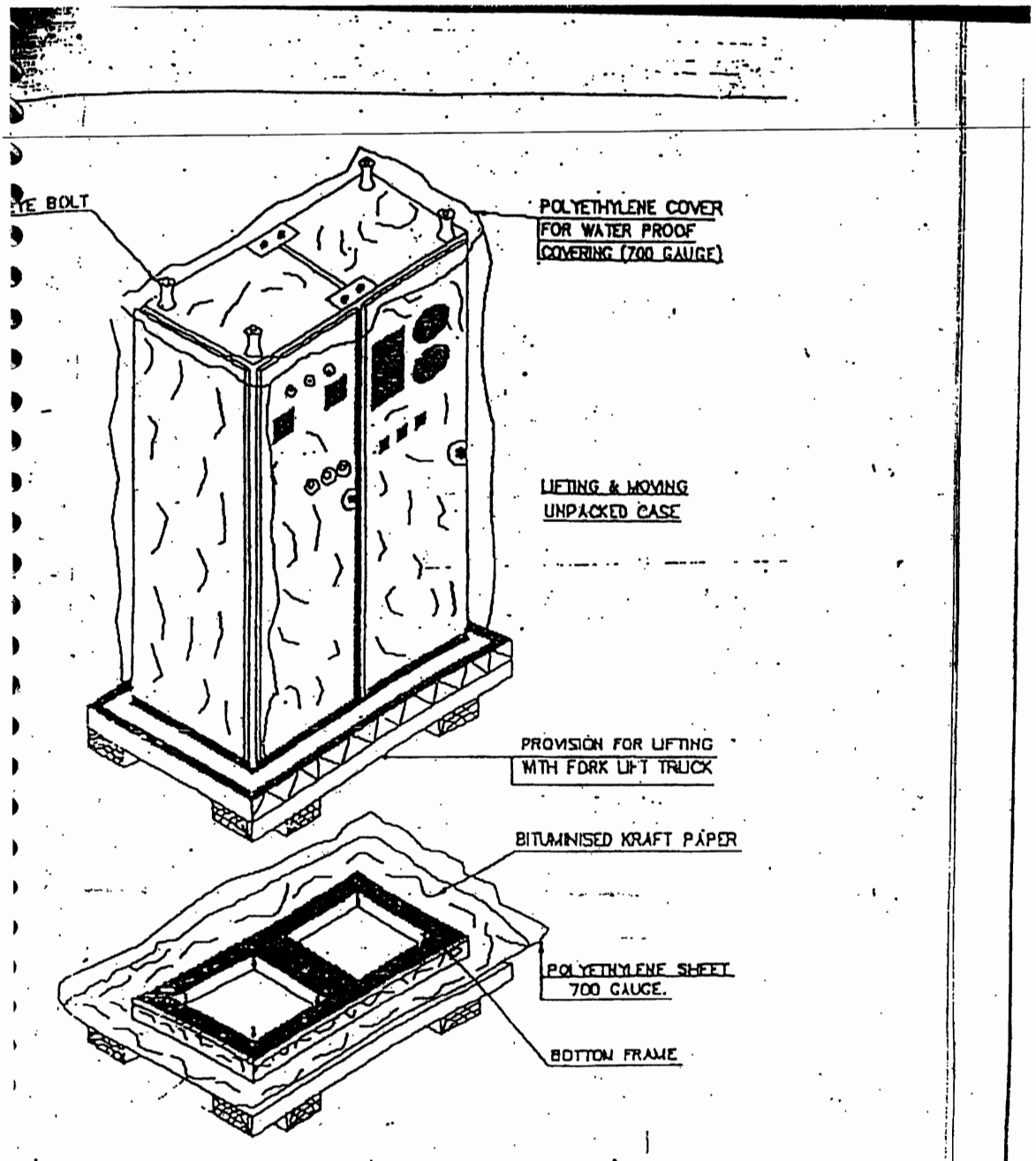


FIG-13: MARKING PLATE


EYE BOLT
POLYETHYLENE COVER FOR WATER PROOF COVERING (700 GAUGE)
LIFTING & MOVING UNPACKED CASE
PROVISION FOR LIFTING WITH FORK LIFT TRUCK
BITUMINISED KRAFT PAPER
POLYETHYLENE SHEET 700 GAUGE.
BOTTOM FRAME
036

FIGURE–14

Sht 16 of 17

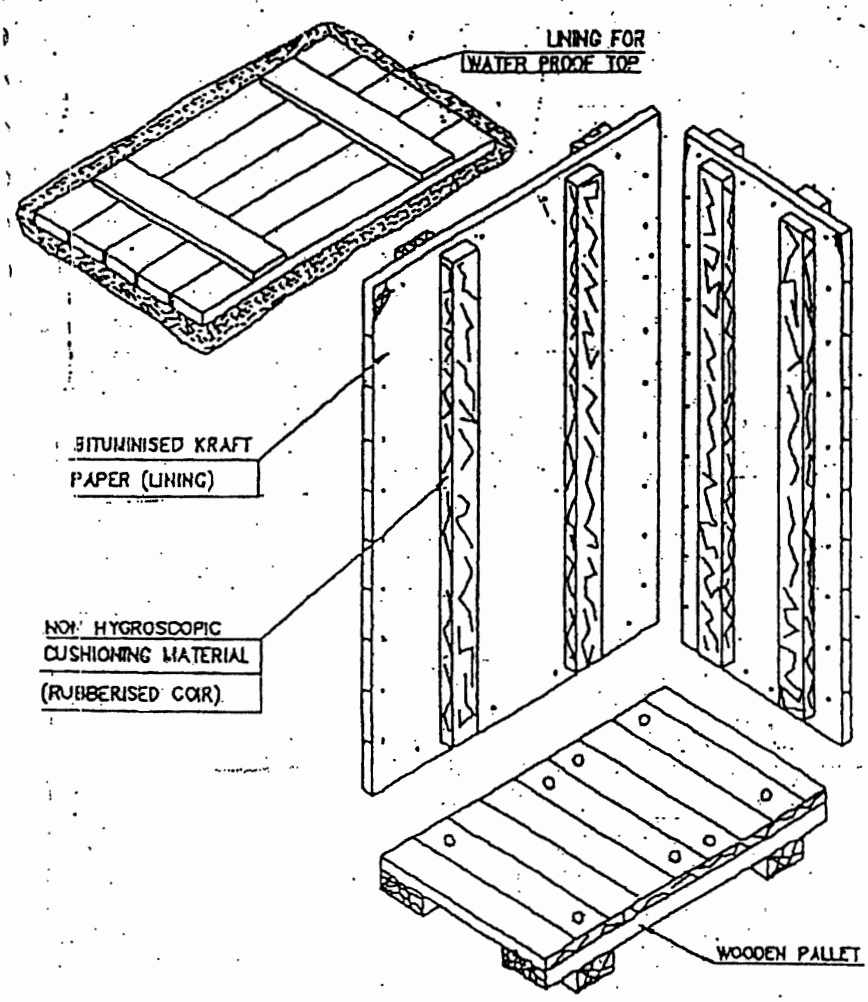


FIGURE-15

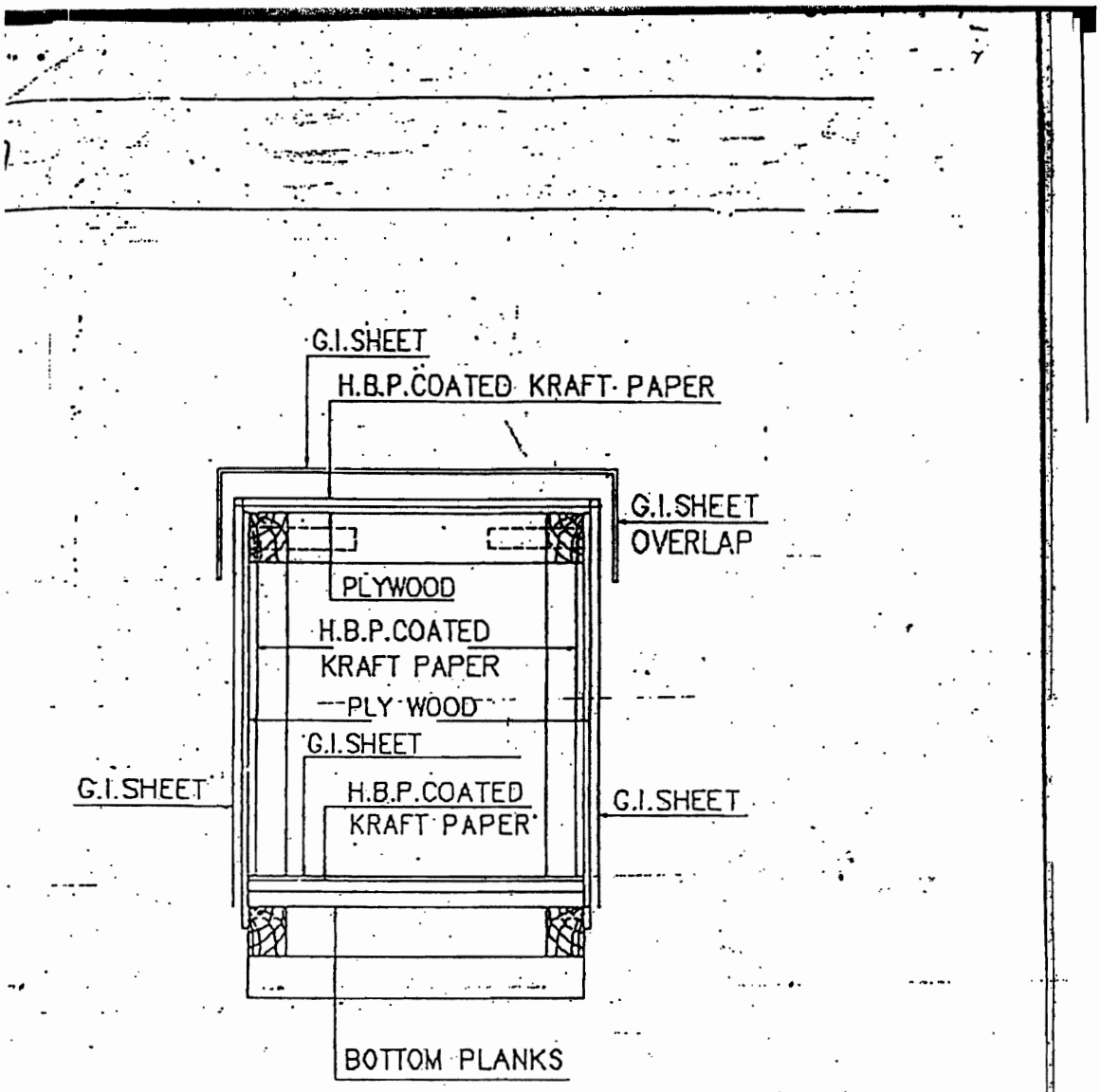


FIG-16 : CLOSED PACKING CASE WITH G.I.SHEET SHOWING LAYERS OF PACKING MATERIALS.

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10.0 TYPICAL PACKING DETAILS/PROCEDURE FOR MECHANICAL ITEMS

10.1 INSULATION MATERIAL (MINERAL WOOL MATTRESSES)

This specification covers the requirements of seaworthy packing and marking for bonded mineral (rock) wool mattresses having metallic hexagonal wire netting as facing on one or both sides.

10.1.1 TYPE OF CONSTRUCTION

Mattress shall be packed in Polythene (of 0.2 mm thickness) all around and sealed to prevent moisture absorption during transit and storage. Further it shall be wrapped with Bitumen coated Polythene bonded/lined Hessian and stitched and then packed in 5 ply DFC carton box.

Silica gel is used for this purpose to protect contents over sufficiently long time from corrosion. Silica gel shall be of indicating type conforming to IS:304-1979 packed in cotton bags placed at different positions inside the packing for absorbing moisture and shall not come into direct contact with the material inside the package. The quantity of silica gel shall be enough for storage period of one year. However, it shall not be less than 4 gms per litre volume of case subject to minimum of 400 gms per case.

Each mattress as well as the packages shall be serial numbered. Also, printed sheets indicating the nominal thickness, density and wire netting details (i.e. material and size) shall be placed below the wire netting.

Following details shall be legibly written on the packages. The details shall also be typed on a sheet of paper & kept in a sealed Polythene cover, inside the packages

a) Project Name
b) Purchase Order No.
c) Sl. No. of package
d) Size of mattress (Thickness x Length x Width)
e) Density
f) Wire netting material and size
g) Weight of the package

10.2 INSULATION MATERIAL (ALUMINIUM COIL)

Heavy Gauge Aluminium Coil Packaging are done by Eye-to-Sky packaging or by Eye to eye packaging as per the proven practice being followed by manufacturer of Aluminium sheets.

10.2.1 Type of construction for Eye to Sky packaging

a. Strapping of coil with polyester strap around circumference at one place.

b. Putting paper I. D. Edge protector.

c. Wrapping the coil with VCI stretch film after putting silica gel bags (4 nos.) Inside the coil.

d. Wrapping the coil with HDPE film.

e. Covering the coil including its build up & bore with masonite / particle board.

f. Putting metallic I. D on coil.

g. Putting O.D edge protector (paper) on coil.

h. Putting circumferential polyester strap (3 nos.) & eye polyester strap (4 nos.).

i. After placing the coil on coil tilter ply wood (10mm thick) of suitable size along with wooden pallet is to be put at the bottom side of the coil.

j. Coil is to be tilted to eye-to-sky position.

k. Final strapping with metallic strap to unit coil and skid at 2 places with top cover of plywood.

l. Fixing the coil with wooden blocks at 4 corners.

m. Labeling 2 nos.(one metallic & one adhesivetype) For specification, net wt. & gross wt.

10.2.2 Type of construction for Eye to Eye packaging

a. Strapping of coil with polyester strap around circumference at one place.

b. Putting paper I. D. Edge protector.

c. Wrapping the coil with VCI stretch film after putting silica gel bags (4 nos.) Inside the coil.

d. Wrapping the coil with HDPE film.

e. Covering the coil including its build up & bore with masonite / particle board.

f. Putting metallic I. D on coil.

g. Putting O.D edge protector (paper) on coil.

h. Putting circumferential polyester strap (3 nos.) & eye polyester strap (4 nos.).

i. Placing of coil on wooden skid Coil is to be tilted to eye-to-sky position.

j. Final strapping of coil and skid at 2 places with steel strap. Fixing the coil with wooden blocks at 4 corners.

Labeling 2 nos.(one metallic & one adhesive type) For specification net wt. & gross wt.

10.3 Packing Procedure for Online Tube Cleaning System and accessories

This procedure is applicable for the shipment of Onload Tube Cleaning System and accessories by sea.

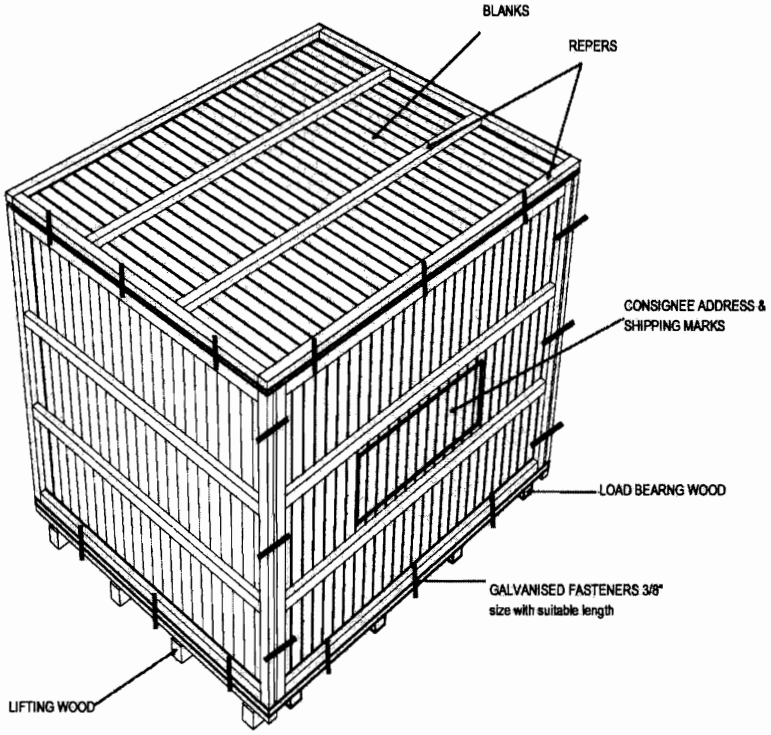
10.3.1 Packing details:

- The Packing case shall be made of treated rubber wood. The design of the case shall be as per Annexure IIIA & IIIB.
- The Equipments shall be placed on the wooden base of the Packing case and fastened if required to arrest the movement of the same.
- Equipment shall be covered by Polythene sheet and inside wall surfaces of the wooden cases also shall be covered by polythene sheet.
- All Nozzles shall be closed with plywood dummies.
- All electrical components assembled or loose shall be covered with polythene sheets along with silica gel pack.
- Silica gel desiccants shall be kept inside each case in sufficient quantities in order to absorb the moisture.

- Thermocol packing shall be made for glass items like Ball vessel sight glass, Vpiece
- sight glass & pressure gauge.
- Silica gel desiccants shall be kept inside of each case to absorb the moisture.
- A Packing list covered in a polythene envelope shall be fixed inside and outside of each packing case.
- Shipping marks and consignee address shall be painted on the outer surface of the case.
- All handling instruction required for the case like top, sling, rain, handle with care etc, shall be marked on the case as per the symbol attached.
- Machined surface will be applied with Anti rust oil and covered by polyurethane sheet to protect from external oxidation.
- All valves will be closed with dummies to protect the internals and placed in the wooden case which will covered by polyurethane sheet.

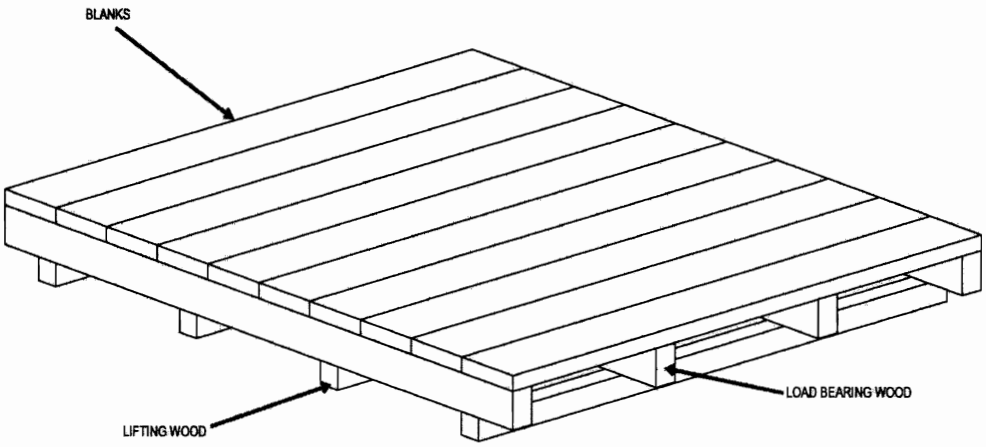
MODEL: FASTNERS TYPE (BASE, SIDE &TOP ATTACHED WITH BOLT, NUT & WASHER)

This Type of case to be used for following items:
1. BALL SEPERATOR
2. BALL COLECTOR SKID



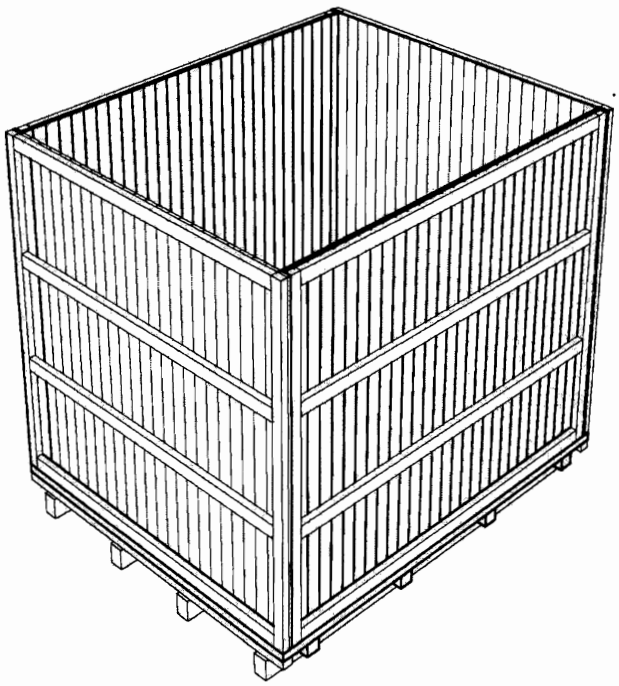
SHEET 05 of 10

BASE FRAME

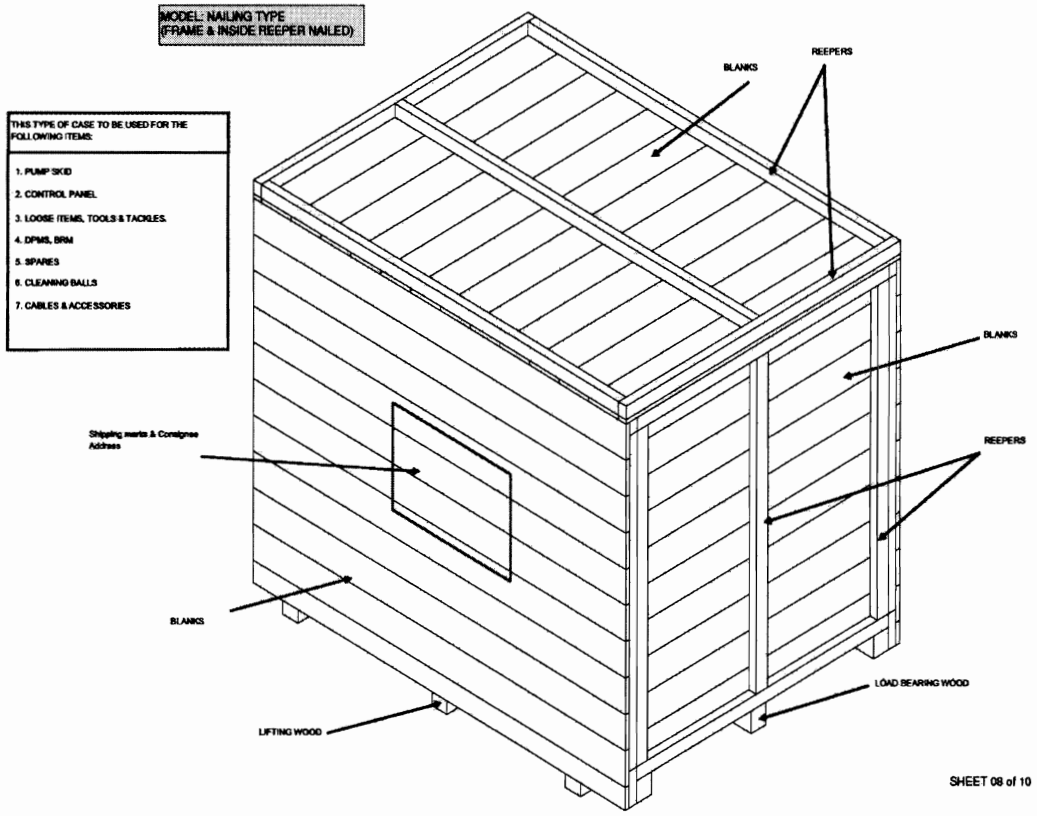


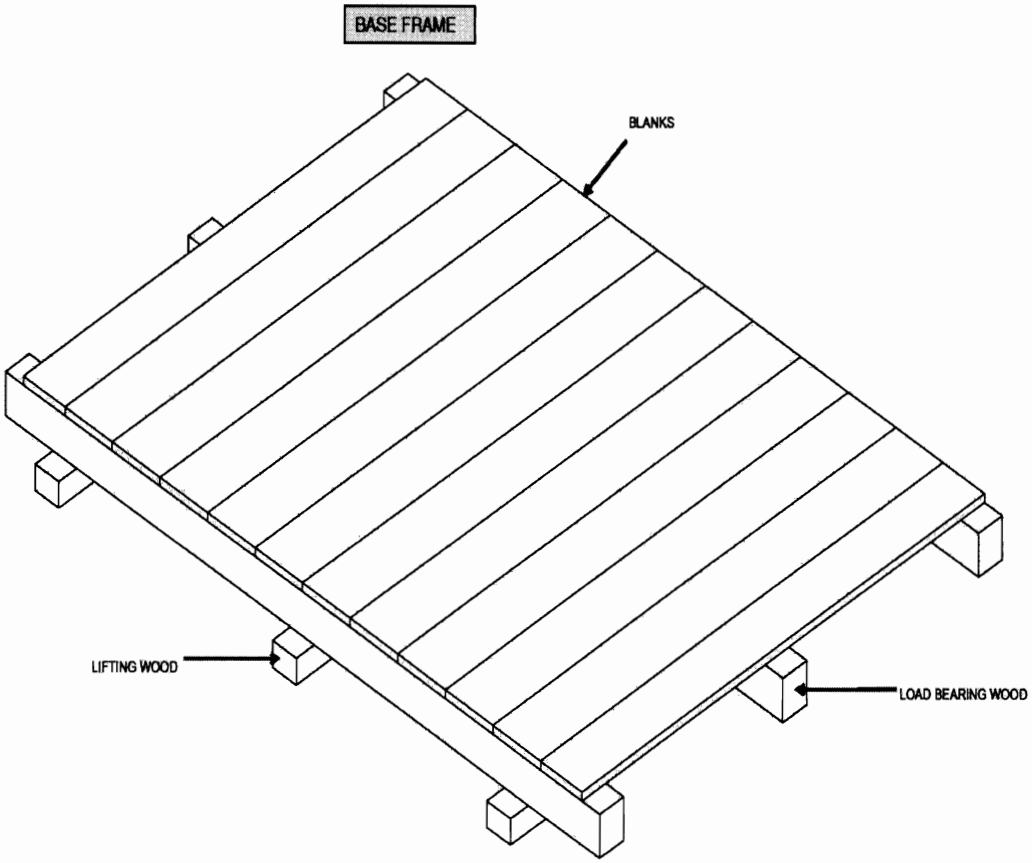
SHEET 06 of 10

MODEL: FASTNERS TYPE - WITHOUT TOP



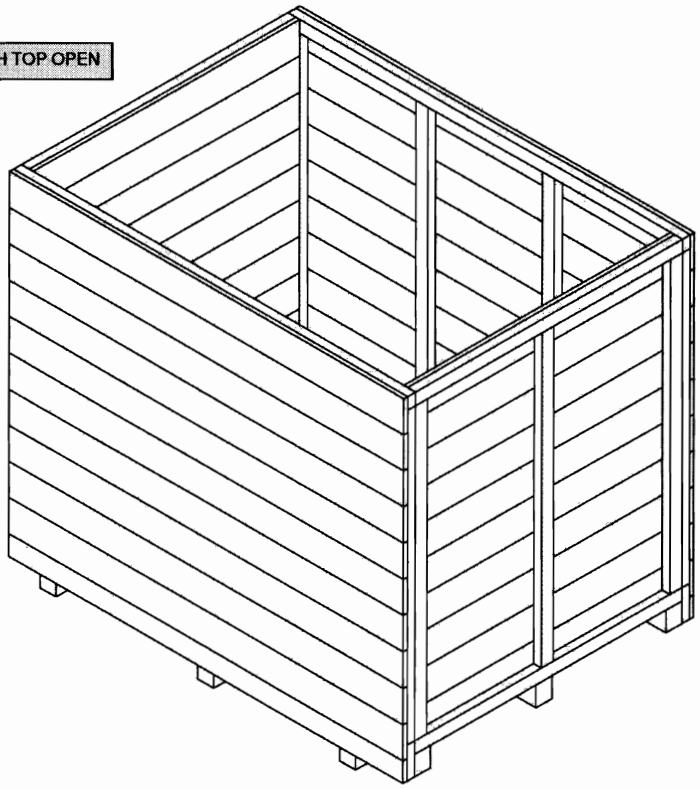
SHEET 07 of 10


MODEL: NAILING TYPE
(FRAME & INSIDE REEPER NAILED)
THIS TYPE OF CASE TO BE USED FOR THE FOLLOWING ITEMS:
1. PUMP SKID
2. CONTROL PANEL
3. LOOSE ITEMS, TOOLS & TACKLES.
4. DPMS, BRM
5. SPARES
6. CLEANING BALLS
7. CABLES & ACCESSORIES
BLANKS
REEPERS
BLANKS
REEPERS
Shipping marks & Consignee Address
BLANKS
LOAD BEARING WOOD
LIFTING WOOD
SHEET 08 of 10



SHEET 09 of 10

NAILING TYPE MODEL WITH TOP OPEN



SHEET 10 of 10

10.4 PACKING OF LOOSE ITEMS

Loose mechanical, electrical and C&I items e.g. valves, fittings, pressure/temperature gauges/switches, circuit breakers, relays etc shall be individually wrapped using polyethylene sheets/U foam/ thermocol sheets/air bubble sheets depending upon the items and then packed in wooden boxes. The left out spaces and top of the boxes shall be filled with rubberized coir to get proper cushioning effect, Special attention shall be paid to relays, instruments etc for arresting the movements of their operating mechanism during transportation.

The construction of wooden packing cases shall be as per clause 9.3.1 retaining its all features concerning strength of the box. The construction of wooden packing case for electrical and C&I items shall be as per fig-16.

Inner surface of 6 sides of the box shall be lined with bitumen coated hessian polyethylene kraft paper. Rubberized coir of min. 25mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of the boxes.

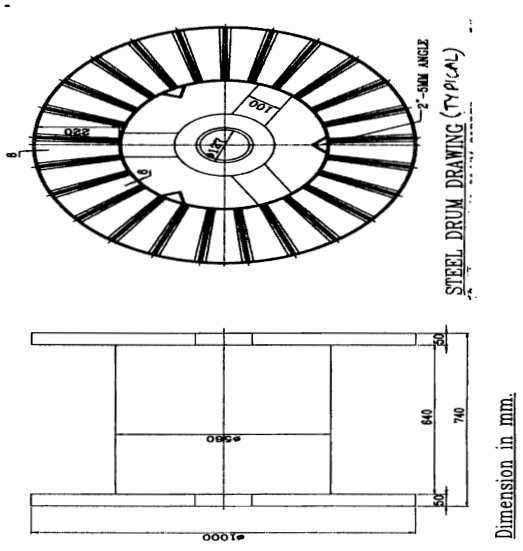
11.0 PACKING OF ELECTRICAL ITEMS

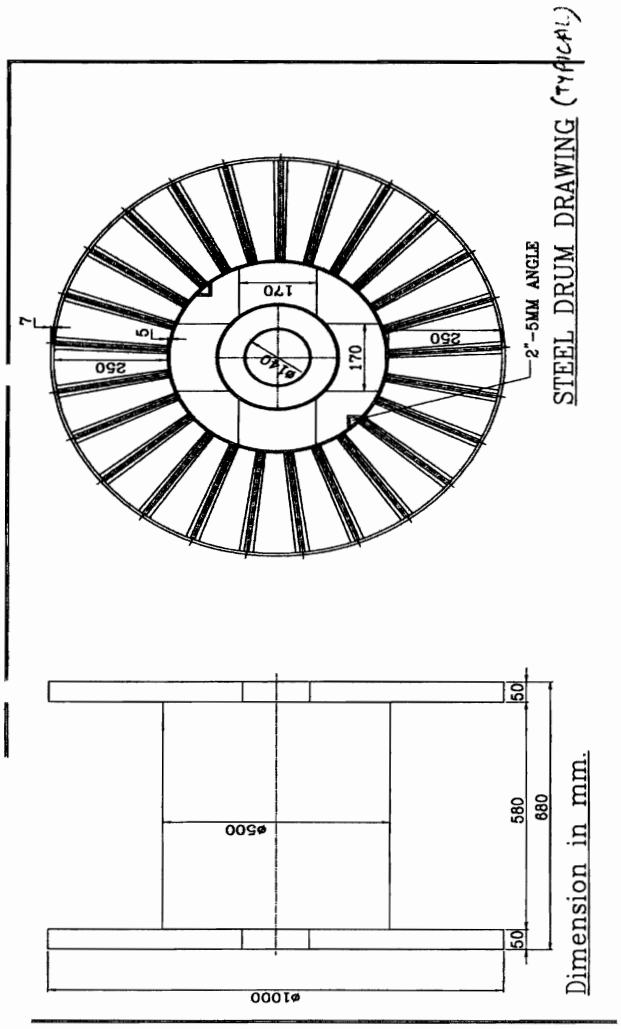
11.1 CABLES

11.1.1 Type of Equipment
All type of cables..

11.1.2 Type of Construction

New or practically new cable drums made of steel and painted with epoxy resin paint are to be used. Cable ends are carefully protected before packing. Over the cables polyethylene sheet shall be wrapped and then sealed properly. Cable drum can be put in wooden crates for ease in transportation and handling. (Wooden cable drum is also acceptable, however vendor to furnish constructional details for approval).


2-50X6 ANGLE
STEEL DRUM DRAWING (TYPICAL)
1000
820
640
740
50
50
Dimension in mm.



11.2 PACKING OF CABLE TRAYS & ACCESSORIES AND CABLE TRAY SUPPORT MATERIAL

11.2.1 Cable trays can be packed in wooden boxes as per fig 1 to 11 or in steel boxes. Details of steel box construction is as indicated below.

1) All Dimensions are in "mm" unless otherwise stated.
2) Packing Box shall be fabricated using 50x50x6mm MS Angle, 50x3mm Flat, 2.5 mm thick C Channel, 1mm & 1.6mm Thick sheet.
3) Finish of Packing Box Shall be Galvanized.
4) Angle & Channel Section forming part of the Main frame shall be welded thoroughly with each other to give a rigid structure.
5) Sheet Section and Flat section shall be bolted/ Riveted/ Welded suitably to the Main frame stated in '4' above.

6) Welding Portion on galvanized surfaces shall be painted with Zinc Rich Paint.

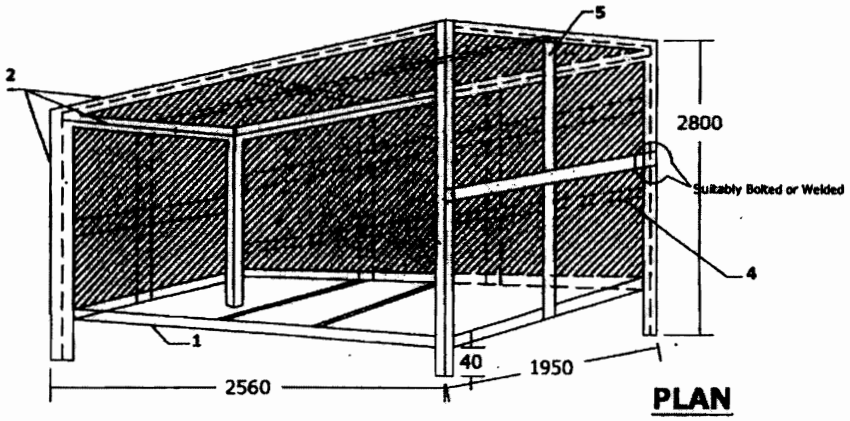
7) Dispatch details such as consignor/consignee address, contract and case details, 'country of origin, port of delivery, stacking instructions shall be written on one of the side of boxes. An anodized aluminium plate as per details and specifications given in page 3 of 5 shall be provided on the boxes

8) One copy of packing slip wrapped in polythylene bag covered with suitable aluminium .packing slip holder to be nailed on the external surface of the box. One more copy 9f the packing Slip wrapped in polythylene bag to be kept inside the box at the prominent place.

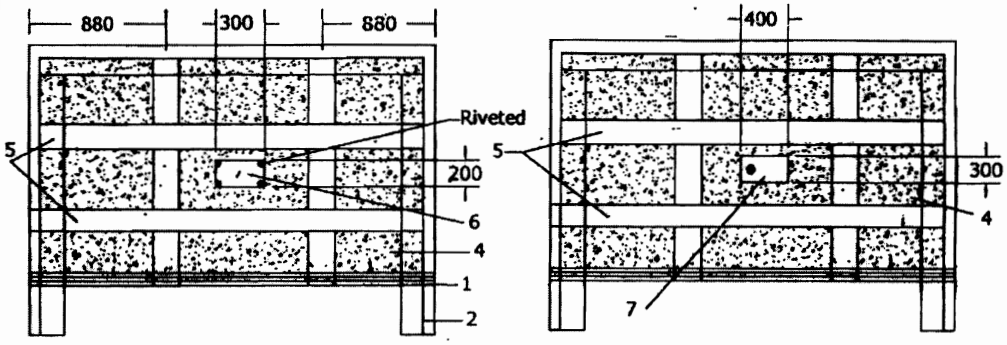
9) **INDICATION MARKS ON THE BOXES:** Markings shall be provided on the boxes indicating position of Boxes for handling, storage and nature of consignment. For guidelines referred page 4 of 5. The ink issued for this purpose as well as for marking dispatch instruction shall be indelible/non-washable marking ink.

10) Each item as mentioned in BOQ shall be packed & supplied as a set comprising of required numbers of associated fasteners & hardware etc

STEEL PACKING (TYPICAL DETAILS)



PLAN

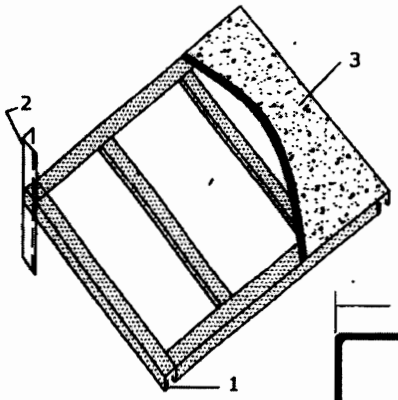


FRONT SIDE OF BOX

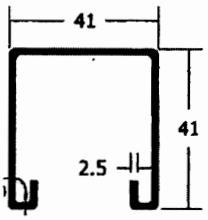
BACK SIDE OF BOX

Note:

1. "C" Channel to be used on Bottom Frame.
2. 50x50x6 Angle to be used Vertically on four sides of the Box and Horizontally on four sides on the top Frame.
3. 1.6mm thick sheet (plain) on Bottom Plate.
4. 1.0mm thick sheet to cover top & four sides of BOX.
5. 50x3 Flat as additional cross members to be used Horizontally & Vertically on top & Four Sides of Box.
6. Anodised Alluminium Plate for Marking.
7. Hinged Inspection Window.



BOTTOM FRAME ARRANGEMENT



DETAILS OF "C" CHANNEL

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11.3 PACKING FOR STATION LIGHTING SYSTEM

Aspects of packing specific to equipments / items of station lighting system are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

11.3.1 For LIGHTING TRANSFORMER, DISTRIBUTION BOARDS, LIGHTING PANELS,

a) Construction of packing case for LIGHTING DIATRIBUTION BOARDS, LIGHTING PANELS, TRANSFORMER . shall be EITHER as per FIGURE 1,2,3,5,6,7,8,9,10,11 OR FIGURE 14,15,16.

b) Each Panel/Transformer shall be individually covered with double polythene sheet of thickness 175 microns minimum.

c) All the 6 inner surfaces of packing shall be nailed with bitumen coated hessian polythene craft paper. Wherever 2 pieces of craft paper are used, the joint shall have minimum overlap of 20mm.

For the top frame it shall be project on all sides by 100mm and shall be nailed on sides .

d) The gap between the panels and packing case shall be filled with rubberized coir of thickness 50mm minimum and width 100mm. The distance between two consecutive supports of rubberized coir shall be less than 500mm.

e) Silica get packed in cotton bags shall be placed at different positions inside the packing.

f) Packing case shall be finally covered with GI sheet of thickness 0.4mm minimum.

11.3.2 For LUMINARIES, RECEPTACLES. EMERGENCY LIGHT, 240/24V TRANSFORMER, CEILING FAN, SWITCH BOARDS, FLEXIBLE CONDUIT, WIRES, EARTH WIRE. JUNCTION BOXES, ERECTION COMMIOSSIONING SPARES, RECOMMENDED SPARES , ERECTION MATERIAL AND CONSUMBALES

a) Construction of packing case for THE ABOVE MATERIAL shall be as per FIGURE 1to11.

b) Items placed inside the case shall be covered with double polythene sheet of thickness 175 microns minimum.

c) All the 6 inner surfaces of packing shall be nailed with bitumen coated hessian craft paper. wherever 2 pieces of craft paper are used, the joint shall have minimum overlap of 20mm. For the top frame it shall be project on all sides by 100mm and shall be nailed on sides.

d) Silica get packed in cotton bags shall be placed at different positions inside the packing.

11.3.3 For CONDUIT PIPE

As per international practice pipes are shipped in open bundles with metal strapping. Packing as per attached figure A shall be provided which is described as following:

a) Each bundle shall be wrapped with 2 layers of 175 microns thick polythene sheet.

b) Then bundle will be wrapped with bitumen coated hessian craft paper.

c) Bundle shall be strapped with steel straps.

d) An anodized aluminium packing description plate as per Figure No. 13 shall be provided.

11.3.4 For POLES

Poles will be wrapped with 2 layers of minimum 175 microns thick polythene sheet and then with bitumen coated hessian craft paper, packed as per Figure – C i.e. bundling.

11.3.5 For STRUCTURAL STEEL

Structural steel will be different sizes and shapes. Hence it will be packed as per Figure No. B and described as following :

a) Each bundle shall be wrapped with 2 layers of 175 microns thick polythene sheet.
b) Then bundle will be wrapped with bitumen coated hessian craft paper.
c) Bundle shall be strapped with steel straps.
d) An anodized aluminium packing description plate as per Figure No. 13 shall be provided.

PACKING PROCEDURE FOR CONDUIT PIPE

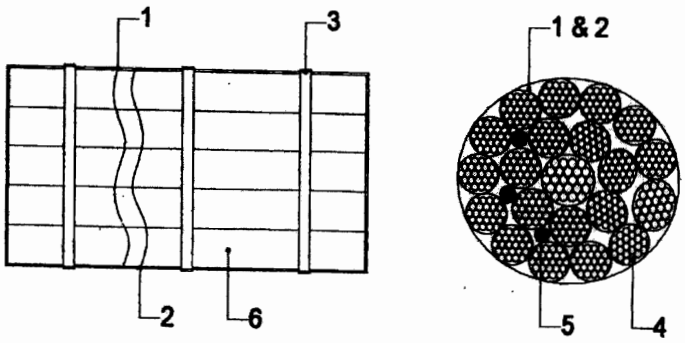


FIGURE "A"

1) LAYER OF BITUMEN COATED HESSIAN KRAFT PAPER.
2) LAYER OF POLYTHENE SHEET.
3) METAL STRAPPING.
4) CONDUIT PIPES.
5) SILICA GEL POUCHES.
6) BUNDLES OF CONDUIT PIPES.

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PACKING PROCEDURE FOR STRUCTURAL STEEL

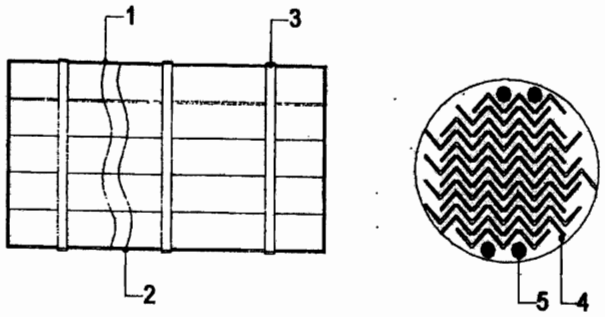


FIGURE "B"

1) LAYER OF BITUMEN COATED HESSIAN KRAFT PAPER.
2) LAYER OF POLYTHENE SHEET.
3) METAL STRAPPING.
4) STRUCTURAL STEEL.
5) SILICA GEL POUCHES.

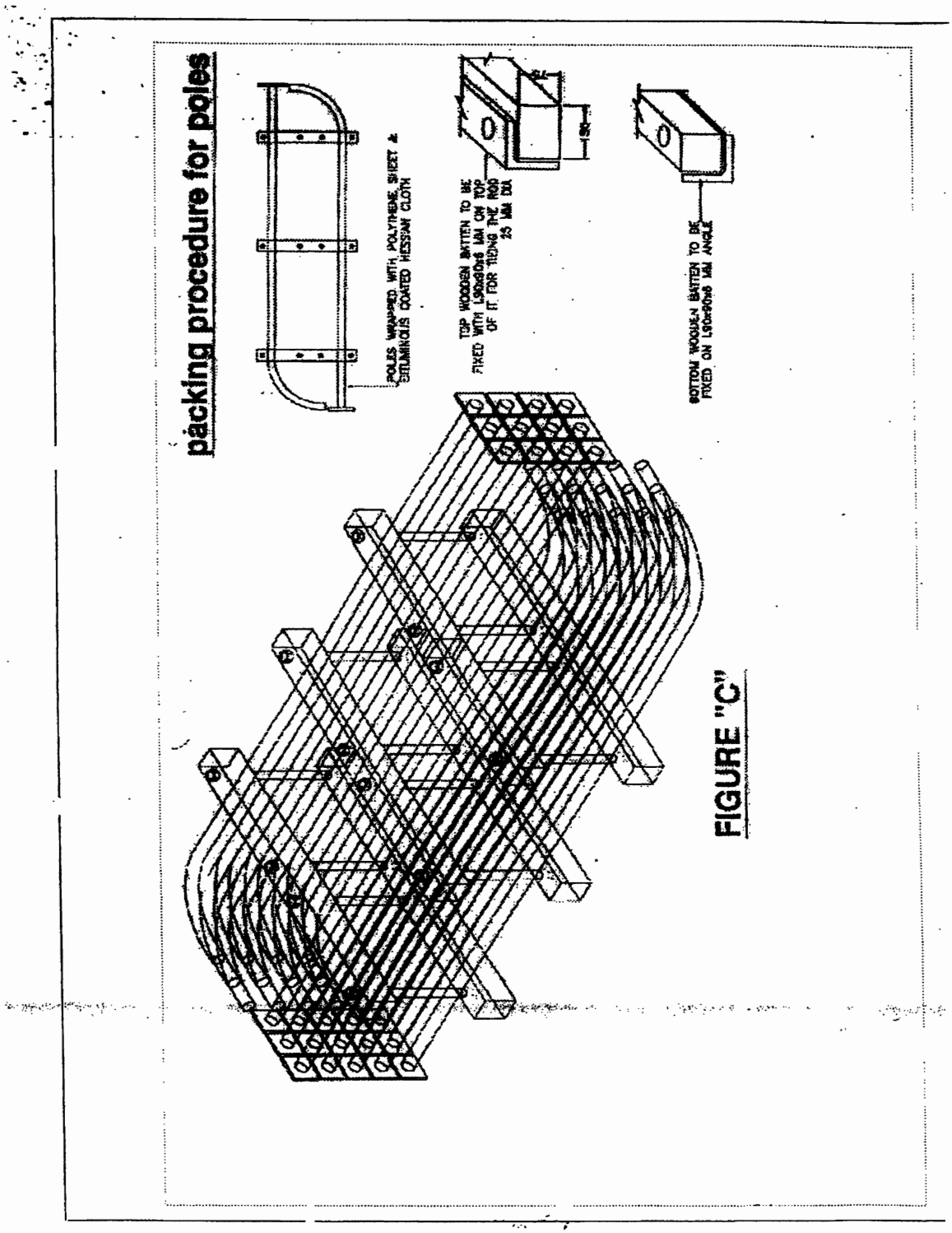


FIGURE "C"

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11.4 PACKING FOR DC BATTERY

The packing procedure for seaworthy packing of DC Battery is defined below, which is capable of withstanding impacts, compression, vibration, toppling, sea water spray, prevention against rust, temperature and extreme atmospheric conditions. Aspects of packing specific to equipments / items of DC Battery are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

The packing procedure consists of various stages namely primary packing, cushioning, securing, desiccant, outside packing box, Runners/ sliders/ transverse bars of plywood, etc., provided for each movement.

a) The packing boxes shall be made up of plywood boxes (thickness 9mm min.) with blocks at the bottom of the box for provision for handling the boxes using the forklift. The packing boxes sizes are generally standardized to half-euro size (capable of handling equipment's weight).

b) Rubberized coir of 25mm thickness shall be provided as cushioning material at the bottom and thermocole of 20mm shall be provided inside on all four sides. Other than this polyethylene film wrap or cover also will be provided. Left out spaces to be filled with rubberized coir/ thermocol to get cushioning effect.

c) Silica gel in dust free air permeable cotton/paper bag shall be placed in the packing boxes for storage period of 1 year as per IS 304 (1979)

d) While packing the cells, transit caps (polypropylene) of red and blue shall be used for big size cells for ensuring that cells does not get damaged during the transport due to vibrations etc.

e) The battery accessories shall be packed with suitable precautions as follows:

i) Copper connectors shall be packed after making bunches with lead wire seals to avoid misplacement.

ii) Hardware items shall be packed in polyethylene bags (Thickness $\geq$ 0.175mm) with item slip

iii) Battery rack shall be packed in dismantled condition, wrapped with polyethylene sheet

iv) For Ni-Cd type battery, electrolyte in solid form for dry cells shall be packed in cans with KOH, LiOH being packed separately.

f) Galvanized Steel straps are provided for binding the packing box sides.

g) The handling instructions shall be marked in indelible/ non-washable ink, indicating the upright position.

11.5 PACKING OF SERVICE TRANSFORMERS(OIL FILLED) & ACCESSORIES

This instruction is applicable for packing of transformers (oil filled), its accessories and components so as to ensure safe delivery to end user. Aspects of packing specific to equipments / items of transformers(oil filled) are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

11.5.01 PACKING DETAILS :

a Items shall be packed in case / crates as per the shipping list.

b All fragile items and small items shall be packed in cases and to be marked as "Fragile, handle with care Fragile items".

c Fragile accessories are to be first packed in their original boxes (VENDOR's packing). Very

small / delicate items such as glass thermometer, door keys shall be packed in separate box.

d In case original box is found damaged, suitable alternate box or packing method using felt or foam sheet and polythene wrap to be used.

e These boxes are then placed in identified wooden boxes. Inside of such boxes are lined with a layer of polythene sheet, packing wool / grass and another layer of polythene sheet before placing the boxes. All boxes are then wrapped with this polythene sheet before closing the box. Fragile items shall not be placed loose, one above the other inside the case.

f All wiring cables, connection flats of non-ferrous materials, CTs, valves bellows shall also be packed.

g Items like CTs, Oil communicating bushings, insulators, wired equipments and housings such as RTCC Panel, M. Box, Drive Mechanism, thermometers, gauges shall be wrapped in polythene from all around.

h Buchholz relay and OSR relay openings will be blanked using covers, before putting them in the box

i Items shall be carefully lowered and arranged inside the crate / case and each item shall be locked from all sides in such a way to avoid its movement in any way. Wooden stoppers and separators shall be provided for this and nailed to the crate / case wood.

j Wooden planks and batons in contact with fragile items shall be provided with kit foam at the locations of contact.

k Oil communication bushings shall be packed in separate case on V or U shape wooden felted supports, as in case of condenser bushings.

l While placing and arranging the items inside the crates / cases, these shall be verified for correctness and then the packing note shall be signed. The cover top of the crate / case shall then be closed.

m The main equipment like transformer tank shall be packed suitably to prevent any damage during transit / storage. Support structures like frame, header supports etc. shall be crated. Conservator headers shall also be crated. Radiators pipe work and other instruments & components shall be packed in cases. All the cases shall be lined with polythene from inside.

11.6 ALTERNATIVE PACKING CASES FOR CONTROL PANELS AND SWITCH GEARS

For Control and switch gear panels, construction of wooden packing cases may be provided as per fig 14 & 15 and as detailed below.

Thickness of planks for all sides, binding and jointing battens shall be at least 25 mm. Width of the plank shall be at least 125mm and that of binding and jointing planks shall be at least 100mm.

Top frame shall be suitable so that it does not collapse due to sandwiching between slings while lifting. Longitudinal and traverse bars for the bottom wooden pallet to be suitably selected.

Diagonal bracings shall be as per cl 9.3.1.3 and all other requirements shall be as per clauses 9.3.1.4 to 9.3.1.6.

12.0 Containerization

As required by BHEL, the VENDOR shall stuff the GOODS into 20 or 40 foot containers (dry, open top, flat racks, etc.).
The maximum inside dimensions of containers are to be considered:

- 40 foot containers: 11.80 m x 2.20 m x 2.05 m
- 20 foot containers: 5.80 m x 2.20 m x 2.05m
-

The present definition of containerization is valid for sea containers only. Vendor to check the size of containers before start of packing of equipment.

12.1 Protection of Cases/Crates

Since shipping containers are in general not water tight, packing in contact with the floor of the container shall be raised in order to prevent it from being damaged by the accumulation of water.

12.2 Mechanical Constraints

The mechanical constraints for "general use" closed containers are of a different nature (height of "stacking" being limited inside the containers), the packing for the GOODS may be of a lighter structure. However, it is necessary that the packing be appropriate so as to protect the GOODS on site during the storage period, as required after discharging of the GOOD'S from the containers.

Note:

It is the responsibility of the VENDOR to ensure that the cases/crates are stowed, secured and fastened inside the container. The VENDOR will take all necessary precautions to conform to the maximum weight allowed and the centre of gravity of the container. The securing and fastening of the cases/ crates can be carried out by nailing timbers on the bottom or on the vertical sides of the container.

13.0 Other Services to be provided by Vendor

In addition to the packing and shipping documents, VENDOR must also carry out the following services, which shall be included in his quotation:

Carriage of VENDOR's sub-contracted equipment and material, which must be re-grouped in VENDOR's or PACKER's workshops, whilst waiting for packaging.

BHEL reserves the right to postpone the shipping of the GOODS. In this event, any storage and insurance costs during the first ninety (90) days shall be borne by the VENDOR.

Loading, including lifting, securing, lashing, and stowing, of all cases, crates, or packages onto means of transportation such as, but not limited to, trailers, containers, etc.

14.0 Responsibilities and Guarantees

VENDOR is responsible for the choice of category for packing according to the transport facilities used, and on the basis of the present document. In case of doubt or disagreement regarding the choice, VENDOR must inform BHEL prior to packing and await BHEL's approval. All phases of packaging, marking, loading, etc. will be subject to BHEL inspection.

BHEL reserves the right to reject the packing when the packing does not conform to these instructions and/or when the packing does not ensure perfect protection of the GOODS.
VENDOR is responsible for the weights and dimensions declared, and the marking of the packages.

The documents must be in strict conformity with the packing contents.
The packing specified in these "Packing, Marking and Shipping Instructions" is guaranteed for a twelve (12) months storage period after delivery on site.

VENDOR is responsible for providing storage recommendation adapted to the GOODS. According to this guarantee, VENDOR is held responsible in the event of goods becoming

useless, damaged or broken, as a result of poor packing and/or stowing, or due to corrosion, subsequent to insufficient or inadequate protection. All direct or indirect costs resulting thereof, will be back-charged to VENDOR.

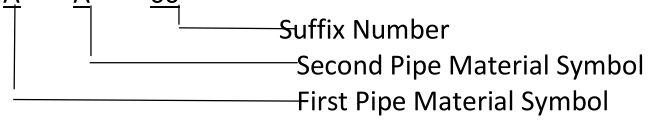
1. General
   This specification covers the basic requirements for the design and materials of process and utility piping for the Flue Gas Desulfurization Plant.
2. Material Selection
   1) Basically, rubber lined pipes are selected to prevent the corrosion and erosion for process service, namely slurry line and other line possible to contact with raw gas.
   2) Class AA60 is applied according to process line conditions.
   3) For utility services, other classes are applied.
   4) In principle, piping material will conform to ASTM, but ASTM equivalent material specified by other authorized code may be applied.
   5) Non-asbestos type shall be used for Packing and Gasket.

3. Design of Piping Component
   1) In principle, each component of all piping will be selected from ANSI ASME or international standard in the dimensions and other requirements.
   2) Metric series are applied to the bolt thread.
   3) Nozzle weld tees or extruded tees are used as branch connection in lined piping, in general.
   4) Short radius elbow may be used for 550mm or larger size piping.
   5) Fittings for 50 and smaller galvanized piping shall be of screwed type.

4. Piping Material
   1) Symbols of Piping Service Class

   Piping service class name is composed of the following symbols.

   Example: A A 60

   Note:

First Pipe Material Symbol	
A: Lining	AA: Rubber Lining
B : Stainless Steel	BA: 304 Stainless steel
C: Carbon Steel	CA: A53 Gr.B Welded
	CC: A53 Gr.B or AI06 Gr.B/C
	CG: Galvanized

2) Class No. and Fluid Designation

CLASS NO.	FLUID NAME	SYMBOL	
AA60	Gypsum Slurry Filtrate Slurry Waste Water Duct Drain Beltfilter Vent Gas	GS FS WW DD VBG	
BA01	Instrument Air Lube Oil (Low Pressure)	AI LOL	
CC01	Process Water Raw Water Cooling Water Supply Cooling Water Return Vacuum Pump Vent Antifoam Agent	WP WR WCS WCR VG AA	Note 1

Note I
Class AA60 shall be applied for process water service line in contact with corrosive and abrasive media.

3) Abbreviations

Abbreviations used throughout this specification are as follows:

BB	:	Bolted Bonnet
BC	:	Bolted Cover
BE	:	Bevel End
BW	:	Butt Weld
CAL	:	Calculation
CR	:	Chloroprene Rubber
E	:	Electric Resistance Weld
EPDM	:	Ethylene Propylene Diene Methylene Rubber
Eq	:	Equal
FE	:	Flange End
FF	:	Flat Face
G. OP	:	Gear Operation
Gal.	:	Galvanized
HEX.	:	Hexagon
IIR	:	Isobutylene Isoprene Rubber

ISRS	:	Inside Screw Rising Stem
La	:	Larger
L.OP	:	Lever Operation
NB	:	Nominal Bore
NW	:	Nozzle Weld
OS&Y	:	Outside Screw & York
PE	:	Plane End
PP	:	Poly Propylene
PTFE	:	Poly Tetra Fluoro Ethylene
RF	:	Raised Face
R/L	:	Rubber lined or rubber seated
S	:	Seamless
SB	:	Screw Bonnet
SC	:	Screw Cover
SCH	:	Schedule No.
SCR'D	:	Screwed
Sm	:	Smaller
SO	:	Slip On
St.	:	Stelliting
SW	:	Socket Weld
W	:	Weld
WN	:	Welding Neck
W/LINING	:	With Lining
V#	:	Valve No.
13 CR	:	13% CHROMIUM

CLASS	Max.Press. (MPaG)	1.1		C.A. mm	CLASS
AA60 (1/1)	Max.Temp. (degC)	65			AA60 (1/1)
FLUID	GYPSUM SLURRY				

ITEM	Size	Thickness	Specification	ITEM No.
PIPING	DN25 - DN50	SCH40	A53-B SML PE (I:R/L) ASME	
	DN65 - DN150	SCH40	A53-B E.R.W BE (I:R/L) ASME	
	DN200 - DN300	SCH20	A53-B E.R.W BE (I:R/L) ASME	
	DN350 - DN400	SCH10	A53-B E.R.W BE (I:R/L) ASME	
	DN450 - DN500	SCH10	A53-B E.R.W BE (I:R/L) ASME	
	DN550 - DN1000	7.9T	A134(A283-C) EFW BE (I:R/L) ASME	
	DN1100- DN1200	9.5T	A134(A283-C) EFW BE (I:R/L) ASME	
FITTING	DN25 - DN50	Suit to PIPE	BW A234-WPB (I:R/L) ASME-B16.9	
	DN65 - DN150	Suit to PIPE	BW A234-WPBW (I:R/L) ASME-B16.9	
	DN200 - DN300	Suit to PIPE	BW A234-WPBW (I:R/L) ASME-B16.9	
	DN350 - DN500	Suit to PIPE	BW A234-WPBW (I:R/L) ASME-B16.9	
	DN550 - DN1000	Suit to PIPE	BW A134(A283-C) EFW (I:R/L) ASME-B16.9	
	DN1100- DN1200	Suit to PIPE	BW A134(A283-C) EFW (I:R/L) ASME-B16.9	
SMOOTH BEND	DN25 - DN80	Suit to PIPE	BW A53-B (I:R/L)	
FLANGE	DN25 - DN600		SO A105 ASME150 SO FF (I:R/L) ASME-B16.5	
	DN650 - DN1800		SO A105 AWWA CL.B SO FF (I:R/L) AWWA-C207	
PINCH VALVE	DN25 - DN150		PN 16 A126-B TRIM-13CR SLEEVE-CR LINING-IIR FF HAND WHEEL	
GASKET	DN25 - DN600		V-2000 RUBBER RUBBER OR EQ. ASME150 2.0T FLAT RING	
	DN650 - DN1800		V-2000 RUBBER RUBBER OR EQ. AWWA CL.B 2.0T FLAT RING	
BOLT & NUT	ALL SIZE		STUD U HEAVY NUT A307-GR.B/A563-GR.A FINISHED	

Note: I: R/L - Replaceable Wear Resistant Natural Rubber Lining of minimum 6mm thickness. Additional thickness of 2 mm rubber lining shall be provided in bends.

CLASS	Max.Press. (MPaG)		1		C.A. mm
BA01 (1/1)	Max.Temp. (degC)		45		
FLUID	INSTRUMENT AIR, LUBE OIL				
ITEM	Size	Thickness	Specification		
PIPING	DN6- DN50	SCH40S	A312-TP304 SML PE ASME		
	DN65-DN250	SCH20S	A312-TP304 E.R.W BE ASME		
FITTING	DN6 - DN50	Suit to PIPE	3000LB SW A182-F304 ASME-B16.11		
	DN65 - DN250		BW A403-WP304 ASME-B16.9		
FLANGE	DN6 - DN50	Suit to PIPE	SW GR.304 GR.304 ASME150 SW RF ASME-B16.5		
	DN65 - DN250		LOOSE A105 ASME150 LOOSE ASME-B16.5		
GATE VALVE	DN6 - DN50		API-602 PN 16 A182-F304 AISI304 SW BB,OS&Y HAND WHEEL		
	DN65 - DN250		ASME-B16.34 PN 16 A351-CF8 AISI304 RF BB,OS&Y HAND WHEEL		
GASKET	DN6 - DN150		V-6500 NON-ASBESTOS OR EQ. ASME150 1.5T FLAT RING		
	DN200- DN250		V-6500 NON-ASBESTOS OR EQ. ASME150 3.0T FLAT RING		
BOLT & NUT	ALL SIZE		STUD U HEAVY NUT A307-GR.B/A563-GR.A FINISHED		

CLASS	Max.Press. (MPaG)		0.11	0.85		C.A. mm
CC01 (1/1)	Max.Temp. (degC)		155	45		
FLUID	WATER, VENT GAS					
ITEM	Size	Thickness	Specification			
PIPING	DN6 - DN50	SCH80	A53-B SML PE ASME			
	DN65 - DN150	SCH40	A53-B E.R.W BE ASME			
	DN200 - DN300	SCH20	A53-B E.R.W BE ASME			
FITTING	DN6 - DN50		3000LB SW A105 ASME-B16.11			
	DN65 - DN150	Suit to PIPE	BW A234-WPB ASME-B16.9			
	DN200 - DN300		BW A234-WPB ASME-B16.9			
FLANGE	DN6 - DN150	Suit to PIPE	SO A105 ASME150 SO RF ASME-B16.5			
	DN200 - DN300		SO A105 ASME150 SO RF ASME-B16.5			
GATE VALVE	DN6 - DN50		API-602 PN16 A105 13CR SEAT STL SW BB,OS&Y HAND WHEEL			
	DN65 - DN300		ASME-B16.34 PN16 A395 13CR RF BB,OS&Y HAND WHEEL			
GLOBE VALVE	DN6 - DN50		API-602 PN16 A105 13CR SEAT STL SW BB,OS&Y HAND WHEEL			
	DN65 - DN300		ASME-B16.34 PN16 A395 13CR RF BB,OS&Y HAND WHEEL			
CHECK VALVE	DN6 - DN50		API-602 PN16 A105 13CR SEAT STL SW BC,LIFT			
	DN65 - DN300		ASME-B16.34 PN16 A395 13CR RF BC,SWING			
BALL VALVE	DN6 - DN100		ASME-B16.34 PN16 A105 AISI304 RF BALL LEVER. FULL BORE			
BUTTERFLY VALVE	DN50 - DN150		ASME-B16.34 PN16 A216-WCB 13CR EPDM RF WAFER WAFER LEVER.			
	DN50 - DN150		ASME-B16.34 PN16 A216-WCB 13CR EPDM RF WAFER WAFER AIR CYLINDER W/L.SWITCH			
	DN50 - DN150		ASME-B16.34 PN16 A216-WCB 13CR EPDM RF WAFER WAFER ELECTRIC MOTOR W/L.SWITCH			
	DN200 - DN300		ASME-B16.34 PN16 A216-WCB 13CR EPDM RF WAFER WAFER WHEEL WITH GEAR			
	DN200 - DN300		ASME-B16.34 PN16 A216-WCB 13CR EPDM RF WAFER WAFER AIR CYLINDER W/L.SWITCH			
	DN200 - DN300		ASME-B16.34 PN16 A216-WCB 13CR EPDM RF WAFER WAFER ELECTRIC MOTOR W/L.SWITCH			
GASKET	DN6 - DN150		V-6500 NON-ASBESTOS OR EQ. ASME150 1.5T FLAT RING			
	DN200 - DN300		V-6500 NON-ASBESTOS OR EQ. ASME150 3.0T FLAT RING			
BOLT & NUT	ALL SIZE		STUD U HEAVY NUT A307-GR.B/A563-GR.A FINISHED			

SECTION II

STANDARD TECHNICAL SPECIFICATION

1.0	STANDARD TECHNICAL REQUIREMENTS – EQUIPMENTS/ COMPONENTS OF GDWE
I	DESIGN CONSTRUCTION –VACUUM BELT FILTERS
1.	The vacuum belt filter shall be proven design in operation for similar capacities. The filter cloth shall be polyester or polypropylene as per the proven design of the supplier and shall be guaranteed for a minimum life of not less than 7000 hrs.
2.	The complete frame of the filter and all parts in contact with gypsum shall be made of corrosion resistant material.
3.	In case, the contractor offers a design with an underlying belt for carrying the filter cloth, the same shall be endless, factory vulcanized rubber belts. The belt shrouds and the sealing belts shall provide a leak tight arrangement to prevent overflow of gypsum slurry. The sealing belt shall have minimum life of not less than 7000 hrs.
4.	The vacuum box shall ensure tight sealing with the belt/cloth and shall be of proven design. The material of construction of the Vacuum Box shall be preferably UHMW-PE (Ultra High Molecular Weight – Poly Ethylene). Bidder may offer alternate material proven for the specified chloride content of the slurry.
5.	The belt filter shall have an automatic cloth tracking mechanism and shall be provided with all required instrumentation as per the supplier's proven practice. The belt filter shall have an automatic cloth tensioning mechanism.
6.	The filter shall be provided with minimum 2 stages of cake washing for removing impurities in the gypsum. One stage of cloth washing arrangement shall also be provided.
7.	The service factor of the gear unit (if any) shall be minimum 1.5.
8.	Piping and wiring within the skid should be in the vendor's scope.
9.	Nozzles and connections The suction and discharge pipes will be flanged and will have the same nominal test procedure as the body of the pump. Threaded connections are not admitted in these pipes.
10.	The flanges shall comply with the following standards: - Steel flanges as per ANSI B16.5 (raised face type, at least class 150) - Cast iron flanges as per ANSI 16.1 (flat face type, at least class 125) The pipe shall be designed according to API676 with regards to the force.
II	DESIGN AND CONSTRUCTION OF VACUUM PUMPS
	1) The mechanical vacuum pumps and accessories shall be used for continuous duty, to create and maintain vacuum by removing air and other non-condensable gases with associated water vapour, from the vacuum belt during gypsum dewatering operation. Final selection should consider compatible operation of the Gypsum Dewatering Equipment (GDWE) & pump over the full range of anticipated operation. 2) The pumps shall be of single stage or two stage liquid ring type with suitable compression ratio, to meet the all operating condition, ensuring no cavitation's under all operating conditions. Bidder shall indicate the arrangement being offered to avoid cavitation. 3) The pump shall be of liquid ring design with both the stages (if it is a two-stage pump) mounted on a common shaft. The unit shall require no external lubrication and shall not be damaged by slugs of water and entrained gases. 4) Each pump unit with the accessories shall be furnished as a package unit mounted on a common steel base plate.

	5) The pumps shall be connected to its motors by flexible couplings. All couplings shall have suitable rigid steel coupling guards having closed ends and anchored to the base plate. 6) The materials of construction of all the parts including all accessories shall be suitable to the fluids being handled/ used. 7) Impeller Tip speed to be kept in range of 13-22 m/sec. 8) Pipe fittings: not less than Schedule 40 **Material of Construction of Vacuum Pump:** MOC of vacuum pump shall be as below mentioned or better material: 1) Casting: ~ 2% Ni Cast Iron (GB 9439, HT 250)/ASTM A48, CLASS35 2) Shaft: Carbon Steel, En-8 or better 3) Impeller: Nodular Iron (ASTM A536, Gr.65-45-12) or better 4) Shaft Sleeve :(If applicable) Stainless Steel
b)	Shaft
	The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed. The shaft shall be ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibration and torques coming in during operation.
c)	Shaft Sleeves
	Renewable type fine finished shaft sleeves shall be provided at mechanical seals. Shaft sleeves shall be fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.
d)	Bearings
	Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble free operation shall be furnished. The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Antifriction bearings of standard type, if provided, shall be selected for a minimum life 20,000 hrs. of continuous operation at maximum axial and radial loads and rated speed. Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearings assembly. Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearings housing.
e)	Mechanical Seals
	Mechanical seals shall be of single type with either sliding gasket or bellows between the axially moving face and shaft sleeves or any other suitable type. The sealing faces should be highly lapped surfaces of materials known for their low frictional coefficient and resistance to corrosion against the liquid being pumped.
	The pump supplier shall coordinate with the seal maker in establishing the seal chamber of circulation rate for maintaining a stable film at the seal face. The seal piping system shall form an integral part of the pump assembly. For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating. Necessary provision for seal water supply along with complete piping fittings and valves as required shall form integral part of pump supply.
f)	Pump Shaft Motor Shaft Coupling

	The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guards shall also be provided.
g)	Base Plate
	A common base plate mounting both for the pump and motor shall be furnished. The base plate shall be fabricated steel and of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the piping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, internal differential thermal expansion and hydraulic piping thrust. Suitable drain troughs and drip lip shall be provided.
h)	Drive Motor (Prime Mover)
	The kW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified.
III	GYPSUM DISCHARGE CHUTE
a)	The minimum valley angle of chutes shall be 60 degrees at the feeding point to guide the material in the direction of belt travel. Transfer chutes shall be adequately sized and sloped to ensure smooth flow of Gypsum without any accumulation anywhere.
b)	Chutes shall be made of minimum 20 mm thick TISCRAL / SAILHARD/ LSLAS07 or equivalent material. All chutes should have one inspection door at every floor and for the ones in between the floors (more than 1.5 meter above the operating floor level) suitable access for trouble free maintenance shall be provided. For sealing of inspection doors labyrinth type arrangement to be provided.
c)	Complete chute work in the region of flap gates (if applicable) shall be fabricated from 20 thk TISCRAL or equivalent. In case of vertical chute (valley angle more than 80 degree) complete chute, work shall be of 20 mm thick TISCRAL or equivalent material. While finalizing the chute work inside the building, arrangement for shifting and replacing chute legs, proper handling arrangement/wall openings, trolleys, hoists shall also be provided. While fabricating the chute, no welds in between shall be allowed.
	One (1) no. chute blockage switch for each belt filter of proven type (subject to approval of the employer) shall be provided. Chute blockage switch shall trip the feeding conveyor in case of Chute blockage and protect the feeding conveyor equipment.
IV	PIPING
a)	The slurry pipes shall be sized to minimize erosion and avoid settling of the gypsum at all load operation. Slurry pipes shall be designed to keep the velocity above the settling velocity under all operating conditions. The bidder may provide a recirculation line with motorized isolation valve for the above purpose. All the pipes handling slurry shall be provided with replaceable rubber lining of proven quality. The slurry pipes shall be lined with replaceable wear resistant natural rubber lining of minimum 6 mm thickness. Additional thickness of 2 mm in rubber lining shall be provided at bends. The bidder can provide slurry pipes of size lower than 300 NB made up of FRP material (silicon carbide coating on slurry exposed surface) if it has previous experience of providing the same. Outer surface of the pipes should be fire retardant. All the rubber-lined pipes shall be of flanged connection.
b)	Valves shall be of proven type and type contractor shall submit details valve schedule for employer's approval. Reference list for previous installations for similar application shall also be furnished to the employer.
c)	The isolation valves provided in all the slurry lines shall be of knife gate type/butterfly type unless specifically mentioned. Motorized actuators shall be provided for valves requiring frequent operation as indicated in the relevant scheme.

d)	Necessary arrangements for purging & flushing of all the process pipelines, equipments etc. shall be required.
e)	Belt filter washing pumps shall have a minimum flow line to tank with a restriction orifice.
f)	All Lube oil, Instrument Air piping shall be made up of Gr.304 Stainless Steel material.
g)	All process water & Cooling water piping shall be made up of Carbon Steel Pressure Piping.
V	PROCESS/CLARIFIED WATER PUMPS
a)	The cake/cloth wash pumps shall be horizontal centrifugal type designed for continuous operation with semi-open or closed impeller. Casing, Gland and Stuffing Box shall be of 2.5 Ni Cast Iron to IS:210 Grade FG 260 or equivalent. Impeller, wearing rings (as applicable) shall be of Stainless Steel -316 grade and Shaft & Shaft sleeves shall be of SS-410 grade. Pump re-circulation line shall be provided for pumping system. Pumps shall be provided with accessories such as Y-type suction strainers, Coupling guard, drain plugs, vent valves etc. MOC of Filtrate Extraction Pumps as follows: a) Casing: 1. Ductile Iron (65-45-12, ASTM A536) with replaceable rubber liner- 14000 hours to be guaranteed. OR 2. Ductile Iron with Hi Chrome liner – 14000 hours to be guaranteed. OR 3.a) Hi Chrome (ASTM 532 Grade IIIA) - 24000 hours to be guaranteed. b) Impeller: Hi Chrome or superior material with 14000 hours guarantee. c) Solid Shaft: Duplex 2205 /EN8D /EN9 d) Shaft sleeve at mechanical seal: CD4MCU ASTM A 743/ Duplex 2205 e) Base Plate: Carbon steel with Epoxy Coating Bidder shall provide MOC of proven design to be approved during detailed engineering as per equipment/system/process requirement. The material and thickness of the liners shall ensure a minimum service life of 2 years before replacement.
VI	GENERAL
a)	Cake/Cloth Wash pump shall be 1500/3000 RPM. The Vacuum Pump is a low speed machine and the RPM shall be selected by the bidder meeting the equipment/ system requirement. Bidder to note that above shall be subject to BHEL/BHEL's Customer approval during contract stage.
b)	For gypsum, the bulk density shall be taken as 900 kg/m^3 for volumetric computation and 1250 kg/m^3 for torque and drive requirements. Refer respective P&IDs for Slurry details.
c)	The slurry pumps shall be provided with motorized/ pneumatic suction and discharge valves. In addition, flushing water lines with motorized valves shall be provided for each pump for automatic flushing of the pump after each shut down. The flushing water for the pumps shall be taken from the process water supply.
d)	The slurry pump casing should be radially split to allow easy removal of impeller.
e)	Customer approval shall be a requirement in case of difference of opinion.

ANNEXURE - 1

DRAWINGS / DOCUMENTS TO BE SUBMITTED WITH THE BID

Bidder should submit the filled up (wherever applicable), signed and stamped copy of the following documents along with the offer/ bid for technical evaluation:

Sl. No.	Reference	Description
1.	Annexure-2	COMPLIANCE CUM CONFIRMATION CERTIFICATE
2.	Annexure-3	PRE BID CLARIFICATION SCHEDULE
3.	Annexure-4	DEVIATION SHEET (COST OF WITHDRAWAL)
4.	Annexure-5	SCHEDULE OF GUARANTEES
5.	Annexure-6	LIST OF MAKES OF SUB-VENDOR ITEMS
6.	Annexure-7	LIST OF TOOLS & TACKLES
7.	Annexure-8	EQUIPMENT DATA SHEET / SCHEDULE (TO BE FILLED BY BIDDER)
8.	Annexure-9	LIST OF COMMISSIONING SPARES
9.		UNPRICED SCHEDULE IN THE PRICE FORMAT ISSUED ALONG WITH TENDER
10.		**FILLED UP GUARANTEED POWER CONSUMPTION FORMAT ISSUED ALONG WITH PRICE FORMAT IS REQUIRED TO BE NECESSARELY SUBMITTED ALONG WITH BID, FAILING WHICH BID SHALL BE LIABLE FOR REJECTION. VALUE FOR POWER CONSUMPTION QUOTED BY THE BIDDER IN THE SPECIFIED FORMAT, SHALL BE CONSIDERED AS FINAL AND ANY REQUEST BY BIDDER FOR ANY CHANGE IN QUOTED POWER CONSUMPTION AT LATER DATE, SHALL NOT BE CONSIDERED BY BHEL.**

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, if not sought/required for bid evaluation 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, the same shall be resolved by the bidder 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, the 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 are deemed to be included in the base price.

g) All sub-vendors shall be subject to BHEL / CUSTOMER approval in the event of order.

h) Guarantee/Warranty 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

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/documents/quality plans submission, comment incorporation & approval shall be as stipulated elsewhere in the specification. 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 tampered with this compliance-cum-confirmation certificate and if at any stage any tampering 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/installation manual for each of the equipment supplied under this contract as per the schedule of submission of documents and well before the scheduled erection of the equipment / component concerned.

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 shall 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.

ANNEXURE-3

PRE-BID CLARIFICATION SCHEDULE

S. NO.	SECTION/CLAUSE/PAGE NO.	STATEMENT OF THE REFERRED CLAUSE	CLARIFICATION REQUIRED

The bidder hereby clarifies that above mentioned are the only clarifications required on the technical specification for the subject package.

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal

DEVIATION SHEET (COST OF WITHDRAWAL)

(TO BE FILLED UP BY BIDDER IN THE FORMAT ATTACHED AS ANNEXURE –II OF GENERAL CONDITIONS OF CONTRACT ISSUED ALONG WITH TENDER. ANY DEVIATION QUOTED ELSEWHERE/ IN OTHER FORMAT SHALL NOT BE CONSIDERED)

SCHEDULE OF GUARANTEES

1.0 PERFORMANCE GUARANTEE

All performance tests for GDS shall be carried out in accordance with the relevant latest international codes/standards.

1) Bidder shall furnish Performance guarantee for the design, manufacture, material, safe and trouble-free operation of the Gypsum Dewatering EQUIPMENT (GDWE) and its accessories.

2) Bidder shall furnish guaranteed power consumption for the gypsum dewatering system. Guaranteed Power Consumption in the applicable format shall be submitted in sealed envelope along with price bid as part of techno-commercial offer. However along with unpriced format, bidder shall furnish guaranteed power consumption format indicating "Quoted" in the table provided in Annexure-IV of the price schedule.

3) Vendor shall Guarantee and demonstrate each Vacuum Belt Filter capacity of minimum 36.33 TPH wet gypsum cake with an inlet solid concentration of 45% by weight.

4) The contractor shall guarantee and demonstrate that gypsum cake moisture content shall not be more than 10% and chloride content shall not be more than 100 ppm. The filter cloth and sealing belt shall be guaranteed for a minimum life of not less than 7000 hrs.

5) The liners in hydro-cyclone shall have a minimum wear life of not less than 7000 hrs.

6) Noise level ≤85 dB (A) at 1 m horizontal distance from equipment/enclosures & 1.5 m above operating floor is to be guaranteed.

7) Vibration levels measured on the non-rotating parts shall not exceed the zone limit “B” as defined in ISO 10816 at steady conditions and shall not exceed the zone limit “C” as defined in ISO 10816 at transient conditions.

8) Acceptance tests to be carried out as per the procedure defined by the bidder which shall be submitted for BHEL/ NTPC approval.

9) In the event that the performance test is unsuccessful, bidder shall take necessary remedial action at his cost and the performance test shall be repeated.

Bidder shall submit signed & stamped copy of this document.

LIST OF MAKES OF ITEMS

S.N.	ITEM NAME	MANUFACTURER	LOCATION

LIST OF SPECIAL TOOLS & TACKLES

S.N.	ITEMS	QUANTITY

EQUIPMENT DATA SHEET/SCHEDULE

S.No.	Description		Data
1.0	**GENERAL**		
	a. Client	:	BHEL-PEM, Noida
	b. Project	:	2 X 500 MW NTPC SIPAT TPS, STAGE-II - FGD (LOT-6)
	c. End Customer	:	NTPC Limited
	d. Location	:	Bilaspur District of Chhattisgarh - INDIA.
	e. Service	:	Continuous
	f. Installation	:	Inside the Building
	g. Quantity for 2 FGD units	:	2 sets (1W+1S)
2.0	**MANUFACTURER DETAILS**		
	a. Model	:	Bidder to Provide
	b. Type	:	Bidder to Provide
3.0	**OPERATING CONDITION**		
	Medium to be handled	:	Gypsum Slurry
4.0	**Technical Data**		
4.1	**PRIMARY HYDRO-CYCLONE**		

	i. Stage	Bidder to Provide
	ii. Manufacturer	Bidder to Provide
	iii. Number of Hydro cyclone	Bidder to Provide
	iv. Diameter of Hydro cyclone	Bidder to Provide
	v. Diameter of Vortex Finder	Bidder to Provide
	vi. Diameter of Apex Valve	Bidder to Provide
	vii. Diameter of Feed Inlet	Bidder to Provide
	viii. Design Pressure	Bidder to Provide
	ix. Working Pressure	Bidder to Provide
	x. Feed Flow rate	Bidder to Provide

	xi. Overflow Rate	Bidder to Provide
	xii. Underflow Rate	Bidder to Provide
	xiii. Mesh of separation (50% Removed)	Bidder to Provide
	xiv. Solid content of feed slurry	Bidder to Provide
	xv. Solid content in underflow of Hydrocyclone	Bidder to Provide
	xvi. Solid content in Overflow of Hydrocyclone	Bidder to Provide
	xvii. Type of cyclone	Bidder to Provide
	a) Cyclone Dia/Height (mm)	Bidder to Provide
	b) Required Liquid Feed Pressure	Bidder to Provide
	c) Cyclone Connection Number/Dia. (mm)	Bidder to Provide
	d) Feed	Bidder to Provide
	e) Overflow	Bidder to Provide
	f) Underflow	Bidder to Provide
	g) Rf Value (Underflow Slurry (m3/hr/Feed Slurry (m3/hr))	Bidder to Provide
	h) Material	Bidder to Provide
	i) Shell	Bidder to Provide
	j) Internal Structure Part	Bidder to Provide
	k) Lining	Bidder to Provide
	l) Particle Size Distribution	Bidder to Provide
	m) Weight	Bidder to Provide

4.2	**VACUUM BELT FILTERS (VBF)**			
	a. Manufacturer		:	Bidder to Provide
	b. Model No.		:	Bidder to Provide
	c. Dimensions (W x L x H) (m x m x m)		:	Bidder to Provide
	d. Cloth Width	m	:	Bidder to Provide
	e. Cloth Length	m	:	Bidder to Provide
	f. No. Working / Stand-by		:	Bidder to Provide

	g. Capacity (Guaranteed) Kg/hr Gypsum (Dry) m3/kg Gypsum (Slurry)	: :	Bidder to Provide
	h. Inlet Flow Volume m3/h	: :	Bidder to Provide
	i. Gypsum Flow (Dry) Kg/hr	:	Bidder to Provide
	j. Moisture Removed %	:	Bidder to Provide
	k. No. of stages of cake washing / water flow m3/h	:	Bidder to Provide
	l. No. of stages of cloth washing / water flow m3/h	:	Bidder to Provide
	m. Design Pressure of Vacuum Chamber	:	Bidder to Provide
	n. Operating Pressure of Vacuum Chamber	:	Bidder to Provide
	o. Material / Thickness mm	:	Bidder to Provide
	i. Casing	:	Bidder to Provide
	ii. Cloth	:	Bidder to Provide
	iii. Gypsum Discharge Hopper	:	Bidder to Provide
	iv. Vacuum Box	:	Bidder to Provide
	p. Life of Cloth hrs	:	Bidder to Provide
	q. Type /Material of Carrying Belt	:	Bidder to Provide
	r. Type / Material of Sealing Belt	:	Bidder to Provide
	s. Life of Carrying Belt hrs		Bidder to Provide
	t. Life of Sealing Belt hrs		Bidder to Provide
	u. Automatic Cloth Tensioning Mechanism Provided		Yes / No - Bidder to confirm
4.3	**VACUUM RECEIVER TANK**		
a.	No. of Tank for each VBF	:	Bidder to Provide
b.	Capacity (m3)	:	Bidder to Provide
c.	Dimensions (Dia x Height) (mm x mm)	:	Bidder to Provide
d.	Material / Thickness (mm)	:	Bidder to Provide
e.	Lining Material / Thickness mm	:	Bidder to Provide
4.4	**Vacuum Pumps**		

a.	Manufacturer	:	Bidder to Provide
b.	Make/Model		
c.	Type	:	Bidder to Provide
d.	No. of Pumps for each Vacuum Belt Filter	:	Bidder to Provide
e.	Rated Capacity Flow (m^3/hr)	:	Bidder to Provide
	Rated Capacity Head (mWCl)	:	Bidder to Provide
	Rated Capacity Power (KW)	:	Bidder to Provide
f.	Power consumption (KW)	:	Bidder to Provide
g.	Pump Speed (rpm)	:	Bidder to Provide
h.	Motor Rating (KW)	:	Bidder to Provide
i.	Motor Speed (rpm)	:	Bidder to Provide
j.	Margins (Flow/Head) (%/%)	:	Bidder to Provide
k.	Operation Pressure	:	Bidder to Provide
l.	Design Pressure	:	Bidder to Provide
m.	Material/Thickness (mm) of	:	Bidder to Provide
	Base/Lining	:	Bidder to Provide
	Casing	:	Bidder to Provide
	Shaft	:	Bidder to Provide
	Impeller	:	Bidder to Provide
n.	Type of seal	:	Bidder to Provide
o.	Sealing Water Flow (m3/hr)	:	Bidder to Provide
p.	Bearing	:	Bidder to Provide
	No. of Bearings	:	Bidder to Provide
	Type Of Bearings	:	Bidder to Provide
q.	Type of coupling	:	Bidder to Provide
r.	Whether silencer provided at outlet	:	Yes/No
4.5	**SLURRY PIPES**	:	
a.	Pipe size (mm)	:	Bidder to Provide
b.	Type of Joints	:	Bidder to Provide
	Pipe to Pipe/Pipe to Fittings		Bidder to Provide

	Fittings		Bidder to Provide
c.	Material / Thickness (mm)of Pipe	:	Bidder to Provide
d.	Material Thickness of lining	:	Bidder to Provide
e.	Estimated Life of liners (hrs.)	:	Bidder to Provide
f.	Slurry Solid concentration (w/w %)	:	Bidder to Provide
g.	Slurry Settling Velocity (m/s)		Bidder to Provide
h.	Pipe Velocity (m/s)		Bidder to Provide
4.6	**BELT FILTER WASH PUMPS**		
a.	No. for each VBF		
b.	No. of stand-by pumps for each VBF		
c.	Make / Model		
d.	Impeller Type		
e.	Material / Thickness (mm) of Impeller and lining		
f.	Casing Type		
g.	Material/Thickness of Casing/Lining		
h.	Rated Flow/Head (m3/hr./mWCl)		
4.7	**CAKE WASH PUMPS**		
i.	No. for each VBF		
j.	No. of stand-by pumps for each VBF		
k.	Make / Model		
l.	Impeller Type		
m.	Material / Thickness (mm) of Impeller and lining		
n.	Casing Type		
o.	Material/Thickness of Casing/Lining		
p.	Rated Flow/Head (m3/hr./mWCl)		
4.8	**BELT ACCESSORIES**		
4.8.1	**Bearing**		
a.	Carrying	:	Bidder to Provide
b.	Return	:	Bidder to Provide

4.8.2	**Material**		
a.	Roller	:	Bidder to Provide
b.	Spindle	:	Bidder to Provide
4.8.3	**Pulleys**		
i)	General (for all types of Pulleys)	:	Bidder to Provide
a.	Pulley Shaft Diameter	:	Bidder to Provide
ii)	**Drive Pulleys**		
a.	Lagging	:	Bidder to Provide
b.	Lagging thickness	:	Bidder to Provide
c.	Minimum angle of wrap	:	Bidder to Provide
d.	Maximum out of roundness	:	Bidder to Provide
iii)	**Other Pulleys**		
a.	Lagging	:	Bidder to Provide
b.	Lagging thickness	:	Bidder to Provide
iv)	**Rubber for lagging**		
a.	Type	:	Bidder to Provide
b.	Hardness	:	Bidder to Provide
c.	Elongation	:	Bidder to Provide
d.	Strength	:	Bidder to Provide
e.	Abrasion Loss	:	Bidder to Provide
f.	Specific Gravity	:	Bidder to Provide
g.	Adhesion Strength	:	Bidder to Provide
v)	**Bearings for Pulleys**		
a.	Type	:	Bidder to Provide
b.	Casing	:	Bidder to Provide
c.	Sealing	:	Bidder to Provide
d.	Lubrication	:	Bidder to Provide
e.	Pulley Material	:	Bidder to Provide
f.	Shaft Material	:	Bidder to Provide
4.9	**Chutes and Hoppers**		

a.	Minimum Valley Angle	:	Bidder to Provide
b.	Material :	:	Bidder to Provide
	i) Chute work	:	Bidder to Provide
	ii) Sliding zones & adjacent sides	:	Bidder to Provide
	iii) No striking/ Non sliding zones	:	Bidder to Provide
	iv) Chute with valley angle 80 degree and above	:	Bidder to Provide
	v) In the zone of magnetic field	:	Bidder to Provide
	vi) In the zone of flap gates	:	Bidder to Provide
	vii) Discharge Hoods overhead pulleys	:	Bidder to Provide
c.	Inspection Doors	:	Bidder to Provide
d.	Chute Construction	:	Bidder to Provide
	i) Corners	:	Bidder to Provide
	ii) Joints Bolted	:	Bidder to Provide
	iii) Bolt size	:	Bidder to Provide
	iv) Bolts spacing	:	Bidder to Provide
	v) Fixing Arrangement	:	Bidder to Provide
4.9.1	**Skirt Boards**		
a.	Length	:	Bidder to Provide
b.	Height	:	Bidder to Provide
c.	Width Side plate Top cover	:	Bidder to Provide
4.9	**Secondary (Waste Water) Hydrocyclone**	:	Bidder to Provide
	i) Stage	:	Bidder to Provide
	ii) Manufacturer	:	Bidder to Provide
	iii) Number of Hydrocyclone	:	Bidder to Provide
	iv) Diameter of Hydrocyclone	:	Bidder to Provide
	v) Diameter of Vortex Finder	:	Bidder to Provide
	vi) Diameter of Apex Valve	:	Bidder to Provide
	vii) Diameter of Feed Inlet	:	Bidder to Provide
	viii) Design Pressure	:	Bidder to Provide

	ix) Working Pressure	:	Bidder to Provide
	x) Feed Flow rate	:	Bidder to Provide
	xi) Overflow Rate	:	Bidder to Provide
	xii) Underflow Rate	:	Bidder to Provide
	xiii) Mesh of separation (50% Removed)	:	Bidder to Provide
	xiv) Solid content of feed slurry	:	Bidder to Provide
	xv) Solid content in underflow of Hydro-cyclones	:	Bidder to Provide
	xvi) Solid content in Overflow of Hydro-cyclones	:	Bidder to Provide
	xvii) Type of cyclone	:	Bidder to Provide
	a. Cyclone Dia/Height (mm)	:	Bidder to Provide
	b. Required Liquid Feed Pressure	:	Bidder to Provide
	c. Cyclone Connection Number/Dia. (mm)	:	Bidder to Provide
	d. Feed	:	Bidder to Provide
	e. Overflow	:	Bidder to Provide
	f. Underflow	:	Bidder to Provide
	g. Rf Value (Underflow Slurry (m^3/hr/Feed Slurry (m^3/hr)	:	Bidder to Provide
	h. Material	:	Bidder to Provide
	i. Shell	:	Bidder to Provide
	j. Internal Structure Part	:	Bidder to Provide
	k. Lining	:	Bidder to Provide
	l. Particle Size Distribution	:	Bidder to Provide
	m. Weight	:	Bidder to Provide

LIST OF COMMISSIONING SPARES

S.N.	ITEMS	QUANTITY