NTPC LIMITED

3x800 MW PATRATU TPP PHASE-I

TECHNICAL SPECIFICATION

FOR

LIME FEEDING/DOSING SYSTEM

(WASTEWATER NEUTRALISATION SYSTEM FOR FGD)

SPECIFICATION NO.: PE-TS-434-571-A102

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

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION	SPECIFICATION No: PE-TS-434-571-A102
		SECTION
		REV. 00
		SHEET : 1 OF 1

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SECTION - I

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION INTENT OF SPECIFICATION	SPECIFICATION No: PE-TS-434-571-A102 SECTION : I Sub Section: A REV. 00 SHEET 1 OF 3

SECTION-I

SUB-SECTION-A

INTENT OF SPECIFICATION

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION INTENT OF SPECIFICATION	SPECIFICATION No: PE-TS-434-571-A102 SECTION : I Sub Section: A REV. 00 SHEET 2 OF 3

1.0 INTENT OF SPECIFICATION

1.1 The specification covers Supply part, Services part and supply of Mandatory spares. Scope of work 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, equipment supply, maintenance tools & tackles, fill of lubricants & consumables till handing over, 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 Lime feeding/dosing system (LDS) - Operation & Maintenance, Troubleshooting etc., training of customer at manufacturer's works (3 persons for 2 days including lodging and boarding) & handover in flawless condition of the package to the customer complete with all accessories for the total scope defined for lime dosing/feeding system as per BHEL NIT & tender technical specification, amendment & agreements till placement of order for Flue Gas Desulphurization (FGD) plant of **3x800 MW Patratu TPS, Ramgarh, Jharkhand** of M/s Patratu Vidyut Utpadan Nigam Limited (PVUNL), a Joint Venture amongst Govt. of Jharkhand, JUVNL, JBVNL and NTPC Ltd.

1.2 There are three (3) units of 800 MW (each) and each unit is envisaged with one (1) FGD system. Two (02) Sets of lime feeding / dosing system (1 working + 1 standby) common for all three units shall be provided. Bucket Elevator, 2-way Diverter Flap Gate, surge hopper vibrating feeders shall be 1 no. each and common for complete lime feeding / dosing system. Lime Dosing pumps after the neutralisation tanks shall be common (1 working + 1 standby). Supplier to read/refer P&ID/ technical specifications in conjunction with data sheets, as enclosed with the specifications.

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 (Supervision of E&C by supplier & E&C by BHEL), performance and guarantee/demonstration testing of **LIME FEEDING / DOSING SYSTEM.**

1.4 The Bidder shall offer only proven design, which meets the Provenness criteria indicated in the NIT. Necessary document 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.

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION INTENT OF SPECIFICATION	SPECIFICATION No: PE-TS-434-571-A102 SECTION : I Sub Section: A REV. 00 SHEET 3 OF 3

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 -II); 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).

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION PROJECT INFORMATION	SPECIFICATION No: PE-TS-434-571-A102 SECTION : I Sub Section : B REV. 00

SECTION: I

SUB-SECTION: B

PROJECT INFORMATION

CLAUSE NO.	PROJECT INFORMATION

PATRATU STPS EXPANSION PHASE-I (3X800 MW)

1.00.00 BACKGROUND

A Memorandum of Agreement (MOA) has been entered on 29.07.2015 amongst Govt. of Jharkhand (GoJ), Jharkhand Urja Vikash Nigam Limited (JUVNL), Jharkhand UrjaUtpadan Nigam Limited (JUUNL), Jharkhand BijliVitaran Nigam Limited (JBVNL) and NTPC Limited to form a Joint Venture Company of NTPC Limted& JBVNL for transfer of Patratu Thermal Power Station (PTPS) located in Ramgarh District of Jharkhand State to the proposed JV Company for Performance Improvement of existing capacity & 4000 MW Capacity expansion of PTPS.

Further to signing of JV agreement on 29.07.2015, a Joint Venture Company namely Patratu Vidyut Utpadan Nigam Limited (PVUNL) has been incorporated amongst GoJ, JUVNL, JBVNL and NTPC Ltd. on 15.10.2015. The Performance Improvement of existing capacity and 4000 MW Capacity expansion of Patratu STPS will be implemented by the JV Company (JVC). The configuration of expansion of 4000 MW shall consist of 5 units of 800 MW to be implemented in two phases; Phase-I: 3x800 MW and Phase-II: 2x800 MW.

The present proposal is for Patratu STPS Phase-I (3x800 MW). The project is envisaged to be commissioned during XIII Plan period.

2.00.00 CAPACITY

Patratu STPS Phase-I: 3x800 MW - Present proposal

3.00.00 MODE OF OPERATION

Base Load

4.00.00 LOCATION AND APPROACH

4.01.00 Patratu Thermal Power station (PTPS) is located just outside the coal belt of South Karanpura in Ramgarh District of Jharkhand State. The nearest Railway Station is Patratu which is at a distance of about 4 km on Barkakhana-Barwadih Railway line.

4.02.00 **The latitudes and longitudes of the site are as follows:**

Corner name	Latitude	Longitude
Top Corner	23° 38 ‘ 60 ‘’ N	85° 17’ 51.5” E
Bottom Corner	23° 38 ‘12.5 ‘’ N	85° 17’ 27” E
Left Corner	23° 38 ‘ 22.5 ‘’ N	85° 17’ 10.6 ‘’ E
Right Corner	23° 38 ‘ 40 ‘’ N	85° 17’ 57 ‘’ E

4.03.00 **Airport**

The nearest commercial airport is Ranchi at about 45 km by road.

CLAUSE NO.	PROJECT INFORMATION
	A copy of Vicinity plan of the project site is placed at **Annexure - I**.
5.00.00	**LAND**
	The total land to be transferred to JV Company is 1859 acres. Out of 1859 acre, about 1234 acres of land has been envisaged for Plant, Ash pond and Land on railway track of the for Phase-I (3x800 MW). The balance 625 acre of land shall be transferred during commencement of Phase-II (2x800 MW).
6.00.00	**WATER**
	The make-up water for PSTPS is to be met from Patratu Dam on Nalkari River (capacity 99 MCM i.e. 110 Cusecs). About 52.34 Cusecs of water will be available at 90% dependable monsoon flow after considering evaporation loss.
	GoJ/JUVNL owns and controls water of Patratu Dam. GoJ/JUUNL supplies water to PTPS and to the other entities in the vicinity from this water reservoir. JUVNL had entered into agreements with these other entities for supply of water from water reservoir. JUVNL shall revisit these agreements to meet the requirement of water for expansion projects, if required.
	Make up water requirement of PSTPS, Phase-I (3x800 MW) would be about 27 Cusecs with “Air Cooled Condenser” based power plant. GoJ shall provide the required water from the existing reservoir to the JV Company.
	The JVC shall be responsible for the water supply arrangement starting at the downstream of intake chamber from where water supply commences for the Station. Ownership of the entire water supply system and related plant and equipment, including the water treatment plant, shall be that of the JVC and after the asset transfer, the JVC shall maintain, take care and use the same. The additional facility including addition of plant, equipment etc. for enhanced requirement (if any) and drawl of water shall be the responsibility of JVC and to be arranged by the JVC at their own cost.

CLAUSE NO.	PROJECT INFORMATION
7.00.00	**COAL**
7.01.00	**Coal Requirement, Availability and Linkage** About 12 MTPA of coal will be required to meet coal requirement of the Phase-I (3x800 MW) of the project. The Banhardih captive coal block at a distance of about 155 km from plant is allocated to JUVNL for end use of Patratu expansion. The coal from Banhardih captive coal block shall be transferred to the JVC for the usage of PSTPS with the approval of Ministry of Coal, GOI. MOC (11.09.15) has accorded in-principle approval of the Central Govt. to assign Banhardih Coal Block allocated to JUVNL to the JV Company.
7.02.00	**Coal Transportation** The envisaged mode of coal transportation from the coal mines to the power plant is by Indian Railways through BOBR / BOX- N wagons.
7.03.00	**Coal Quality** The primary fuel for the main steam generator shall be coal. The domestic coal quality parameters are indicated in **Annexure-IV-2** and imported coal parameters are indicated in **Annexure-IV-4** are to be considered for steam generator design.
7.04.00	**Fuel Oil** The fuel oils to be used for start-up, coal flame stabilization and low load operation of the steam generator shall be Heavy Fuel Oils having the characteristics given at **Annexure-IV-3**and Light Diesel Oil having the characteristics given at **Annexure-IV-1.**
8.00.00	**NOT USED**
9.00.00	**STEAM GENERATOR TECHNOLOGY** The steam generators shall be super critical once through type, water tube, direct pulverized coal fired, top supported, balanced draft furnace, single reheat, radiant, dry bottom type, suitable for outdoor installation. The gas path arrangement shall be single pass (Tower type) or two pass type.
10.00.00	**FLUE GAS DESULPHURIZATION SYSTEM (FGD) &SCR:** The project is envisaged with Flue Gas Desulfurization (FGD) system and SCR meeting Ministry of Environment, Forest & Climate Change notification dated 07.12.2015. Limestone to be used for design of FGD system shall be as per the characteristic given at Annexure-IV-5.
11.00.00	**POWER EVACUATION SYSTEM** 85% of power from the project is envisaged to be allocated to Jharkhand State subject to approval of Ministry of Power, while balance 15% would be as unallocated portion and Project is envisaged as regional project. Since major power (85%) is proposed to be absorbed by Jharkhand, the issue of Associated Transmission

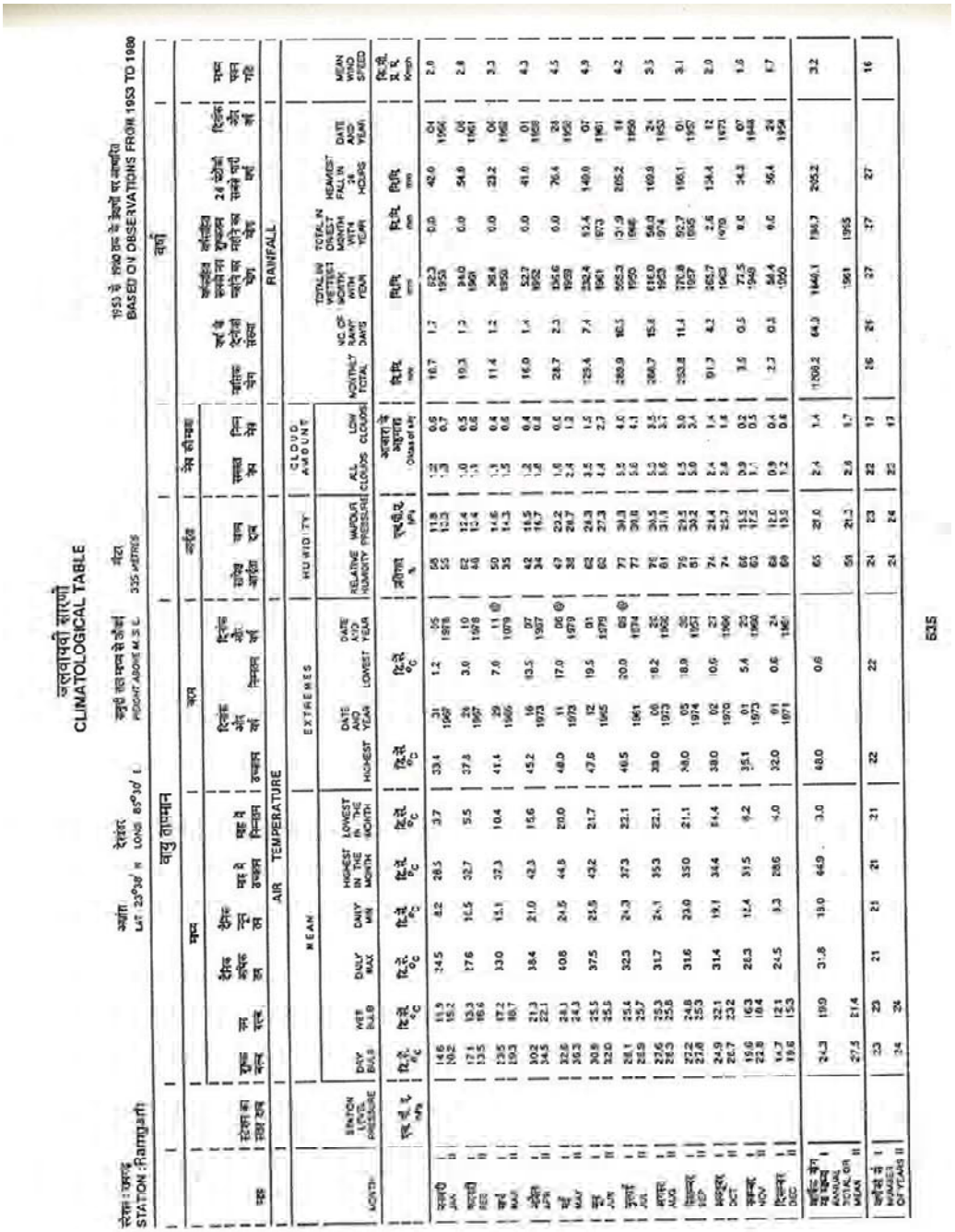
ANNEXURE-I


PROTECTED FOREST
DAMODAR RIVER
SANKU
EASTERN RAILWAY
Barwadih
Dhanbad Branch
Kirtpara
Sankul
RADIUS 10KM
Patratu
Saunda
Bhurkunda
ASH DYKE-II
PROPOSED PATRATU STPP
ASH DYKE-I
Jaynagar
Naikari Nadi
Belkydra
Nawatoli
Patelnagar
Kurse
Matkoma
Bhandra
GHAGHRA P F
HARIHARPUR P F
JARAD P F
LEM P F
RESERVOIR
Reservoir
PROTECTED FOREST
Uchringa
Labga
Amatolia
Gegda
Berghutuwa
Melani
Kanhatanr
Kagabera
Talapur
Sango

CLAUSE NO.	PROJECT INFORMATION	एनटीपीसी NTPC

ANNEXURE-II

C

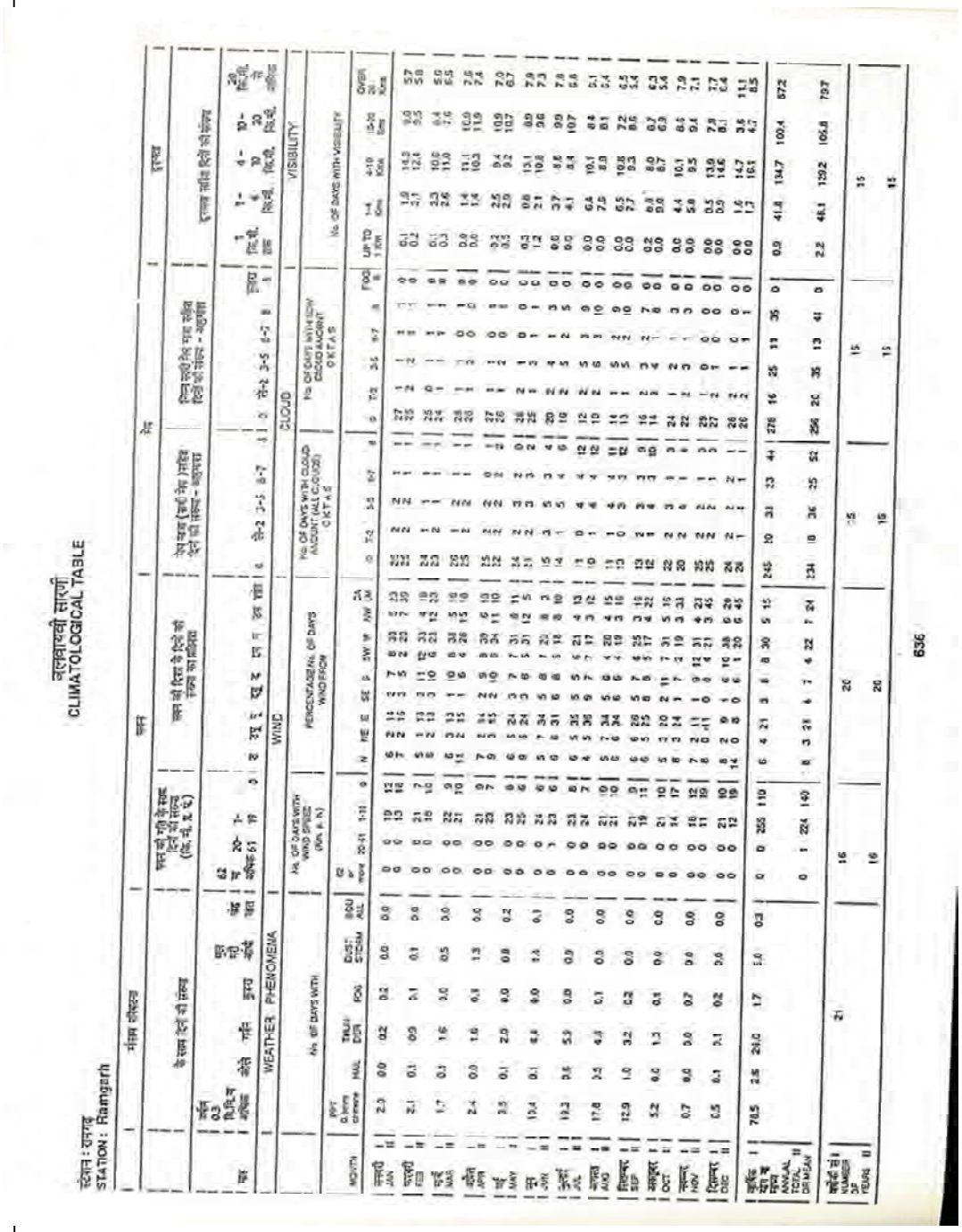


जलवायवी सारणी
CLIMATOLOGICAL TABLE

स्टेशन : रामगढ़ STATION : Ramgarh
अक्षांश LAT 23°39′ N देशांतर LONG 85°31′ E
ऊंचाई से ऊपर मापक से जोड़ा गया HEIGHT ABOVE M.S.L. 335 METRES
1953 से 1980 तक के वेधों पर आधारित BASED ON OBSERVATIONS FROM 1953 TO 1980

MONTH	STATION LEVEL PRESSURE	AIR TEMPERATURE: MEAN DRY BULB	MEAN WET BULB	MEAN DAILY MAX	MEAN DAILY MIN	HIGHEST IN THE MONTH	LOWEST IN THE MONTH	EXTREMES: HIGHEST	DATE AND YEAR	LOWEST	DATE AND YEAR	HUMIDITY: RELATIVE HUMIDITY	VAPOUR PRESSURE	CLOUD AMOUNT: ALL CLOUDS	LOW CLOUDS	RAINFALL: MONTHLY TOTAL	NO. OF WET DAYS	TOTAL IN WETTEST MONTH FROM YEAR	TOTAL IN DRIEST MONTH FROM YEAR	HEAVIEST FALL IN 24 HOURS	DATE AND YEAR	MEAN WIND SPEED
जनवरी JAN		14.6 10.2	11.9 8.2	24.5	8.2	28.5	3.7	33.4	31 1968	1.2	05 1978	58 55	11.8 10.3	1.3 0.7	0.5 0.3	16.7	1.7	52.3 1953	0.0	42.0	01 1956	2.0
फरवरी FEB		17.1 13.5	13.3 10.6	27.6	11.5	32.7	5.5	37.3	25 1967	3.0	10 1978	52 48	12.4 13.4	1.0 0.5	0.5 0.3	10.3	1.3	34.0 1961	0.0	34.0	04 1961	2.8
मार्च MAR		23.5 19.3	17.2 15.7	33.0	15.1	37.3	10.4	41.4	29 1965	7.0	11 @ 1979	50 55	14.6 14.3	0.4 0.5	0.4 0.3	11.4	1.2	36.4 1959	0.0	23.2	04 1965	3.3
अप्रैल APR		30.2 24.5	21.3 22.1	38.4	21.0	42.3	15.6	45.2	16 1973	13.5	07 1957	42 34	15.5 16.7	1.2 0.8	0.4 0.3	16.0	1.4	52.7 1962	0.0	41.0	01 1958	4.3
मई MAY		32.6 28.3	24.1 24.3	40.8	24.5	44.8	20.0	48.0	11 1973	17.0	06 @ 1979	47 38	23.2 23.7	1.6 1.3	0.5 0.4	28.7	2.3	136.6 1958	0.0	76.4	24 1958	4.5
जून JUN		30.8 32.0	25.5 25.5	37.5	25.8	43.2	21.7	47.8	12 1965	19.5	01 1979	82 82	24.3 27.3	3.5 4.4	1.5 2.3	125.4	7.4	252.4 1961	13.4 1973	148.0	07 1961	4.9
जुलाई JUL		28.1 28.9	25.4 25.7	32.3	24.3	37.3	22.1	46.5	1961	20.0	05 @ 1974	77 77	34.3 30.8	5.5 5.6	4.0 4.1	283.9	16.1	552.3 1926	31.9 1946	205.2	11 1958	4.2
अगस्त AUG		28.9 28.3	25.6 25.8	31.7	24.1	35.3	22.1	33.0	08 1973	18.2	22 1966	78 81	34.5 31.1	5.3 5.6	3.5 3.7	266.7	15.8	616.0 1926	54.0 1974	169.9	24 1955	3.3
सितम्बर SEP		27.2 27.8	24.8 25.3	31.6	23.0	35.0	21.1	34.0	05 1974	18.8	30 1951	79 81	33.5 33.2	5.0 5.4	3.0 3.4	253.8	11.4	770.8 1957	52.7 1995	166.1	01 1957	3.1
अक्टूबर OCT		24.9 26.7	22.1 23.2	31.4	19.1	34.4	14.4	38.0	02 1970	10.6	27 1966	74 74	21.4 23.3	2.4 2.6	1.4 1.5	91.3	4.2	352.7 1963	2.6 1970	134.4	12 1973	2.0
नवम्बर NOV		19.6 22.8	16.3 18.4	28.3	12.4	31.5	9.2	35.1	01 1973	5.4	23 1968	68 63	15.5 17.5	0.9 1.1	0.5 0.5	7.0	0.5	77.5 1948	0.0	34.3	07 1944	1.8
दिसम्बर DEC		14.7 19.6	12.1 15.3	24.5	8.3	28.6	4.0	32.0	01 1971	0.6	24 1967	69 69	12.0 15.0	0.4 0.8	0.4 0.6	2.3	0.3	34.4 1950	0.0	30.4	24 1959	1.7
वार्षिक योग ANNUAL TOTAL OR MEAN	I	24.3	19.9	31.8	18.0	44.9	3.0	48.0		0.6		65	25.0	2.4	1.4	1109.2	64.3	1441.1 1961	136.7	205.2		3.2
वर्षों की संख्या NUMBER OF YEARS	II	27.5	27.4					22		22		24	23	22	17	16	26	27	27	27		16
	I	23	23	21	21	21	21															
	II	24	24									24	24	22	17							

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जलवायवी सारणी
CLIMATOLOGICAL TABLE

स्टेशन : रामगढ़
STATION : Ramgarh

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Annexure-2

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:

a)	Steel structures	:	2%
b)	Reinforced Concrete structures	:	5%
c)	Reinforced Concrete Stacks	:	3%
d)	Steel stacks	:	2%

CLAUSE NO.	TECHNICAL REQUIREMENTS

ANNEXURE- (d)

CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT

All structures shall be designed for wind forces in accordance with IS 875 (Part-3) and as specified in this document. See Annexure – B for site specific information.

Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard.

Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method.

Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than “5” and/or if the fundamental frequency of the structure is less than 1 Hz.

Susceptibility of structures to across-wind forces, galloping, flutter, ovalling etc. should be examined and designed/detailed accordingly following the recommendations of IS 875(Part-3) and other relevant Indian standards.

It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects.

Damping in Structures

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

a) Welded steel structures : 1.0%

b) Bolted steel structures : 2.0%

c) Reinforced concrete structures : 1.6%

d) Steel stacks : As per IS 6533 & CICIND Model Code whichever is more critical.

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 metre above the mean ground level: 39 metre/second

b) The risk coefficient “K_1” : 1.06

c) Category of terrain : Category-2

Annexure-(E)

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):2002 and IS:1893 (Part 4):2005. Pending finalization of Parts 2, 3 and 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for structures other than the buildings and industrial structures including stack-like structures.

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 Annexure-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 Annexure-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 and 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 structures	Concrete	5 %
Reinforced Stacks	Concrete	3 %
Steel stacks		2 %

CLAUSE NO.	TECHNICAL REQUIREMENTS

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).

For buildings, if the design base shear (VB) obtained from modal combination is less than the base shear ($\overline{V}B$) computed using the approximate fundamental period (Ta) 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 $\overline{V}B$/ VB. However, no reduction is permitted if $\overline{V}B$ is less than VB.

For regular buildings less than 12m in height, design seismic base shear and its distribution to different floor levels along the height of the building may be carried out as specified under clause 7.5, 7.6 & 7.7 of IS:1893 (Part 1) and using site specific design acceleration spectra. The design horizontal acceleration spectrum value (Ah) shall be computed for the fundamental natural period as per clause 7.6 of IS:1893 (Part 1) using site specific spectral acceleration coefficients with appropriate multiplying factor given in Annexure-I. Further, the spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the building falls to the left of the peak in the spectral acceleration curve.

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.

SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT

CLAUSE NO.	TECHNICAL REQUIREMENTS

Annexure-(f)

QA REQUIREMENT

All Civil, Structural and Architectural construction work at the project shall be executed strictly in accordance with the Quality Assurance guidelines specified in separate part of this Specification.

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.

For regular buildings less than 12m in height, design seismic base shear and its distribution to different floor levels along the height of the building may be carried out as specified under clause 7.5, 7.6 & 7.7 of IS:1893 (Part 1) and using site specific design acceleration spectra. The design horizontal acceleration spectrum value (Ah) shall be computed for the fundamental natural period as per clause 7.6 of IS:1893 (Part 1) using site specific spectral acceleration coefficients with appropriate multiplying factor given in Appendix-I.

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.

APPENDIX – I

SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT

The various site specific seismic parameters for the project site shall be as follows:

1)	Peak ground horizontal acceleration (MCE)	: 0.41 g
2)	Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra	
a)	for ordinary moment resisting steel frames designed and detailed as per IS:800	: 0.103
b)	for braced steel frames designed and detailed as per IS:800	: 0.077
c)	For special moment resisting RC frames designed and detailed as per IS:456 and IS:13920	: 0.062
d)	for RCC chimney	: 0.205
e)	for liquid retaining tanks	: 0.123
f)	for steel chimney	: 0.154
g)	for design of structures not covered under 2 (a) to 2 (f) above and under 3 below	: 0.103
3)	Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted	: 0.205

Notes:
1. g = Acceleration due to gravity
2. For industrial structures, analysis for verification of mechanism shall be carried out as per IS:1893 (Part 4):2015

The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.

APPENDIX – I

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
(In units of 'g')

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
0	1.000	1.000	1.000
0.03	1.000	1.000	1.000
0.04	1.555	1.405	1.293
0.05	2.190	1.828	1.578
0.06	2.898	2.267	1.857
0.07	3.670	2.720	2.131
0.075	3.670	3.175	2.267
0.08	3.670	3.175	2.500
0.083	3.670	3.175	2.500
0.085	3.670	3.175	2.500
0.09	3.670	3.175	2.500
0.1	3.670	3.175	2.500
0.105	3.670	3.175	2.500
0.11	3.670	3.175	2.500
0.115	3.670	3.175	2.500
0.12	3.670	3.175	2.500
0.125	3.670	3.175	2.500
0.13	3.670	3.175	2.500
0.135	3.670	3.175	2.500
0.14	3.670	3.175	2.500
0.145	3.670	3.175	2.500
0.15	3.670	3.175	2.500
0.2	3.670	3.175	2.500
0.22	3.670	3.175	2.500
0.23	3.670	3.175	2.500
0.24	3.670	3.175	2.500
0.3	3.670	3.175	2.500
0.35	3.670	3.175	2.500
0.4	3.670	3.175	2.500
0.45	3.111	2.822	2.222
0.5	2.800	2.540	2.000
0.55	2.545	2.309	1.818
0.6	2.333	2.117	1.667
0.65	2.154	1.954	1.538
0.7	2.000	1.814	1.429
0.75	1.867	1.693	1.333
0.8	1.750	1.588	1.250
0.85	1.647	1.494	1.176
0.9	1.556	1.411	1.111
0.95	1.474	1.337	1.053
1	1.400	1.270	1.000

APPENDIX – I

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
(In units of 'g')

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
1.05	1.333	1.210	0.952
1.1	1.273	1.155	0.909
1.15	1.217	1.104	0.870
1.2	1.167	1.058	0.833
1.25	1.120	1.016	0.800
1.3	1.077	0.977	0.769
1.35	1.037	0.941	0.741
1.4	1.000	0.907	0.714
1.45	0.966	0.876	0.690
1.5	0.933	0.847	0.667
1.55	0.903	0.819	0.645
1.6	0.875	0.794	0.625
1.65	0.848	0.770	0.606
1.7	0.824	0.747	0.588
1.75	0.800	0.726	0.571
1.8	0.778	0.706	0.556
1.85	0.757	0.686	0.541
1.9	0.737	0.668	0.526
1.95	0.718	0.651	0.513
2	0.700	0.635	0.500
2.05	0.683	0.620	0.488
2.1	0.667	0.605	0.476
2.15	0.651	0.591	0.465
2.2	0.636	0.577	0.455
2.25	0.622	0.564	0.444
2.3	0.609	0.552	0.435
2.35	0.596	0.540	0.426
2.4	0.583	0.529	0.417
2.45	0.571	0.518	0.408
2.5	0.560	0.508	0.400
2.55	0.549	0.498	0.392
2.6	0.538	0.488	0.385
2.65	0.528	0.479	0.377
2.7	0.519	0.470	0.370
2.8	0.500	0.454	0.357
2.85	0.491	0.446	0.351
2.9	0.483	0.438	0.345
2.95	0.475	0.431	0.339
3	0.467	0.423	0.333
3.05	0.459	0.416	0.328
3.1	0.452	0.410	0.323
3.15	0.444	0.403	0.317

APPENDIX – I

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
(In units of 'g')

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
3.2	0.438	0.397	0.313
3.25	0.431	0.391	0.308
3.3	0.424	0.385	0.303
3.35	0.418	0.379	0.299
3.4	0.412	0.374	0.294
3.45	0.406	0.368	0.290
3.5	0.400	0.363	0.286

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION	SPECIFICATION No: PE-TS-434-571-A102
		SECTION : I
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		REV. 00

SECTION: I

SUB SECTION: C

TECHNICAL SPECIFICATION

	3x800 MW PATRATU TPP PHASE-I	SPECIFICATION No: PE-TS-434-571-A102
	LIME FEEDING / DOSING SYSTEM	SECTION : I
	TECHNICAL SPECIFICATION	SUB-SECTION : C1
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SECTION: I

SUB-SECTION: C 1

SPECIFIC TECHNICAL REQUIREMENT

1.0 SYSTEM DESCRIPTION

The purpose of the specification is to provide complete Lime feeding/dosing system (LDS) for use in waste water neutralization in Flue Gas Desulphurization (FGD) plant for PVUNL Patratu TPS 3x800 MW, under the scope of this tender.

Lime dosing system is provided to dose lime solution in wastewater tank of FGD system to increase pH from acidic zone to neutral (or slightly basic pH) (i.e. from 5.5 to 7.0) and after mixing of the effluent (using agitator/re-circulation system of the pumping system), the effluent shall be discharged once the waste water has been neutralized to desired pH. The lime dosing is envisaged to be done in wastewater tank continuously.

Lime powder is to be stored in sacks in storage area/room provided at the ground floor of Gypsum Dewatering Building. Lime powder is filled manually in surge hopper which shall feed lime to vibrating feeder/Bucket Elevator (Bucket conveyor). Bucket elevator discharges lime powder in each of the lime silos, from where the lime powder is fed to neutralisation tanks via outlet chutes/pipes using rotary feeders and screw conveyors provided at the bottom of lime silos. The lime is being dissolved in service water inside neutralization tanks with the help of the motorized agitators (provided in neutralization tanks). The dilute solution of lime prepared in neutralisation tank is then fed to the wastewater tank by means of lime slurry pumps (1W+1SB -common for LDS). The dosing is controlled as per requirements of desired pH in wastewater. (Tentative range of neutralization is from pH 5.5 to pH 7.0).

All piping, valves & instrumentation up to the employer's terminal point shall be in the supplier's scope. Supply of complete lime feeding & dosing system shall be in supplier's scope. The complete waste water neutralization system shall be automated and controlled from the control room (DCS control system-by BHEL).

2.0	TECHNICAL INFORMATION	
1.2.1	Quantity of Lime Feeding/Dosing System	Two (2x100%) Lots (one working +one standby), however Common Bucket Conveyor (1 no.) and (1W+1SB) dosing pumps for LDS
1.2.2	Quantity of water to be neutralized	330 m^3/hr.
1.2.3	Purity of Lime	83 %

3.0 SCOPE OF SUPPLY & SERVICES

The specification covers Supply part, Services part and supply of Mandatory spares. Scope of work 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, fill of lubricants & consumables till handing over, 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 Lime feeding/dosing system (LDS) - Operation & Maintenance, Troubleshooting etc., training of customer at manufacturer's works (3 persons for 2 days including lodging and boarding) & handover in flawless condition of the package to the customer complete with all accessories for the total scope defined for lime dosing/feeding system as per BHEL NIT.

Design: 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 PVUNL.

Supply: Includes manufacturing/fabrication, shop floor testing, stage inspections, final inspections, painting, packing & transportation, customer clearance/port clearance (as applicable) and any other statutory clearances and delivery at site.

Services: following services are included in vendor's scope-

1. Supervision of Erection and Commissioning of the complete Lime feeding/dosing system at project site is in bidder's scope. Detailed Erection and commissioning procedure, check list shall be submitted by successful bidder and same shall be followed by BHEL for erection and commissioning of the system at site.

2. Trial run at site and carrying out Performance guarantee tests at site & handover in flawless condition of the package to the customer.

3. Training of customer/ client O&M staff covering all aspects of the Lime Feeding/Dosing system - operation & maintenance, troubleshooting etc. at site.

4. Training of customer at manufacturer's works (3 persons for 2 days including lodging and boarding).

5. TA/DA, boarding and lodging of bidder's personnel shall be borne by the bidder and shall be inclusive in supervision portion.

6. During implementation of logic and FAT of BHEL DCS, bidder will depute his concerned representative for technical support as and when required by customer / BHEL.

7. Bidder to attend regular engineering meeting with BHEL and Customer fortnightly in BHEL or Customer office as decided during detail engineering. Vendor will depute his entire concerned engineering representatives along with the project manager for discussion and approval of engineering drawings/ documents during detailed engineering to meet project's various milestones and completion schedule, without any price implication to BHEL and Customer. Meeting can be held at site also.

8. Relevant requirements as per GTR, GCC, ECC & SCC etc.

Supplier's scope covers complete Lime Feeding/Dosing system including start-up spares and special tools as given below. Supplier to refer enclosed progressive `Layout Details of Gypsum Dewatering building' drg. No.- 9585-001-109-PVM-B-046. Supplier to note that Lime preparation/neutralisation tanks shall be placed on ground level. Slurry feeding/dosing pumps shall also be placed on ground level for further dosing lime to Waste Water Tank (00 HTM 05 BB 001)- refer `P & ID -Waste Water System' drg no.- 9585-001-109-PVM-F-014.

The scope of supply for complete Lime Feeding/Dosing system shall include but not limited to the following:

S.No.	Scope of work for Lime Dosing/Feeding system
1.	Entire Lime Feeding/Dosing System as per cloud marked portion of P&ID (drg no.- 9585-001-109-PVM-F-014, 2 sheets), Equipment Data sheet (Section-II, Annexure-8) & other Technical

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION SPECIFIC TECHNICAL REQUIREMENT	SPECIFICATION No: PE-TS-434-571-A102 SECTION : I SUB-SECTION : C1 REV. 00 SHEET 4 OF 18

S.No.	Scope of work for Lime Dosing/Feeding system
	Specification requirements enclosed with this specification.
2.	1- No. of Surge hopper shall be supplied (sloping portion lined with SS 304).
3.	1-No. of Vibrating feeder/feeding arrangement shall be supplied for feeding Lime from surge hopper to Bucket elevator.
4.	1-No of Continuous Discharge twin feed type Bucket Elevator(conveyor) shall be supplied with standard components like buckets(SS-304), belt, drive/tail pulleys with shaft & bearing assemblies, middle/top/bottom casings, take up unit, drive base frame, drive unit – geared motor, chain for final power transmission, zero speed switch, complete with 2-way (Motorised) Diverter Flap Gate along with all flanges/chutes, supporting steel structure, platforms, ladders, railings, and holdback as applicable along with all accessories and necessary hardware to handle/ discharge lime from ground level to Lime silo. Chute for feeding lime from bucket elevator to the lime silos shall be supplied.
5.	2- Nos of Lime Silos (MS with SS 304 lining on conical portion) complete with supporting steel structure, platforms, ladders, railings, level switches, air relief devices, etc. shall be supplied. Aeration pads/ flexible vibro pads/ electro-magnetic vibrators for conical portion of silo shall be supplied as per system requirement to ensure free flow of lime from silo to onward equipment.
6.	2-Nos. of self-cleaning bag filters system of suitable capacity along with blowers, automatic/on-load cleaning system, etc shall be supplied.
7.	2-Sets of flanges of 250 NB/suitable size along with all flanges/chutes, required arrangement for connecting silos outlet to inlet chutes of downstream equipment (Valves/ Rotary feeders / screw conveyors) shall be supplied.
8.	2-Nos. of Manual Knife Gates (KGV) shall be supplied for isolation purpose /control the feeding of lime from lime silos to downstream equipment.
9.	2-Nos. of Motorized Knife Gates (KGV) shall be supplied to control the feeding of lime from lime silos to screw conveyors
10.	2-Nos of Rotary vane feeders/ Rotary air lock feeders (MOC –Stainless Steel) along with gear boxes, motors, etc shall be supplied.
11.	2-Nos of Screw Conveyors shall be supplied. Screw conveyors shall be complete with screw flight with pipe, trough, end plates, inlet/outlet standard chutes, end shafts with bearings & plumber blocks, drive base frame, dust seals, drive geared motor, output coupling, zero speed switch and necessary hardware along with all accessories to handle/ discharge lime to neutralization.
12.	2-Nos of Neutralisation Tanks (MSRL) with SS dissolving baskets, Agitators of SS construction with motors, reduction gears and its mounting arrangement, drain, manholes, level transmitters, level gauges, etc shall be supplied.
13.	2-Nos Lime Slurry Pumps (1W+1S after Neutralisation tanks) shall be supplied.
14.	Process water piping from TP outside building to neutralisation tanks along with overflow and drain piping of tanks, back-flushing pipeline along with valves, fittings, etc shall be supplied.
15.	Lime slurry piping from Neutralization Tanks to feeding/dosing pumps inlet & from feeding/dosing pumps outlet to Waste water tank inlet along with re-circulation line with all required valves, fittings, etc shall form part of supply.
16.	All Interconnecting pipes/ ducts, valves and all chutes (inlet and discharge) for complete lime feeding system shall also be supplied.
17.	Painting and Rust Prevention during shipment and construction shall be ensured by bidder.
18.	Transportation of complete lime feeding/dosing system to site.

S.No.	Scope of work for Lime Dosing/Feeding system
19.	Special tools & tackles as applicable. These shall form the part of main supply (if applicable).
20.	Erection and start-up spare as applicable. These shall form the part of main supply (If applicable).
21.	Installation, operation and maintenance manuals.
22.	Bidder to quote for the Recommended Spare Parts (for 24 months operation) with break up price (shall not be part of evaluation/PO).
23.	All instruments as required for the complete lime dosing/feeding system shall be supplied.
24.	Inspection and testing at site.
25.	Any other items required for completeness of the equipment other than items covered in the exclusions.
26.	Mandatory spares as per attached list in specs at Section I-D-Annex II.
27.	Supervision of E &C, trial run at site and carrying out Performance guarantee tests at site, training of customer/ client O&M staff is also in bidder's scope.

4.0 BASIC DESIGN

This section covers the Design manufacturing and performance requirement of the Lime feeding/dosing system and accessories.

4.1 BUCKET ELEVATOR (CONVEYOR) SYSTEM (1-Set)

1 General Requirement

The type (Centrifugal/Continuous) of the Bucket Elevator shall be chosen by Bidder for the material and conditions specified. The Bucket Elevator shall be sized to handle the design capacity at the specified material bulk density & maximum material size. The equipment shall be complete with all necessary sub-systems and components and shall be designed and supplied in conformance with the attached datasheets, site conditions, specific Employer's requirements and applicable International, National, State and Local codes. The Equipment shall be complete in all aspects and all items required for erection/smooth operation shall be in Bidder's scope, unless otherwise noted in exclusions. Sizing of the equipment and components shall be the responsibility of the Bidder, based on the service conditions specified.

2 Codes and Standards

All design, fabrication, testing, supply and erection, if applicable, shall conform to the latest edition of all the relevant standards and regulations issued by the governing bodies. Bidder shall follow the applicable INDIAN/INTERNATIONAL codes by the following Organizations:

EN European Norm
IEC International Electro Technical Commission
ISO International Organization for Standardization
DIN German Institute for Standardization (To be used when no EN standards exist)

Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted. Nothing in this specification shall be construed to relieve the contractor of the required statutory responsibility. In case of any conflict in the standard and this specification, the decision of the Employer shall be final and binding.

3 Design Criteria

The equipment shall be designed for continuous twenty-four-hour service. The Equipment shall be designed for service in a heavy-duty industrial application, handling abrasive materials in a dusty environment. The Bucket Elevator should be sized to handle the design capacity as indicated on the Data Sheet with the minimum material bulk density and a maximum bucket filling of 75%.

4 Casing

Casing to be self-supported, dust-tight construction and capable of supporting head shaft, drive, and service platform. Head section is to be split and equipped with handles or lifting lugs for easy removal. Access and inspection doors are to be provided. Intermediate sections are to have a minimum plate thickness of 4 mm. Boot section to be fabricated of minimum 6 mm steel plate, with front and rear access panels. A beam is to be provided in casing for servicing internal gravity take-up. The beam may be located either in the boot section or intermediate section as applicable.

5 Buckets

Size, capacity and type of buckets and appropriate reinforcement necessary for the application shall be adequately sized. Provide pin holes in bottom of buckets for air relief, as necessary, when handling materials such as Lime. Bucket width is to be a minimum of four times the maximum particle size.

6 Belting

Belting shall be provided as specified elsewhere in the specification.

7 Pulley

Drive and guide pulleys shall be provided as specified elsewhere in the specification and shall be at least the minimum recommended for belt conveyor pulleys.

8 Head Shaft and Bearings

The bearings on head shaft to be antifriction type with one bearing fixed and the other expansion. All bearings are to have an L10 life of 60000 hours.

9 Foot Shaft and Bearings

The tail shaft is to be of hardened steel with tool steel sleeves operating in heat treated white iron bearings. All bearings are to have an L10 life of 60000 hours.

10 Take-up

Take-up shall be screw or internal gravity type with guide rails and weights included.

11 Drive

Bucket elevator drive should be sized as follows:
Minimum power for drive, either:
100% bucket filling @ minimum material bulk density, or
75% bucket filling @ maximum material bulk density, whichever is greater.

12 Inspection and Access Doors

Inspection doors and access doors shall be loose-hinged type with quick-opening jamb bar fasteners and gaskets enclosed and retained in the door. Access doors shall be 1.5m minimum.

13 Dust Vent

A dust collecting vent in the head section and boot section shall be furnished with drilled flanges. Bidder quote is to include recommended vent volumes for the boot and head sections of the elevator. The Pick-Up velocity shall not be greater than 2.5m/sec.

14 Drive Equipment

The Drive Equipment for Bucket Elevator shall be as specified elsewhere in the Specification.

4.2 SCREW CONVEYORS (2-Nos.)

1 Necessary overload protection guard for geared motor and drive chain to be provided.
2 Zero speed switch not required. However, speed sensing flag to be provided.
3 The motor and Gear reducer should be mounted such that there is not vibration during operation of the conveyor.
4 All fasteners shall be of Gr. 8.8 and reputed make.
5 The data as per Annexure-8 to be filled in by vendor (in the same format only).

4.3 LIME SILOS (2-Nos.)

Contractor shall provide 2x 100% Lime Storage Silos for feeding lime to the Lime Neutralisation tanks. The lime storage silo shall be of minimum 24 hr. capacity (refer tentative dimensions in data sheet & attached sketch) and shall be complete with supporting steel structure, platforms, railings, ladders, power operated outlet gates, level switches, air relief devices, etc. For dust free operation each silo should be provided with a covering arrangement and a self-cleaning bag filter system of suitable capacity along with blower, automatic/on-load cleaning system, 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.

4.4 NEUTRALISATION TANKS (2-Nos.)

Contractor shall provide 2x 100% Lime Neutralization tanks (dosing tanks) which shall be of minimum 8 hr. capacity (refer tentative dimensions in data sheet & attached layout) made of carbon steel with rubber lining.

Lime Neutralization tanks shall be designed, fabricated, erected and tested in accordance with the IS:803, latest edition. Additional Corrosion allowance of 3mm on the minimum tank shell thickness as calculated by IS:803, latest edition shall be provided by the Contractor. Tanks shall be made from IS:2062 quality mild steel plates of tested quality. The tanks shall be of welded construction. Interior surface of the tanks shall be lined with replaceable chlorobuty/bromobutyl rubber lining of minimum 5 mm thickness and the outside surface shall be coated with paint as approved by the Employer. The tanks shall be provided with SS dissolving basket, Agitator of SS construction with motor, reduction gear and its mounting arrangement, drain, manholes, over flow & inlet level control valves, level transmitters, level gauges, etc. Coarse-

screen(s) at suction-side of the lime dosing pumps (pumps installed after the neutralisation tank shall be provided.

4.5 AGITATORS (2-Nos., 1 in each Neutralisation Tank)

Agitators shall be supplied in neutralisation tanks to prevent caking and settlement of particles out of the lime slurry. Agitators shall be designed for continuous operation unless otherwise specified. Vertical agitators shall be used in Neutralisation tank. The design of the agitators shall be of proven type.

Standard type agitators with suitable characteristics shall be used wherever practical. The agitators shall be complete with motor, gearbox, agitator shaft, coupling, safety guards, mechanical seal, impeller, support legs, agitator mounting flange including bolts nuts and gasket etc.

All agitator parts and accessories in contact with the stirred fluid shall be constructed of materials specifically designed for the conditions and nature of the stirred fluid and be resistant to erosion and corrosion. The material for the shaft and agitator blades shall be in accordance with Alloy 926 or better. This does not release the Contractor of the responsibility for selecting the correct materials. Each agitator and its associated equipment shall be arranged in such a manner as to permit easy access for operation, maintenance and agitator removal without interrupting plant operation.

To prevent mechanical blocking load start-up after standstill of pumps, piping and agitators for slurries shall be applied with C-hose connection. Lifting lugs and eyes and other special tackle shall be provided as necessary to permit easy handling of the agitators and their components.
Static and dynamic (as far as applicable) balancing of all agitators shall be carried out after assembly.

All agitator parts and components shall be designed and calculated for fatigue life, considering maximum bending loads, induced by fluctuating hydraulic forces and torsional loads, based on the installed motor power. All exposed moving parts shall be covered by guards.

The shape of the impeller blades of agitators shall be designed to avoid wear on the impellers which will affect the agitator performance as specified for a minimum period of 2 years of continuous operation under design conditions for the range of application specified in the specification. In order to avoid excessive wear impeller tip speeds must not exceed 12 m/s. Belt drives (if applied) shall be properly designed to provide a minimum lifetime of 2 years under design conditions. Detailed calculation is to be submitted by bidder in support of selected rpm of agitator.

4.6 LIME FEEDING/DOSING PUMPS (2-Nos.)

The Contractor shall offer only proven design lime feeding/dosing pumps which were in successful operation in similar application at previous installations. The design, manufacture, installation and testing of the pumps shall follow the latest applicable Indian / International (ASME / EN / Japanese) Standards.
The pumps shall be designed for continuous operation. The pump shall be capable of delivering the rated flow at rated head with margins.

All the slurry pumps shall be provided with motorized 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 form the process water supply. The pump casing should be radially split to allow easy removal of impeller.

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.

The material and thickness of the liners 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 hrs. The design of the shaft shall ensure that the operating speed is at least 20% above the critical speed of the shaft. The pump shall be provided with seals of proven type and shall be designed for minimization of seal water consumption (if/as applicable). The shaft shall be supported on heavy duty ball/roller bearings.

4.7 LIME SLURRY LINES, VALVES & INSTRUMENTS

Lime slurry pipes shall be designed to keep the velocity above the settling velocity under all operating conditions. The contractor 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 Contractor can provide slurry pipes of size lower than 3” made up of abrasion resistant FRP material (silicon carbide coating on slurry exposed surface) if it has previous experience of providing the same.

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. The valves shall be of proven type and the contractor shall submit a detailed valve schedule for employer’s approval. Reference list for previous installations for similar application shall also be furnished to the employer. Bidder shall provide all necessary arrangements for purging & flushing of all the process pipelines, equipment etc.

4.7.1 PIPING, VALVES AND ACCESSORIES: Complete engineering and supply of interconnected piping (slurry, air and water pipes) along with valves, rubber lining (wherever applicable), supports, gaskets, fasteners and accessories which is integral to Lime feeding/dosing system (LDS) – One (1) set* which is broadly defined below:

a. Service water piping from service water line taping to Neutralization Tank inlet.
b. Slurry piping from Neutralization Tank to Waste water tank
c. Process water piping from TP outside building to wash tanks along with overflow and drain piping of tanks.
d. Instrument air piping from TP outside building up to equipment related to the system

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

4.7.2 Instruments for the entire Lime feeding/dosing system including integral piping as defined at 4.7.1 above (minimum requirement for each Lime feeding/dosing system is given in the P&ID): One (1) set*

4.7.3 SCOPE OF SUPPLY (ELECTRICAL): For Electrical scope, refer Electrical specification (Sub-section- C3 of Section-I) in conjunction with cloud marked portion of P&ID (drg no.- 9585-001-109-PVM-B-001, 3 sheets)

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

4.7.4 SCOPE OF SUPPLY (C&I): For Control & Instrumentation (C&I) scope, refer C&I specification (Sub-section- C4 of Section-I) in conjunction with cloud marked portion of P&ID (drg no.- 9585-001-109-PVM-B-001, 3 sheets)

4.7.4.1 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/ cabinet.

4.7.5 Electric and C&I common equipment including but not limited to

i. Local control panel, if required
ii. LT Motors
iii. Junction Box
iv. Instruments
v. Push buttons

4.7.6 First fill lubricants: 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.

4.7.7 Painting and rust prevention during shipment and construction.

4.7.8 Packing & forwarding to project site. Refer project information specified elsewhere in the specification.

4.8 APPROACH AND HANDLING FACILITIES

Proper approach shall be provided for access to all equipment during normal operation and maintenance. Equipment 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 5m height from the nearest platform. Below this height a vertical ladder with minimum clear

width of 600 mm may also be acceptable. Platform with a minimum clear width of 1000 mm shall be provided all around the lowest absorber spray levels and mist eliminators. Similar platforms shall be provided at subsequent elevations if they are more than 3000 mm apart from each other. An adequately sized manhole with platform (min. 2 sq. m) shall be provided above each spray level. Ladders/staircase shall be provided for the access to the platform. A 1500 mm space shall be provided around all pumps. Minimum Headroom (free height) under all floors, ducts, walkways and stairs shall be 2.50 M.

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

4.10 Recommended spare parts list to be furnished (is not part of scope of supply/evaluation).

4.11 Any other items required not covered above but required for the completeness of the system; same 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.

***One set means complete requirement for lime feeding/dosing system.**

5.0	**TERMINAL POINTS**
5.1	Process water & instrument air will be provided at one location, located at 5 m from building boundary. Further piping from terminal point to LDS system utilities are in bidder's scope.
5.2	Inlet at Lime feeding surge hopper.
5.3	Lime dosing inlet flange of waste water tank.
6.0	**EXCLUSIONS**
6.1	Waste water tank and all other items which are outside cloud marked portion of P&ID (drg no.-9585-001-109-PVM-F-014, 2 sheets)
6.2	All civil construction.
6.3	Ventilation & lighting in area/building.
6.4	Other exclusions control system and as mentioned in Electrical & C&I parts of this specification.
6.5	Process water, Instrument Air, Service Air upto terminal points.
6.6	Monorail beams for electrical hoists

7.0 CODES & STANDARDS AND OTHER REQUIREMENTS

The design of Lime Feeding system shall conform to the latest edition of International codes accepted by the Buyer according to good engineering practice.

List of codes/standards recommended: (The list is not exhaustive)

S.No.	Description	Material	Design & others
1	Piping	AISI, ASTM, ASME, DIN, EN, BS or Equivalent	AFNOR, ANSI, API, ASME, ASTM, AWWA, BS, DIN, EN, EJMA
2	Machinery	AISI, ASTM, ASME, DIN, EN, BS or Equivalent	AFNOR, AFBMA, AGMA, ANSI, API, ASTM, AWS, BS, DIN, IEC, HI, HEI, ISO, NEC, NEMA, EN, TEMA, VDI
3	Instrumentation	AISI, ASTM, ASME, DIN, EN, BS	AFNOR, ANSI, API, ASME, BS, DIN, EN,

		or Equivalent	IEC, IEEE, ISA, ISO, NC
4	Electrical	AISI, ASTM, ASME, DIN, EN, BS or Equivalent	BS, VDE, IEC, EN, ANSI, IEEE, NEMA
5	Civil	AISI, ASTM, ASME, DIN, EN, BS or Equivalent	AFNOR, ASCE, ASNT, BS, DIN, EN, ANSI, ACI, AISC, AWS, SSPC
6	Structural Steel	SA/IS2062	BS/EN 1993 (Eurocode-3) or Equivalent international codes.

The design, materials, construction, manufacture, inspection, testing and performance of Lime Feeding system shall also comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed. It is the supplier's responsibility to fully comply with the latest version of changes in regulations, codes and standards.GB Standards are not acceptable.

If there is a conflict between this specification and a referenced document or between the codes and standards the most stringent shall apply.

7.1 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) PVUNL Safety Rules for Construction and Erection
(u) PVUNL Safety Policy
(v) Any other statutory codes / standards / regulations, as may be applicable.

7.2 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

7.3 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.

7.4 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.

7.5 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.

7.6 All items of equipment shall comply with the stipulations of Inspectorate of Factories and other statutory bodies of Government of India and Chief Electrical Inspectorate of the State in which the plant site is located, wherever applicable. Wherever required, the successful bidder has to obtain the necessary approvals from statutory authorities and other concerned agencies. All cost on these accounts shall be borne by the successful Bidder.

8.0 COMMON REQUIREMENTS FOR PUMPS

(a) 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.

(b) The pump shall be provided with seals of proven type. The shaft shall be supported on heavy-duty ball/roller bearings.

(c) 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.

(d) 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.

(e) 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.

(f) 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.

(g) 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.

(h) Pumps shall have stable head-capacity characteristics curve from run-off to shut-off. Shut-off head should be minimum 125% of Best Efficiency Point (BEP).

(i) 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.

(j) External flushing is required to remove the accumulated particles and all related information should be mentioned in datasheet.

(k) 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.

(l) In case rubber or nonmetallic linings are used, these will be two pieces molded under pressure and adjusted to the screwed metallic clamping which have been welded to the casting.

(m) 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.

(n) 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.

(o) 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.

(p) Pump induced vibration due to flow pulsations shall be avoided through suitable design.

(q) 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).

(r) All the wear parts of the pump shall be guaranteed for a minimum wear life of not less than 25000 hours.

(s) 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.

(t) 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.

(u) 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.

(v) 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. Even if Motor is excluded from their scope, necessary fastener for motor foot with base plate will remain in pump scope of supply in order to avoid any problem.

(w) Limit of connection: The buyer (BHEL) has an intention to minimize interface for utilities as much as possible. The bidder shall consider this requirement in the planning stage of layout for the equipment. The bidder shall provide the header piping for utilities.

(x) 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.

(y) Rotation arrows shall be cast in or attached with stainless steel plate on each item of rotation equipment at a readily visible location.

(z) 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.

(aa) Skid Mount/Transportation: Equipment shall be fabricated as skid mount design as much as practical to minimize erection at the site.

(bb) 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.

(cc) Provide double nuts for anchor bolts.

(dd) Bidder shall provide allowable vibration level on foundation in foundation drawings and/or general arrangement drawings.

(ee) 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.

(ff) Bidder shall provide the mating flanges with the necessary gaskets.

(gg) 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.

(hh) Bidder to provide capacity of crane or hoist required for safe material handling and the details of heaviest component to be handled.

(ii) 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.

9.0	PROCESS WATER CHARACTERISTICS		
S.No.	**Constituents**	**Unit**	**Water quality**
1.	Calcium as $CaCo_3$	ppm	145.5
2.	Magnesium as $CaCo_3$	ppm	81
3.	Sodium as $CaCo_3$	ppm	70
4.	Potassium as $CaCo_3$	ppm	7
5.	Iron as Fe	ppm	0.3
6.	Total alkalinity as $CaCo_3$	ppm	187.6
7.	Chlorides as $CaCo_3$	ppm	62.3
8.	Sulphate as $CaCo_3$	ppm	54.5
9.	pH		7.0 – 8.2
10.	Turbidity	NTU	<5
Note: Process water will be used preparation of Lime solution in neutralisation tank before dosing.			

10.0	**SPARES, TOOLS & TACKLES**
10.1	**START UP & COMMISSIONING SPARES**
	Start-up & Commissioning Spares shall be part of the main supply of the Lime feeding/Dosing system. 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 Lime feeding/Dosing 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.
10.2	**MANDATORY SPARES**
	a) The list of mandatory spares considered essential by the BHEL's Customer/Employer (PVUNL) 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. 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 prices of mandatory spares indicated by the Bidder in the Bid Proposal sheets shall be used for bid evaluation purposes. e) All mandatory spares shall be delivered at site at least two months before scheduled date of initial operation of the first unit. Bidder to provide the split-up price for mandatory spares during placement of order as per price format.
10.3	**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 and total prices. 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. 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 Bidder shall be liable to provide necessary justification for the quoted prices for these spares as desired by the Employer.
10.4	**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.

10.5	**FIRST FILL OF CONSUMABLES**
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.
2	Bidder shall also supply a quantity not less than 10% of the full charge 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.
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 PVUNL/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.

11.0 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.

12.0 PAINTS / PAINTING

Bidder shall follow BHEL/ PVUNL painting philosophy specified Sub-Section- C2-B Section-I in the specification. However, for components where no specific requirement is stipulated, the bidder shall follow its standard practice.

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION PROJECT SPECIFIC GENERAL REQUIREMENTS	SPECIFICATION No: PE-TS-434-571-A102 SECTION : I SUB-SECTION : C 2A REV. 00

SECTION: I

SUB-SECTION: C 2

CUSTOMER SPECIFICATIONS
PROJECT SPECIFIC GENERAL REQUIREMENTS

SECTION-I
SUB-SECTION-C2-A

GENERAL TECHNICAL REQUIREMENTS

NOT-APPLICABLE PORTION REMOVED FROM GTR

GENERAL TECHNICAL REQUIREMENTS

PART - C

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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 coordinated 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.

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8.00.00	**DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR**
8.01.00	Bidders may note that this is a turnkey contract. 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 and power systems, control & instrumentation, civil & structural works. 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) Water Balance diagram.

viii) Operation Philosophy and the control philosophy of the Main Plant and other plants.

ix) General Layout plan of the power station 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, transformer yard, switchyard 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 station.

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) Start up curves for boiler and both turbines and boiler combined together as a unit for various start ups, viz. cold, warm and hot start up.

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, BFPs, CEPs, Heaters/ Deaerators, Condensers, vacuum pumps etc.

ix) Boiler pressure part schedule and sizing calculations. Boiler performance data and boiler design dossier.

x) Transient, hydraulic and thermal stress analysis of piping and system wherever applicable & input and output data alongwith stress analysis isometrics showing nodes..

xi) Thermal cycle information (heat balance diagrams, boiler performance calculations, condenser and heat exchanger thermal calculations etc.).

xii) Characteristic Curves/ Performance Correction Curves. Hydraulic & Mechanical design calculations for condensers & heaters.

xiii) 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.

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

xv) Protection system diagrams and relay settings.

xvi) Cables schedules and interconnection diagrams.

xvii) Cable routing plan.

xviii) Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, 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 and power system stability study report.

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

xxiii) Detailed DDCMIS system manuals.

xxiv) Detailed flow chart for digital control system.

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

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.

The Contractor's while sumitting 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 submit to the Employer, draft Instruction Manuals for all the equipments covered under the Contract by the end of one year from the date of his acceptance of the Letter of Award. 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. (The 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.

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	(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 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 Main Power Block area, covering Transformer Yard, TG building (including all facilities), Boiler area, ESP area, chimney area and any other facility located in Main Plant Block area 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.

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.

Contractor shall prepare and provide 3D design review model (network ready, 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 and shall make a presentation of the same every 3 months from LOA to enable NTPC to review the progress of engineering or as & when required by employer.

After the completion of engineering of respective area i.e. TG building/ Boiler/ ESP etc., the corresponding complete 3D review model shall be handed over to the employer for its reference.

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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 turnkey 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.

8.04.00 **ENGINEERING INFORMATION SUBMISSION SCHEDULE**

Prior to the award of Contract, a Detailed Engineering Information Submission Schedule 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 categorised 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.

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8.05.00	**Engineering Co-ordination Procedure**
8.05.01	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 :
8.05.02	All engineering correspondence shall be in the name of above coordinators on behalf of the respective organizations.
8.05.03	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.

8.06.00 **ENGINEERING PROGRESS AND EXCEPTION REPORT**

8.06.01 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.

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8.06.02	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.
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.

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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 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.
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.
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.
16.07.00	Safety and relief valves shall be provided with the following: a) Manufacturer's identification.

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	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. 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**

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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. 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.

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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.

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	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

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	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 despatched from the manufacturer's works before the same is accepted, subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC).
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	All brazers, welders and welding operators employed on any part of the contract either in Contractor's/sub-contractor's works or at site or elsewhere shall be qualified

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	as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer..
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 shall be as per relevant code. 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). 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.
22.18.00	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** All solid state electronic system / equipment / sub assembly shall be free from infant mortile components. For establishing the compliance to this requirement, the

contractor / sub – contractor should meet the following.

1) The Contractor / Sub – contractor shall furnish the established procedure being followed for eliminating infant mortile components. The procedure followed by the Contractor / Sub – contractor should be substantiated along with the statistical figures to validate the procedure being followed. The necessary details as required under this clause shall be furnished at the stage of QP finalization.

Or

In case the Contractor / Sub – contractor do not have any established procedure to eliminate infant mortile components then two or 10% whichever is less, most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure.

Elevated Temperature Test Cycle

During the elevated temperature test which shall be for 48 hours, the ambient temperature shall be maintained at 50° C. The equipment shall be interconnected with devices and kept under energized conditions so as to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service.

During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature at 50° C.

In case of any failure during the test cycle, the further course of action should be mutually discussed for demonstrating the intent of the above requirement.

2) **Burn in Test Cycle**

The test shall be conducted on all the panels fully assembled and wired including the panels having undergone the above mentioned elevated temperature test.

The period of Burn in Test Cycle shall be 120 hrs and process shall be similar to the elevated temperature test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

During the above tests, the process I/O and other load on the system shall

	be simulated by simulated inputs and in the case of control systems; the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable. During the Burn in Test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature.
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.
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 despatch. 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 despatch / 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 despatch, 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 despatch of equipment.

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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.

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
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 fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.
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 9.05.03- 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	**TESTING OF MAJOR DESIGN FEATURES:**
	The major design features of the system shall be demonstrated by the Contractor at the Contractor's works or any other place mutually agreed within Six months from the date of LOA. These are the system function tests, which have a major impact on the detailed system design & finalization of important engineering documents like

configuration, functional grouping, BOM etc., but do not require a fully engineered system for conductance. Bidder shall identify these features & include detailed test procedures in the bid, which shall be finalized during discussions with the bidder before award. The developments and any augmentation of standard features undertaken by the Bidder to fulfill the various specification requirements, shall be also be tested during these major design tests. This shall include but not be limited to the following.

a) System accuracy tests of DDCMIS for the various type of inputs identified in Part-B.

b) Loop reaction time for sample loops/ logics.

c) SOE functionality tests.

d) Server changeover.

e) Various response times, having serious implication on operation & maintenance philosophy.

f) Duty cycle of controller/ HMIPIS with simulated load, representative of the final engineered load.

g) Unified HMI for DDCMIS.

The results of the above tests, after its acceptance by the Employer, shall be properly documented and submitted to Employer.

If any of the envisaged tests have been carried out by Bidder in a previous NTPC project, then the same need not be specifically conducted by the Bidder for this project, provided it is clearly established by the Bidder & accepted by the Employer that there is no difference between the system offered for this project & the previous NTPC project with respect to the test. However, even in such a case, test report of the previous project shall be submitted by the Bidder as a part of MDFT (Major Design Feature Test) test report.

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.

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
	i) Safety valves and associated vent pipes for which it shall not exceed 105 dBA-115 dBA. ii) Regulating drain valves in which case it shall be limited to 90 dBA-115 dBA. iii) Mill noise which will be limited to 85-90 dBA. iv) TG unit in which case it shall not exceed 90 dBA. v) For HP-LP bypass valves and other intermittantly operating control valves, the noise level shall be within the limit of 90 dBA. vi) For BFP Motor Noise level shall be with in the limit of 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.

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS

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. 15 deg.C
9. Density	-	Grams per cubic centimetre.

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).

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
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

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
	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 DDCMIS 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 Associa-tion 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 determin-ation of thermal	DIN 52612 (Deutscher Normenausschuss)

		conductivity of thermal insulation materials (two slab guarded hot plate method)	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 monocry-stallines 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.

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	Design and construction of buried thin-wall pipes.
Publication	

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.

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

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS (Annexure-VI)

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

SECTION-I
SUB-SECTION-C2-B

FUNCTIONAL GUARANTEES

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

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

The term “BMCR” (Boiler Maximum Continuous Rating) appearing in the Technical Specification shall mean the maximum continuous steam output of Steam Generator (as defined Cl. No. 1.02.00 Sub-section A-02, Part-B) at super heater outlet at rated parameters.

The term “TMCR” (Turbine maximum continuous rating) appearing in the technical specification shall mean 800 MW electrical power output at generator terminals (power at generator terminals as per clause indicated in this sub-section) under rated steam parameters, 0% cycle make-up and 160 mmHg (abs) condenser pressure unless used in conjunction with a different cycle make-up and/or a different condenser pressure and /or a different throttle steam pressure.

1.00.00 **PERFORMANCE GUARANTEES**

1.00.01 **General Requirements**

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

b) The guaranteed performance parameters furnished by the bidder in his offer, shall be without any tolerance values whatsoever and all margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures.

c) The Contractor shall conduct performance test and demonstrate all the guarantees covered herein, during performance guarantee/acceptance test. The various tests which are to be carried out during performance guarantee/acceptance test 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.

d) 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 bid price.

e) It is the responsibility of the contractor to perform the Performance

Guarantee/Acceptance test as specified in this subsection. The performance tests will be performed using only the normal number of Employer supplied operating staff. Contractor, vendor or other subcontractor personnel shall only be used 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.

f) The Contractor shall make the plant ready for the performance guarantee tests.

g) 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. 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 subjected to the approval of the Employer. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes.

h) 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.

i) The Performance / Acceptance test shall be carried out as per the agreed procedure. The PG test procedure including demonstration tests 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. 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 months from the date of conductance of Performance test. However, preliminary test reports shall be submitted to the Employer after completing each test run.

The P&G test procedures shall be submitted for equipments/ system & subsystem under Contractor's scope for all Guarantees under category I, II & III 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.

j) 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 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.

k) In case during performance guarantee tests 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. However if the specified performance guarantee(s) are still not met but are achieved within the Acceptable Shortfall Limit specified at clause 1.01.02 of this subsection, Employer will accept the equipment/system/plant after levying liquidated damages as per clause 1.01.02 of this sub-section. If, however, the demonstrated guarantee(s) continue to be more than 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:

i) For Category-I Guarantees

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

OR

Accept the equipment/system/plant after levying Liquidated Damages as specified hereunder. The liquidated damages, for shortfall in performance indicated in clause 1.01.02 for this sub-section are on per unit basis and shall be levied separately for each unit, except for the rate indicated for auxiliary power consumption for station auxiliaries which is on station basis. The liquidated damages shall be prorated for the fractional parts of the deficiencies. The performance guarantees coming under this category shall be called `Category - I' Guarantees.

ii) For Category-II Guarantees

Reject the equipment/plant/system and recover from the Contractor the payments already made. The performance guarantees under this category shall be called 'Category - II ' Guarantees. Conformance to the performance requirements under Category -II is mandatory.

iii) For Category-III Guarantees

Reject the equipment / system/plant & 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 guarantee performance. These parameters/capacities shall be termed as category - III, guarantees.

1.01.00 **GUARANTEES UNDER CATEGORY - I**

1.01.01 The performance guarantees which attract liquidated damages (LD) are as follows:

i) Unit Heat Rate

a) Unit Heat rate in kcal/kWhr under rated steam conditions at **160 mm Hg (abs) condenser pressure** with zero (0%) make up at 800 MW unit load (i.e. 100% of rated load).

(b) Unit Heat rate in kcal/kWhr under turbine throttle main steam pressure of 210 Kg/cm2 (abs) and turbine throttle main steam temperature / reheat steam temp. at turbine inlet of 600 deg C / 600 deg C at 160 mm Hg (abs) condenser pressure with zero make up at 600 MW unit load (i.e. 75% of rated load) .

GUARANTEES UNDER CATEGORY – III

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

1.03.01 **Noise**

All the plant, equipment and systems covered under this specification shall perform continuously without exceeding the noise level over the entire range of output and operating frequency specified in General Technical Requirement, Part-C Section-VI of the technical specifications.

Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of IEC 651 or BS 5969 or IS 9779.

Sound pressure shall be measured all around the equipment at a distance of 1.0 m horizontally from the nearest surface of any equipment/ machine and at a height of 1.5 m above the floor level in elevation.

A minimum of 6 points around each equipment shall be covered for measurement. Additional measurement points shall be considered based on the applicable standards and the size of the equipment. The measurement shall be done with slow response on the A - weighting scale. The average of A-weighted sound pressure level measurements expressed in decibels to a reference of 0.0002 micro bar shall not exceed the guaranteed value. Corrections for background noise shall be considered in line with the applicable standards. All the necessary data for determining these corrections, in line with the applicable standards, shall be collected during the tests.

1.03.02 **Steam Turbine and Auxiliaries**

Turbine hall and other EOT Crane :

Over load test, travel & hoist speed checks etc., shall be demonstrated as per IS: 3177 (latest edition).

1.03.03 **Steam Generator and Auxiliaries**

Category-III Guarantees of this sub-section for various systems/ equipment for steam generator and auxiliaries shall be based on and demonstrated corresponding to ambient air condition of 27 deg. C temperature & 60% RH.

(i) Coal Pulverizer capacity at rated fineness

Performance testing shall be conducted on coal pulverizers toward

ANNEXURE – IIA

FORMAT FOR SUBMISSION OF GUARANTEE TEST PROCEDURE

Clause No. as per LOA/ Tech. Specs.	Provision of LOA / Tech. Specs.	Name and Methodology of Test proposed by Vendor	NTPC comments on the tests proposed by vendor

APPENDIX-V

GUARANTEE TEST PROFORMA

VIBRATION LEVEL MEASUREMENTS

Project :

Package :

Date :

Time :

Details of vibration Level Meter

1. Make

2. Model & Sl.No.

3. Date of calibration with name of Test House

Sl.No.	Equipment	Pick *Point	Vibration level Amplitude/Velocity		
			Horizontal Micron/ mm/ sec.	Vertical micron/ mm/sec.	Axial Micron / mm/sec.

* Reading shall be taken at all the bearings of motor, gear box and driven equipment. In case of conveyor galleries, vibrations shall be measured at min. three locations, at midpoint of stringer between two short supports.

NTPC **Contractor**

APPENDIX-VI

GUARANTEE TEST PROFORMA

NOISE LEVEL MEASUREMENT

Project :

Package :

Date :

Details of Sound Level Meter

1. Make
2. Model
3. Date of calibration with name of Test House

Sl.No	Equipment with location	Equipment load/capacity	Measurement* point no.	Sound level dBA.	Remarks

NTPC **Contractor**

* For each equipment location, a Projected Plan Diagram shall be made and the location of measurement points shall be identified.

SECTION-I
SUB-SECTION-C2-C

LOW PRESSURE PIPING

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES

1.00.00 LOW PRESSURE PIPING

1.01.00 The Scope of Low Pressure (LP) piping systems for the following services shall be as defined in various tender drawings & the sub section pertaining to "Terminal points and exclusions" and shall include the following systems:

a) DM water normal make-up system (condenser makeup, ECW makeup for both Steam Generator and Turbo Generator Auxiliaries, make-up to H2 generation plant & CPU regeneration plant etc.)

b) Condenser emergency make up and ECW tank emergency make-up for SG & TG / condensate storage and transfer system.

c) Boiler (Steam Generator) and Deaerator fill system.

d) Equipment Cooling Water (ECW) system including its chemical dosing system for primary circuit for Steam generator and Turbo generator and their auxiliaries.

e) Auxiliary cooling water system.

f) Complete service water system, APH /ESP wash water system, Drinking (potable) water system, clarified water system & HVAC – system, Raw water system (PT plant and ash handling) , other applicable systems mentioned elsewhere in the specification

g) Instrument Air System.

h) Service (plant) Air System.

i) Drain piping system for the piping\equipment etc. under the bidder's scope.

j) Tanks as described elsewhere in the specification for the above systems. (Including condensate storage tanks etc.).

k) Re-circulation pipes along with valves, breakdown orifices etc., wherever required/specified elsewhere in Technical Specification.

l) Any other piping system required making the Low Pressure (LP) piping systems in the bidder's scope complete.

1.02.00 The scope covers the following for the complete LP piping systems mentioned above:

a) Design, engineering, manufacturing, supply, fabrication, testing packaging, transportation to site, storage, taking delivery of Employer supplied equipment from site stores, in plant transportation, erection, cleaning, testing and commissioning of all items i.e., pipes, fittings, supports/ hangers, valves, actuators, motors, specialties, expansion joints, strainers, moisture traps, tanks, chemical dosing system for Equipment Cooling Water System (Primary circuit), instruments, drains, vent including drain/ vent valves ,air release valves etc.

The items though not specifically mentioned or indicated here in but are needed to make the system / equipment complete shall also be furnished and treated as if included in the specification unless otherwise specifically excluded.

1.03.00 Bidder's scope of supply & works shall include but not be limited to the following:

a) Pipes, headers and manifolds, bends, elbows, returns, tees, laterals, crosses, reducers/ expanders, caps and closures, couplings, plugs, sleeves, and saddles, stubs and bosses, unions and other similar fittings, flanges, gaskets, fasteners and sealants, ring joints, backing rings, all types of valves including drain/ vent/ air release valves, 3-way valves(where applicable) with test connection for instruments/ manifolds etc.actuators, specialties, orifices, flow nozzles, etc. as per finalized single line flow diagrams and layout drawings/ isometric drawings.

b) Complete assemblies of hangers, supports anchor, guides, restraints, etc. including welded attachments, clamps, devices tie-rods, turn-buckles, springs and spring cages, shoes, rollers, trapezes etc.

c) Weather hoods for pipes crossing ceilings and walls.

d) Instrument tapping and stub connections, root valves, 3-way valves (where applicable) with test connections, drains and vent valves & expanders / reducers as required and instruments as indicated else where for instruments supplied by the Contractor..

e) Drain funnels, drip pans, moisture traps etc. where ever required shall be provided.

f) Instrument tapping, stub connections, root valves and instrument tubing up to root valves for instruments supplied by the Employer for onward connections by the Employer.

g) All supporting attachments like plates, saddles, stools, shoes, base plate, saddle plates, angles, channels, I-beams, trapeze, cantilevers, brackets, sways, braces, nuts, bolts, cleats, clamps, needed to complete the erection of piping system covered under this specification.

Anchor bolts, bed & foundation plates, pipe sleeves and Nuts to be embedded in concrete for piping where ever indicated in the drawing. All grouting and chipping work (including supply of cement, sand and stone chips) for equipment foundations, pipe supporting etc.

Reinforced concrete valve chambers wherever required for underground piping.

h) Surface preparation, priming and painting of all non-insulated above ground piping and equipment except galvanized steel piping & surfaces , stainless steel piping & surfaces, and gun metal surfaces.

Paints and varnishes, primers, thinners etc. as required for anti-corrosive protection of piping & equipment above ground.

i) Bidder shall provide anti-corrosive protection anticorrosive tape or coating-wrapping on the external surfaces of pipes to all directly buried piping including galvanized carbon steel piping.

j) On the internal surface of all pipes 1000 mm and above, a coat of primer followed by a hot coat of coal tar enamel paint or coal tar epoxy paint shall be applied.

k) Excavation, preparation of bed, backfilling with compaction of soil and removal of extra-earth to designated places in case of pipes to be buried.

l) Bidder shall also design, supply, fabricate, erect, set and commission all hangers, tie-rods, turn-buckles, supports, guides, restraints, anchors, etc. as required for the, piping system. This includes the provision of all associated steel work including brackets, cradle supports, duck foots, channels, angles, etc. It is Bidder's responsibility to estimate these requirements and include them in their offer price. Whenever, straight run of the yard pipes are more than 300 meters, flexibility analysis shall be conducted by the contractor to identify the requirement of loops, type of supports etc.

m) In covered concrete trenches bidder shall supply necessary supporting materials such as stools, saddles, base plates, clamps, U-bolts, angles, clips etc.

n) Bidder shall supply all necessary drains and vents with drain & vent valves including anti-flash funnels and moisture traps for compressed air system as required for the safe and effective draining-venting of the piping systems based on the approved flow scheme / single line diagram. It is bidder's responsibility to identify the requirements of drains, vents, and supply the necessary pipe work, fittings, hangers and supports etc. for the same.

o) Bidder shall supply and install necessary matching pieces as may be needed for connection of piping systems with equipment terminals, valves and specialties.

p) Bidder shall erect all instrument impulse piping and fittings from the tap-off point of the last root valve including the root valve and instruments.

q) Bidder shall perform necessary internal machining of pipe for installing orifices, flow nozzles, straightening vanes etc.

r) The Bidder shall prepare the flow diagrams, detailed dimensional piping layout/ Isometric/ fabrication/ As built drawings of all the systems along with Cross sectional drawings, showing all supports and equipment as required.

s) In addition to submission of drawings as stipulated above bidder shall also furnish the data/ documents with respect to following:

1) Thickness calculation of large diameter buried pipes as per AWWA-M-11.

2) System design calculation of Primary closed circuit ECW and secondary circuit ACW system for flow & pressure balancing.

3) Design calculations for condensate storage tank and Drinking water tank.

4) Static Analysis for Long (more than 300 metre straight run) above-ground piping wherever required.

t) Bidder's scope of supply for fabrication, erection, cleaning, testing and commissioning of the piping systems installed by him shall include the following:-

All welding consumables like welding electrodes, filler rods and wires; gases like oxygen, acetylenes, argon, carbon-dioxide, propane, backing rings etc.

Films for radiographic examination of welds.

X-ray and Gamma -ray equipment including isotopes, dye penetrants, and other required non-destructive testing materials and equipment (all to be taken back by the Bidder after completion of work).

All heating and stress relieving equipment, thermocouples asbestos blankets, cables, temperature recorders, charts heat sensitive chalks and crayons etc. (All to be taken back by bidder after completion of work).

All machinery, equipment tools and tackles as required for transportation handling, fabrication and erection (All to be taken back by Bidder after completion of work).

All equipment/ materials as required for cleaning, flushing, blowing out and hydro testing of the piping systems; these shall include but not be limited to pumps and compressors with prime movers, instruments, pipe work with supports, valves, strainers and other specialties, blanks, plugs, spool pieces, dummy plates, electrical accessories, etc. (All to be taken back by Bidder after completion of work).

All scaffolding materials and false work (To be taken back by Bidder after completion of work).

1.04.00 The Bidder shall provide Services of erection superintendent and foremen, fitters and riggers, welders, transport and crane operators and other skilled and unskilled labour.

The design engineering and providing all temporary pipe work as required for erection, cleaning, flushing, blowing out, testing and commissioning of the piping system is the responsibility of the Bidder.

The Bidder's scope shall include design, supply of required structural steel (except those which are specifically excluded), their fabrication and erection where ever required.

SECTION-I
SUB-SECTION-C2-D
QUALITY ASSURANCE

FGD SYSTEM

BIDDER(S) TO CONSIDER FOR THE ITEMS IN THEIR SCOPE FOR THE LIME FEEDING /DOSING SYSTEM.
ESPECIALLY CL 1.04.00, 1.05.01, 1.07.00, 1.08.00, 1.09.00, 1.10.00, 1.11.00, 1.12.00 & 1.15.00 AND OTHERS, AS APPLICABLE

CLAUSE NO.	QUALITY ASSURANCE

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 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/separator/body casing of the mill shall be tested by RT and MPI. All other welds in main tube/separator shall be tested by MPI/LPI for acceptance. The tube shall be statically balanced.

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.

1.02.0 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.

CLAUSE NO.	QUALITY ASSURANCE

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 as applicable.
iii) Rubber lining shall be tested for hardness and spark test, as applicable.

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.

CLAUSE NO.	QUALITY ASSURANCE

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.

1.09.00 Vibrating Grizzly Feeders and Vibrating Feeders

(a) Shaft forgings to be checked for ultrasonic testing in addition to check for chemical, mechanical, hardness, microstructure etc. as per applicable material specification

(b) Following minimum NDT requirements to be ensured for welds:

i) Butt welds - 10% UT/RT and 100% MPI/DPT.

ii) Fillet Welds - 10% MPI/DPT.

(c) Shop trial run test shall be conducted to checks for speed (RPM), amplitude (stroke), temperature rise and noise level.

1.10.00 STORAGE SILO

1.10.01 All material shall be tested for Chemical & Mechanical properties as per relevant standard. MPI/DP test on welding shall be carried out. Fit up assembly checks shall be carried out at shop for all despatchable segments

1.10.02 **BAG FILTERS** : Bag Leakage test shall be carried out for pressure parts. Pulsing and sequential test on bag filter shall be done.

1.11.00 AGITATORS:

1.11.01 Rubber lining shall be tested for hardness and spark test

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 Rotor components shall be subjected to ultrasonic test at mill and magnetic particle inspection / liquid penetrant examination after rough machining.

1.12.02 Butt welds in rotor components shall be subjected to 100% RT and all welds shall be magnetic particle/dye penetrant tested after stress relieving.

CLAUSE NO.	QUALITY ASSURANCE

1.12.03 All rotating components and assemblies of fan shall be balanced dynamically

1.12.04 Performance test shall be carried out on fans as per Technical specification/ Relevant standard

1.12.05 Test for Natural Frequency and hardness of Fans blades shall be carried out as per Technical specification/ Relevant standard

1.13.00 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.

1.14.00 OTHER CRITICAL EQUIPMENTS:

1.14.01 Checks/ NDTs shall be done as per relevant Indian Standards or equivalent International Standards.

1.15.00 BUCKET ELEVATOR

1.15.01 All plates equal to or above 25 mm thickness shall be ultrasonically tested.

1.15.02 Castings and forgings, forged/rolled bar/section shall be subjected to ultrasonically test in addition to check for chemical, mechanical, hardness, microstructure etc. as per applicable material specification.

1.15.03 Machined and hardfaced surface of casting/forging and other hardened, stellited parts shall be subjected to DPT/MPI in addition to check for case depth, hardness as applicable for chain/sprocket/gear reducer/rollers/wheel/pan etc.

1.15.04 Following minimum NDT requirements shall be followed for welds:
i) Butt Welds in Tension- 100% UT/RT and 100% MPI/DPT.
ii) Butt Welds in Compression- 10% UT/RT and 10% MPI/DPT.
iii) Fillet Welds - 10% MPI/DPT.

1.15.05 For other items like drive system, motor, pulley, belt etc relevant portion of specification shall be applicable.

1.15.06 No load trial run test shall be carried out at shop on completely assembled Bucket Elevator to check for trouble free operation, temperature rise, Noise & vibration. The procedure for the No load trial run shall be submitted for approval.

SECTION-I
SUB-SECTION-C2-E

SURFACE PREPARATION & PAINTING

CLAUSE NO.	TECHNICAL REQUIREMENTS
1.00.00	**SPECIFICATION OF SURFACE PREPARATION & PAINTING**
1.01.00	Surface preparation methods and paint/primer materials shall be of the type specified herein. If the contractor desires to use any paint/primer materials other than that specified, specific approval shall be obtained by the contractor in writing from the employer for using the substitute material.
1.02.00	All paints shall be delivered to job site in manufacturers sealed containers. Each container shall be labelled by the manufacturer with the manufacturer's name, type of paint, batch number and colour.
1.03.00	Unless specified otherwise, paint shall not be applied to surfaces of insulation, surfaces of stainless steel/nickel/ copper/brass/ monel/ aluminum/ hastelloy/lead/ galvanized steel items, valve stem, pump rods, shafts, gauges, bearing and contact surfaces, lined or clad surfaces.
1.04.00	All pipelines shall be Colour coded for identification as per the NTPC Colour-coding scheme, which will be furnished to the contractor during detailed engineering.
1.05.00	**SURFACE PREPARATION**
1.05.01	All surfaces to be painted shall be thoroughly cleaned of oil. Grease and other foreign material. Surfaces shall be free of moisture and contamination from chemicals and solvents.
1.05.02	The following surface preparation schemes are envisaged here. Depending upon requirement any one or a combination of these schemes may be used for surface preparation before application of primer. SP1 Solvent cleaning SP2 Application of rust converter (Ruskil or equivalent grade) SP3 Power tool cleaning SP4 Shot blasting (shot blasting shall be used as surface preparation method for hot worked pipes prior to application of primer) SP4* Shot blast cleaning/ abrasive blast cleaning to SA21/2 (near white metal) 35-50 microns SP5 Shot blasting/ abrasive blasting. SP6 Emery sheet cleaning/Manual wire brush cleaning.
1.06.00	**APPLICATION OF PRIMER/PAINT**
1.06.01	The paint/primer manuacturer's instructions covering thinning, mixing, method of application, handling and drying time shall be strictly followed and considered as part of this specification. The Dry film thickness (DFT) of primer/paint shall be as specified herein.
1.06.02	Surfaces prepared as per the surface preparation scheme indicated herein shall be applied with primer paint within 6 hours after preparation of surfaces.
1.06.03	Where primer coat has been applied in the shop, the primer coat shall be carefully examined, cleaned and spot primed with one coat of the primer before applying intermediate and finish coats. When the primer coat has not been applied in the shop, primer coat shall be applied by brushing, rolling or spraying on the same day

as the surface is prepared. Primer coat shall be applied prior to intermediate and finish coats.

1.06.04 Steel surfaces that will be concealed by building walls shall be primed and finish painted before the floor is erected.Tops of structural steel members that will be covered by grating shall be primed and finish painted before the grating is permanently secured.

1.06.05 Following are the Primer/painting schemes envisaged herein:

PS3 - Zinc Chrome Primer (Alkyd base) by brush/Spray to IS104.

PS3* - Zinc Chrome primer (Alkyd base) by dip coat.

PS4 - Synthetic Enamel (long oil alkyd) to IS2932.

PS5 - Red Oxide Zinc Phosphate primer (Alkyd base) to IS 12744

PS9 - Aluminium paint to IS 2339.

PS9* - Heat resistant Aluminium paint to IS-13183 Gr.-1

PS13 - Rust preventive fluid by spray, dip or brush.

PS14 - weldable primer-Deoxaluminate or equivalent.

PS16 - High Build Epoxy CDC mastic `15' .

PS17 - Aliphatic Acrylic Polyurethane CDE134 ,%V=40.0(min.)

PS18 - Epoxy based TiO2 pigmented coat

PS19 - Epoxy Zinc rich primer (92% zinc in dry film (min.), %VS=40.0(min.)

PS-20 - Epoxy based finish paint

1.06.06 All weld edge preparation for site welding shall be applied with one coat of wieldable primer.

1.06.07 For internal protection of pipes/tubes, VCI pellets shall be used at both ends after sponge testing and ends capped. VCI pellets shall not be used for SS components and composite assemblies.

1.06.08 SG membrane walls and other Flue gas swept pressure part surfaces shall be applied with appropriate primer for protection of surfaces during transit, storage and erection.

1.06.09 a) All un-insulated equipments, pipes, valves etc covered in sub-section A-08 (Steam Turbine & Auxiliary system) shall be painted with paint not inferior to Epoxy resin based paints with minimum DFT of 150 micron.
The paint shall be applied in three stages i.e. primer, intermediate and finish coats in following manner:

- Primer coat – Epoxy based zinc phosphate
- Intermediate - Epoxy based TiO2 pigmented coat
- Finish coat - Epoxy based finish coat

b) Equipment, pipes etc. with high temperature shall be painted with heat resistant aluminum paint (to be selected based on the service condition of component as per IS-13183). Two coats of paint shall be applied with total DFT 40 micron.

c) Surface preparation before painting shall be carried out according to requirement indicated in this sub-section and international standard

CLAUSE NO.	TECHNICAL REQUIREMENTS
1.06.10	A) Specification for the application of Epoxy coating for internal protection of DM tank & other vessels/tanks (as applicable) shall be as follows: Primer : One coat of unmodified epoxy resin along with polymide hardener. Paint : Two (2) coats unmodified epoxy resin along with Aromatic adduct hardener. Total thickness of primer and paint should not be less than 400 microns. B) Specification for application of chlorinated Rubber paint for external protection vessel, tanks, piping, valves & other equipments shall be as follows: i) For Indoor vessel, tanks, piping, valves & other equipments: (a) Surface preparation shall be done either manually or by any other approved method. (b) Primer coat shall consist of one coat of chlorinated rubber based zinc phosphate primer having minimum DFT of 50 microns. (c) Intermediate coat (or under coat) shall consist of one coat of chlorinated rubber based paint pigmented with Titanium dioxide with minimum DFT of 50 microns. (d) Top coat shall consist of one coat of chlorinated rubber paint of approved shade and colour with glossy finish and DFT of 50 microns. Total DFT of paint system shall not be less than 150 microns. ii) For Outdoor vessel, tanks, piping, valves & other equipments: (a Surface preparation shall be blast cleared using non-siliceous abrasive after usual wire brushing, which shall conform to Sa 2-1/2 Swiss Standard. (b Primer coat shall consist of one coat of epoxy resin based zinc phosphate primer having minimum DFT of 100 microns. (c) Intermediate coat (or under coat) shall consist of epoxy resin based paint pigmented with Titanium dioxide with minimum DFT of 100 microns. (d Top coat shall consist of one coat of epoxy paint suitable pigmented of approved shade and colour with glossy finish and DFT of 75 microns. Additionally finishing coat of polyurethane of minimum DFT of 25 microns shall be provided. The paint may be applied in one coat, in case high built paint is used, otherwise two coats shall be applied. Total DFT shall not be less than 300 microns.

ii) Painting specification for inside surfaces (such as inner surfaces of ducts/ tanks/ mills/ dampers/ ESP etc.) that are not covered specifically in above clauses, shall be provided with 2 coats of suitable primer i.e. PS5/ PS9 (Total DFT 60/40 micron) based on the temperature.

F) FGD System
(i) Surface preparation shall be blast cleaned conforming *to* Sa *2-1/2* Swiss Standard. (ii) Primer coat shall consist of epoxy resin based zinc phosphate primer having minimum DFT of 100 microns. (iii) Intermediate coat (or under coat) shall consist of epoxy resin based paint pigmented with Titanium dioxide with minimum DFT of 100 microns. (iv) Top coat shall consist of one coat of epoxy paint suitable pigmented of approved shade and colour with glossy finish and DFT of 75 microns. Additionally finishing coat *of* polyurethane of minimum DFT of 25 microns shall be provided.

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SECTION-I
SUB-SECTION-C3

TECHNICAL SPECIFICATION

FOR

LIME DOSING/FEEDING SYSTEM (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 LIME DOSING/FEEDING SYSTEM **.**

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

b) Customer (NTPC) specification for Motors

c) Customer (NTPC) cabling spec (to be referred by vendor for their scope of work (as per Electrical scope between BHEL & vendor)).

d) Quality plan for motors & NTPC quality assurance

e) Datasheet A for LT Motors (Annexure-I)

f) Datasheet C for LT Motors (Annexure-X)

g) List of Mandatory Spares (If applicable) (Annexure-II)

h) Sub vendor List for Motors & other Electrical items (Annexure-III)

i) Electrical Load data format (Annexure –IV)

j) BHEL cable listing format (Annexure –V)

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGES: LIME DOSING/FEEDING SYSTEM
SCOPE OF VENDOR: SUPPLY & SUPERVISION OF VENDOR'S EQUIPMENT
PROJECT: 3X800 MW PATRATRU TPS

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415 V Switchgear	BHEL	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.
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	

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGES: LIME DOSING/FEEDING SYSTEM
SCOPE OF VENDOR: SUPPLY & SUPERVISION OF VENDOR'S EQUIPMENT
PROJECT: 3X800 MW PATRATRU TPS

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	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	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	
16	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.
17	Electrical Equipment & cable tray layout drawings	-	-	Vendor to furnish drawing (both in print form as well as in AUTOCAD) of Lime Dosing/Feeding Building layout clearly indicating all motors, panels, JB's etc. which require cabling along with their terminal box/location/ Foundation etc.
18	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.

SUB–SECTION – B-07

MOTORS

CLAUSE NO.	TECHNICAL REQUIREMENTS

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 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 Contractor shall provide fully compatible electrical system, equipment, 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 contractors equipment and systems shall be under the contractor 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/IEC:60034
5)	Energy Efficient motors	:	IS 12615, IEC: 60034-30

CLAUSE NO.	TECHNICAL REQUIREMENTS
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. c) Crane duty motors shall be squirrel cage Induction motor as per the requirement. d) Motor operating through variable frequency drives shall be suitable for inverter duty. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable.
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. (c) For BFP motors, starting MVA shall be restricted to meet requirements indicated in B-0.
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.

CLAUSE NO.	TECHNICAL REQUIREMENTS
	41 deg.C over inlet cooling water maximum temperature of 39 deg.C for thermal class 90 (Y) wet wound Boiler circulation pump motor.
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 full load torque.
6.02.02	Pull out torque at rated voltage shall not be less than 205% of full load 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 Except AOP & JOP motors running on D.G emergency supply, starting voltage shall be 80%.

CLAUSE NO.	TECHNICAL REQUIREMENTS
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 & 3.3 kV AC motors : Thermal class 155 (F) insulation. The winding insulation process shall be total Vacuum Pressure Impregnated i.e. resin poor method. The lightning Impulse & intertern insulation surge withstand level shall be as per IEC-60034 part-15. However winding insulation for wet wound Boiler circulation pump motor shall be thermal class 90 (Y) or better. (d) 240VAC, 415V AC & 220V DC motors : Thermal Class (B) or better
7.04.00	Motors rated above 1000KW shall have insulated bearings to prevent flow of shaft currents.

CLAUSE NO.	TECHNICAL REQUIREMENTS
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 85dB (A) except for BFP motor for which the maximum limit shall be 90 dB(A). Vibration shall be limited within the limits prescribed in IS/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 with adjustable alarm contact and preferably 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 KV motors shall be offered with dust tight phase separated double walled (metallic as well as insulated barrier) Terminal box. Suitable termination kit shall be provided 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 & center of 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, 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 and LT motors) to be intimated to the successful bidder during detailed engineering and the contractor shall provide terminal box suitable for the same.

CLAUSE NO.	TECHNICAL REQUIREMENTS
8.00.00	The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance) except for BFP motor. (a) 50 kW to 110 kW : 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
9.00.00	CW motor shall be designed with minimum power factor of 0.8 at design duty point.
10.00.00	**TYPE TEST**
10.01.00	**HT MOTORS**
10.01.01	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 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 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.
10.01.03	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.
10.01.04	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

CLAUSE NO.	TECHNICAL REQUIREMENTS
	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/ employer's 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 interturn insulation shall be as per clause no. 4.2 of IEC 60034, part-15

CLAUSE NO.	TECHNICAL REQUIREMENTS
10.02.00	**LT Motors**
10.02.01	LT Motors supplied shall be of type tested design. During detailed engineering, the contractor shall submit for employer's approval the reports of all the type tests as listed in this specification and carried out within last *ten* years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.
10.02.02	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/ employer's 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 50 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. Over speed test.

CLAUSE NO.	TECHNICAL REQUIREMENTS

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 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	203

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:

CLAUSE NO.	TECHNICAL REQUIREMENTS

Motor MCR in KW	Clearance
UP to 110 KW	10mm
Above 110 KW and upto 150 KW	12.5mm
Above 150 KW	19mm

SUB–SECTION – B-09

CABLING

CLAUSE NO.	TECHNICAL REQUIREMENTS

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/duct banks. Cables from main plant to switchyard control room shall be laid in overhead trestles or duct bank. In case of Duct banks, pull-pits shall be filled with sand and provided with a PCC covering. Directly burried cables, if essential ,shall not have concentration of more than 4 cables in one route. All buried cables, Cables for switchyard and CHP shall be armoured

2.01.02 **Transformer yard**

In transformer yard cables shall be laid in overhead trestle. The main cable routes coming out from Main plant building and crossing the Transformer yard shall be laid in overhead trestles. In transformer yard, trestle height for rail/road crossing shall be suitable for movement of Generator Transformer with bushing.

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 in main plant.

2.01.05 **Cable Vault**

Clear access passage of at least 750mm wide & 2.1 mt clear heights shall be provided at entrances and along the cable trays in cable vault. Wherever the passage is through cable routes & across the cable tray the clear height shall not be less than 1.5 mts.

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

CLAUSE NO.	TECHNICAL REQUIREMENTS
2.01.06	**Boiler Area** Two separate cable routes one on each side shall be provided for each boiler unit. Cables for on set of auxiliaries such as ID, FD, PA fan & half of the coal mills shall be routed in one route & for other set of auxiliaries through other route. Cable trays in boiler & ESP area shall be supported from the boiler and ESP structures. The same shall be coordinated with SG/ESP contractor. Cable trays in these areas shall be in vertical formation to avoid dust accumulation. No cable trenches shall be provided in boiler/ESP area.
2.01.07	**Turbine Hall Area** a)Two separate cable routes shall be provided for cable routing of working and standby drives or different set/group (say 50% capacity) of auxiliaries.
2.01.08	**OffSite Area** In offsite pumphouses, overhead cable tray arrangement shall be followed. However cable trenches may be considered below switchgear/mcc. Trestle In fuel oil pump house, overhead cable tray arrangement shall be provided. RCC trenches provided in MCC room shall be separated from fuel oil area to avoid oil accumulation.
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

3.02.00 **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.

3.03.04 FOR COAL HANDLING PLANT 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) Cable trenches shall be provided only in Switchgear/MCC rooms.

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.

3.04.00 **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.

3.04.00 **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 for power cables shall be tinned copper solderless crimping type suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating

sleeve and shall suit the type of terminals provided on the equipments. Cable lugs and ferrule shall conform to DIN standards.

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 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 inbuilt ELCB rated for suitable adjustable mA sensitivity ranging from 30-300 mA

3.12.00 **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.

3.13.00 **Galvanising**

3.13.01 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.

3.13.02 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

CLAUSE NO.	TECHNICAL REQUIREMENTS
3.14.00	**Welding**
3.14.01	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 . Where specific cable layouts are not shown on drawings, Contractor shall route these as directed by the Project Manager

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 per the drawings. The ferrule shall fit tightly on the core. Spare cores shall have similar ferrules with suffix sp1, sp2, ---etc along with cable numbers and coiled up after end sealing.
4.05.06	All cable terminations shall be appropriately tightened to ensure secure and reliable connections.

	QUALITY PLAN	CUSTOMER :	PROJECT	SPECIFICATION :								
		BIDDER/ VENDOR :	TITLE	NUMBER :								
			QUALITY PLAN NUMBER PED-506-00-Q-003/01	SPECIFICATION TITLE								
	SHEET 1 OF 2	SYSTEM	ITEM ELECTRICAL IN-PROCESS	SECTION VOLUME III								
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	**W**	**V**	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**			**11**
1.O	FABRICATION	1. DIMENTION	MA	MEASUREMENT	100%	APPD. DRG.	APPD. DRG.	INSPC.	2	-	-	
		2.ALIGNMENT	MA	MEASUREMENT & VISUAL	100%	-DO-	-DO-	-DO-	2	-	-	
		3. FINISH SURFACE DEFECT	MA	VISUAL	100%	-DO-	-DO-	-DO-	2	-	-	
.2.0	SURFACE PREPARATION & PRE-TREATMENT	1. PROCESS PARAMETERS SOLUTION STRENGTH TEMPERATURE DIPPING TIME ETC.	CR	PROCESS	PERIODIC	MFR.STD./ BHEL SPEC. RELV. IS	MFR. STD./ BHEL SPEC RELV. IS	LOG BOOK	2	-	-	
		2. SURFACE CONDITION	MA	VISUAL	100%	-DO-	-DO-	-DO-	2	-	-	
3.0	PRIMER & PAINTING (SPRAYED & STOVED)	1. SURFACE FINISH & COVERAGE	MA	VISUAL	100%	-DO-	-DO-	-DO-	2	-	-	
		2. FILM THICKNESS	MA	MEASUREMENT	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3. SHADE	MA	VISUAL	-DO-	-DO-	-DO-	-DO-	2	-	-	
		4. ADHESION	MA	CROSSOUT TYPE	-DO-	-DO-	-DO-	-DO-	2	-	-	
	BHEL		**PARTICULARS**	**BIDDER/VENDOR**								
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

	QUALITY PLAN	CUSTOMER :	PROJECT					SPECIFICATION :			
		BIDDER/ :	TITLE					NUMBER :			
	SHEET 2 OF 2	VENDOR	NUMBER PED-506-00-Q-003/01					SPECIFICATION :			
		SYSTEM	ITEM ELECTRICAL IN-PROCESS					SECTION			VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
4.0	MOUNTING OF VARIOUS ITEMS	1. RIGIDITY	MA	VISUAL	100%	MANUFACTURE DRAWING	MANUFACTURE DRAWING	LOG BOOK				
		2.THICKNESS	MA	VISUAL	100%	-DO-	-DO-	-DO-	2	-	-	
		3. CORRECTNESS & COMPLETENESS	MA	VISUAL	100%	APPD. DRG.	APPD. DRG.	-DO-	2	-	-	
		4. ACCESSIBILITY	MA	VISUAL	100%	-DO-	-DO-	-DO-	2	-	-	
5.0	MARKING/LABELLING	1. CORRECTNESS	MA	VISUAL	100%	-DO-	-DO-					
		2. ADHESION/ FIXING	MA	VISUAL	100%	-DO-	-DO-	-DO-	2	-	-	
6.0	PRE-FINAL INSPECTION	1. ALIGNMENT	MA	VISUAL	100%	BHEL SPEC. & RELV. STD.	BHEL SPEC. & RELV. STD.	TEST CERT.	2	-	-	
		2. PERFORMANCE	MA	ELECTRICAL	100%	-DO-	-DO-	-DO-	2	-	-	
		3. IR & HV	MA	ELECTRICAL	100%	-DO-	-DO-	-DO-	2	-	-	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

		QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION TITLE			
		SHEET 1 OF 2	SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3
	BHEL		**PARTICULARS**		**BIDDER/VENDOR**							
			NAME									
			SIGNATURE									

	QUALITY PLAN	CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :					
		BIDDER/ VENDOR :		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION : TITLE :					
	SHEET 2 OF 2	SYSTEM		ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	

NOTES:

1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON

2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.

Legends for Inspection agency

1. BHEL/CUSTOMER
2. VENDOR (MOTOR MANUFACTURER)
3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)

P. PERFORM
W. WITNESS
V. VERIFY

BHEL	**PARTICULARS**	**BIDDER/VENDOR**
	NAME	
	SIGNATURE	
	DATE	BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN	CUSTOMER :	PROJECT	SPECIFICATION :
		BIDDER/ : VENDOR	TITLE	NUMBER :
			QUALITY PLAN NUMBER PED-506-00-Q-003/01	SPECIFICATION TITLE
	SHEET 1 OF 2	SYSTEM	ITEM ELECTRICAL IN-PROCESS	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.O	FABRICATION	1. DIMENTION	MA	MEASUREMENT	100%	APPD. DRG.	APPD. DRG.	INSPC.	2	-	-	
		2.ALIGNMENT	MA	MEASUREMENT & VISUAL	100%	-DO-	-DO-	-DO-	2	-	-	
		3. FINISH SURFACE DEFECT	MA	VISUAL	100%	-DO-	-DO-	-DO-	2	-	-	
.2.0	SURFACE PREPARATION & PRE-TREATMENT	1. PROCESS PARAMETERS SOLUTION STRENGTH TEMPERATURE DIPPING TIME ETC.	CR	PROCESS	PERIODIC	MFR.STD./ BHEL SPEC. RELV. IS	MFR. STD./ BHEL SPEC RELV. IS	LOG BOOK	2	-	-	
		2. SURFACE CONDITION	MA	VISUAL	100%	-DO-	-DO-	-DO-	2	-	-	
3.0	PRIMER & PAINTING (SPRAYED & STOVED)	1. SURFACE FINISH & COVERAGE	MA	VISUAL	100%	-DO-	-DO-	-DO-	2	-	-	
		2. FILM THICKNESS	MA	MEASUREMENT	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3. SHADE	MA	VISUAL	-DO-	-DO-	-DO-	-DO-	2	-	-	
		4. ADHESION	MA	CROSSOUT TYPE	-DO-	-DO-	-DO-	-DO-	2	-	-	

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN	CUSTOMER :		PROJECT			SPECIFICATION :			
		BIDDER/ VENDOR :		TITLE			NUMBER :			
	SHEET 2 OF 2	SYSTEM		NUMBER PED-506-00-Q-003/01			SPECIFICATION :			
				ITEM ELECTRICAL IN-PROCESS			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
4.0	MOUNTING OF VARIOUS ITEMS	1. RIGIDITY	MA	VISUAL	100%	MANUFACTURE DRAWING	MANUFACTURE DRAWING	LOG BOOK				
		2.THICKNESS	MA	VISUAL	100%	-DO-	-DO-	-DO-	2	-	-	
		3. CORRECTNESS & COMPLETENESS	MA	VISUAL	100%	APPD. DRG.	APPD. DRG.	-DO-	2	-	-	
		4. ACCESSIBILITY	MA	VISUAL	100%	-DO-	-DO-	-DO-	2	-	-	
5.0	MARKING/LABELLING	1. CORRECTNESS	MA	VISUAL	100%	-DO-	-DO-					
		2. ADHESION/ FIXING	MA	VISUAL	100%	-DO-	-DO-	-DO-	2	-	-	
6.0	PRE-FINAL INSPECTION	1. ALIGNMENT	MA	VISUAL	100%	BHEL SPEC. & RELV. STD.	BHEL SPEC. & RELV. STD.	TEST CERT.	2	-	-	
		2. PERFORMANCE	MA	ELECTRICAL	100%	-DO-	-DO-	-DO-	2	-	-	
		3. IR & HV	MA	ELECTRICAL	100%	-DO-	-DO-	-DO-	2	-	-	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
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	SIGNATURE		
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		QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
		SHEET 1 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	**W**	**V**	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**			**11**
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	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVENT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	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	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVENT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	
BHEL			**PARTICULARS**		**BIDDER/VENDOR**							
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 2 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2	
		4.INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	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-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2	
BHEL			**PARTICULARS**		**BIDDER/VENDOR**							
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ : VENDOR	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 3 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	2	
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3	-	2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG. .	MANUFR'S DRG.	-DO-	3	-	2	FOR MV MOTOR INSULA-TION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3	-	2	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	2*	* 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	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3	-	2	

BHEL	PARTICULARS	BIDDER/VENDOR	
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	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 4 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
1.10	BEARINGS	1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
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	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 5 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10	10	10	11
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	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVENT SPEC./ ASTM-E165	MANUFR'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	

BHEL	PARTICULARS	BIDDER/VENDOR	
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	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 6 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-	
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	FOR MV MOTOR
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	THREE DIPS TO BE GIVEN

BHEL	PARTICULARS	BIDDER/VENDOR	
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	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 7 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1	
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1	VERIFICATION FOR MV MOTOR ONLY
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1	

BHEL	PARTICULARS	BIDDER/VENDOR	
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	SIGNATURE		
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	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 8 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10	10	10	11
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1$	1	$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1$	1	$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1$	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY $ NOTE - 2

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
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	DATE		BIDDER'S/VENDORS COMPANY SEAL

BHEL	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 9 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11

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 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 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

Legends for Inspection agency

1. BHEL/CUSTOMER
2. VENDOR (MOTOR MANUFACTURER)
3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)

P. PERFORM
W. WITNESS
V. VERIFY

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

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
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		
Rotor Copper/Aluminium	Y	Y	Y	Y			Y		Y
Stator copper	Y	Y	Y	Y			Y		Y
SC Ring	Y	Y	Y	Y	Y		Y	Y	Y
Insulating Material	Y		Y	Y			Y		
Tubes, for Cooler	Y	Y	Y	Y	Y				Y
Sleeve Bearing	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		
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						

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, No QP for LT motor upto 50KW.
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.

Y1 = for HT Motor / Machines only.

MOTOR

TESTS/CHECKS / ITEMS/ COMPONENTS	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	vibration	Over speed	Tan delta, shaft voltage & polarization index test	Paint shade, thickness & adhesion
Plates for stator frame, end shield, spider etc.										
Shaft										
Magnetic Material	Y		Y							
Rotor Copper/Aluminium										
Stator copper			Y							
SC Ring										
Insulating Material			Y							
Tubes for Cooler		Y								
Sleeve Bearing		Y								
Stator/Rotor, Exciter Coils										
Castings, stator frame, terminal box and bearing housing etc.										
Fabrication & machining of stator, rotor, terminal box										
Wound stator										
Wound Exciter										
Rotor complete				Y	Y					
Exciter, Stator, Rotor, Terminal Box assembly										
Accessories, RTD, BTD,CT, , Space heater, antifriction bearing, gaskets etc.										
Complete Motor						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, No QP for LT motor upto 50KW.

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.

Y1 = for HT Motor / Machines only.

	LV MOTORS **DATA SHEET-A**	SPECIFICATION NO. VOLUME II B SECTION D REV NO. 00 DATE 30.05.2018 SHEET 1 OF 1

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	Degree Of Protection (Indoor/Outdoor)	:	IP54/IP55
5.0	Type of Cooling	:	TEFC/CACA/TETV
6.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V ± 10%
	b) Rated frequency (with variation)	:	50 Hz (Variation: +3% TO –5%)
	c) Combined voltage & freq. variation	:	10%
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal boxes		
	○ 110kW & Above (Breaker controlled)	:	50 kA for 1 sec
	○ Below 110kW (SFU+ Contactor controlled)	:	50 KA for 0.20 sec.
	f) LV System grounding	:	Solidly
7.0	Class of insulation	:	Refer clause 7.03.00 of Customer Motor Specification
8.0	Minimum voltage for starting (As percentage of rated voltage)	:	Refer clause 6.03.00 of Customer Motor Specification
9.0	Power cables data	:	Shall be given during Detailed engg.
10.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg.
11.0	Space heater supply	:	240 V, 1Φ , 50 Hz
12.0	Rating up to which Single phase motor	:	Acceptable upto 0.20 kW
13.0	Tests	:	As per Customer motor spec. (enclosed)
14.0	Energy efficient/ Flame proof motor	:	As per Customer spec. requirement

- **Also detail Customer spec. for Motors to be referred as enclosed with the specification.**

Vendor to refer to this list for items in their scope only(as indicated in Electrical scope sheet between BHEL & Vendor)

एनटीपीसी NTPC	PROJECT :PATRATU STPS (3X800 MW) PACAKGE : EPC Sub Package: MOTORS & VVF Drive Panels CONTRACTOR : M/S BHEL CONT. NO. CS-9585-001-2	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR ; CONTRACTOR-M/S BHEL	REF NO : 9585-001-QOE-R-01 REVISION NO. 00 DATE 20th April 2017

Sl. No.	ITEM	QP / INS CAT.	QP No:- 9585-001-QVE-	QP SUB. SCH.	QP APPL SCHE DULE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL. STATUS AS PER NTPC	SC APPL SCHE DULE	REMARKS
1)	L T (415 V) Motors	Refer Note 1				ABB	FARIDABAD	A		UPTO 55KW
						ABB	BANGALORE	A		55KW – 200KW
						BHARAT BIJLEE	MUMBAI	A		RQP, FOR FLAME PROOF ALSO
						CGL	AHMEDNAGAR	A		FOR FLAME PROOF ALSO
						JYOTI	BARODA	A		
						KEC	BANGALORE	A		FOR FLAMEVPROOF ALSO
						KEC	HUBLI	A		UPTO 90KW; FOR FLAME PROOF ALSO
						LHP	SOLAPUR	A		UPTO 200KW
						MARATHON	KOLKATA	A		FOR FLAME PROOF ALSO
						NGEF	BANGALORE	A		UPTO 15KW
						SIEMENS	MUMBAI	A		
2)	HT MOTOR	1				BHEL	BHOPAL	A		

एनटीपीसी NTPC	PROJECT :PATRATU STPS (3X800 MW) PACAKGE : EPC Sub Package: MOTORS & VVF Drive Panels CONTRACTOR : M/S BHEL CONT. NO. CS-9585-001-2	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR ; CONTRACTOR-M/S BHEL	REF NO : 9585-001-QOE-R-01 REVISION NO. 00 DATE 20th April 2017

SI. No.	ITEM	QP / INS CAT.	QP No:- 9585-001-QVE-	QP SUB. SCH.	QP APPL SCHE DULE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL. STATUS AS PER NTPC	SC APPL SCHE DULE	REMARKS

NOTE 1 : FOR LT MOTORS

a) Less than 30 KW

Acceptance of Motor less than 30 KW is based on COC of the manufacturer & the contractor confirming as follows:
It is hereby confirmed that the above mentioned motor /motors was/ were manufactured taking care of NTPC specific requirements regarding ambient temp., voltage & frequency variation, hot starts, pull out torque, starting KVA/KW, temp. rise, distance between centre of stud & gland plate and tested in accordance with approved drawing /data sheets.

b) 30 KW -50KW

Acceptance of Motor rating between 30 KW & 50 KW is based on NTPC review of Routine Test inspection report as per IS 325 witnessed by main contractor along with COC of the manufacturer & the contractor confirming as follows:
It is hereby confirmed that the above mentioned motor /motors was/ were manufactured taking care of NTPC specific requirements regarding ambient temp., voltage & frequency variation, hot starts, pull out torque, starting KVA/KW, temp. rise, distance between centre of stud & gland plate, space heater and tested in accordance with approved drawing /data sheets.

c) Above 50 KW as per NTPC approved quality plan

Approval Conditions attached to above vendors-as applicable shall prevail.

General Notes:

1) Vendor list & category of the mandatory spares shall be as mentioned above.
2) For item not appearing in the above list, main contractor to approach NTPC for acceptable vendors & inspection categorization of the same.
3) NTPC Approval conditions to above identified vendors shall be adhered to. Vendor's approval conditions will be informed on specific request of Main Contractor.

NTPC

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Patratu Vidyut Utpadan Nigam Limited Patratu Distt-Ramgarh (Jharkhand) C&M Deptt.

This page is the part of Tech. Spec. No. PE-TS-434-571-A002

Vendor to refer to this list for items in their scope only(as indicated in Electrical scope sheet between BHEL & Vendor)

एनटीपीसी NTPC	PROJECT :Patratu STPP (2X660 MW) PACAKGE :EPC Sub Package: Electrical Equipment Supply & Erection CONTRACTOR : M/S BHEL CONT. NO. CS-9585-001-2				LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR Contractor-M/S BHEL				REF NO : 9585-001-QOE-R-01 REVISION NO. 00 DATE 24th April 2017	
Sl. No.	ITEM	QP / INS CAT.	QP No:- 9578-001-QVE-	QP SUB. SCH.	QP APPL SCHEDULE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHEDULE	REMARKS
10.	GI cable trays, fitting	I				Inar Profiles Ltd	Enkapalli	A		

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Patratu Vidyut Utpadan Nigam Limited ★ Distt-Ramgarh(Jharkhand) ★ C & M Deptt.

एनटीपीसी NTPC	PROJECT :Patratu STPP (2X660 MW) PACAKGE :EPC Sub Package: Electrical Equipment Supply & Erection CONTRACTOR : M/S BHEL CONT. NO. CS-9585-001-2	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR Contractor-M/S BHEL	REF NO : 9585-001-QOE-R-01 REVISION NO. 00 DATE 24th April 2017

Sl. No.	ITEM	QP / INS CAT.	QP No:- 9578-001-QVE-	QP SUB. SCH.	QP APPL SCHEDULE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SCAPPL SCHEDULE	REMARKS
	& accessories including bends					Vatco	Mumbai	A		Galvanization at Sigma Mumbai
						Indiana cable trays	Mumbai	A		Galvanization at Karamtara galvaniser
						Industrial Perforation	Kolkata	A		
						Ratan Engineering	Kolkata	A		Galvanization at B.P. Projects
						India Electric Syndicate	Kolkata	A		Galvanization at BMW Industries/B.P Projects
						Steelite engg.	Mumbai	A		
						Premier Power Products	Kolkata	A		Galvanising at Neha Galvaniser
						Indiana Gratings	Pune	A		Galvanization at Poona Galvanizer/ Anand Yeknow Aids Engg
						M.J. Engineering	Okhla/ Bhiwadi	A		
						Jamna Metal	Delhi/ Kundli	A		
						T.R.G	Chennai	A		Galvanization at TM Radhakrishna Chetty & Co
						Amtech	Pune	A		Galvanization at B.G. Shirke - Pune
						Kannade Anand Udyog	Mumbai	A		Fabrication at their units: Plot No. 42, Moriv District Thane & Plot No.: D-35 Anand Nagar MIDC, Addl. Ambernath , Dist.Thane Galvanization and offer the galvanized cable trays for inspection at D-34 Anand Nagar MIDC, Addl. Ambernath, Dist.Thane.
						Rukmani	Raipur	A		Ladder type cable trays only
						Passive Infra	Hasangarh (Rohtak)	A		
						Unitech Fabricators &	Howrah/	A		

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Sl. No.	ITEM	QP / INS CAT.	QP No:- 9578-001-QVE-	QP SUB. SCH.	QP APPL SCHEDULE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC AP PL SC HE DU LE	REMARKS
						Engineers	Hoogly (Kolkata)			
						Patny System	Hyderabad	A		Galvanisation at Gurpreet galvaniser - Hyderabad
						Rabi Engg	Kolkata	A		Galvanizing from NTPC approved sources
						Advance Power Products	Howrah	A		
						Maheswari Electricals	Noida	DR		
						Saral Industries	Raibareli	DR		
						Parmar Metal	Rajkot	DR		
						Pentax	Mumbai	DR		
						Eros metal	Nagpur	DR		
						Vinfab	Thane	DR		
						Namdhari	Ludhiana	DR		
						Indmark Formtech	PUNE	DR		
11.	Cable tray flexible support system (GI)	I	9			Vatco	Mumbai	A		Galvanising at Sigma Mumbai
						Inar profiles	Enkapalli	A		
						Industrial perforations	Kolkata	A		
						Premier power products	Kolkata	A		Galvanising at Neha Galvaniser
						Steelite engg.	Mumbai	A		
						Indiana gratings	Pune	A		Galvanising at Poona Galvaniser
						Amtech	Pune	A		Galvanising at B.G. Shirke
						Ratan Projects	Kolkata	A		Galvanization at NTPC approved sources
						Indmark Formtech	PUNE	DR		
12.	Lead coated steel flexible conduits	III				M/s PLICA	Ghaziabad	A		
						M/s Lapp	Germany	DR		
						M/s Bansal Labs	Bhopal	A		

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Sl. No.	ITEM	QP / INS CAT.	QP No:- 9578-001-QVE-	QP SUB. SCH.	QP APPL SCHEDULE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHEDULE	REMARKS
13.	Junction boxes / Link Boxes/ Test Link Box/ Adopter box, Switch Boxes, Pull Boxes (Hot Dip Galvanized)	III				Main contractor approved sources with galvanization from NTPC approved sources (Note-2)		Noted		
14.	FRP Junction boxes	II	10			Main Contractor approved sources		Noted		
16.	Cable glands	III				Main contractor approved sources		Noted		
17.	Cable lugs	III				M/s Dowell	Mumbai	A		
						M/s Billets Elektro Werke Ltd.	Umbergaon	A		

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						(3 D)				
						M/s Chetna	Nasik	A		
						Additionally Any make's model with VDE or CE or UL or CSA marking or BIS approved with CML no. Refer Note-3		Noted		

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एनटीपीसी NTPC	PROJECT :Patratu STPP (2X660 MW) PACAKGE :EPC Sub Package: Electrical Equipment Supply & Erection CONTRACTOR : M/S BHEL CONT. NO. CS-9585-001-2	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR Contractor-M/S BHEL	REF NO : 9585-001-QOE-R-01 REVISION NO. 00 DATE 24th April 2017

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26.	PVC conduit/hume pipe/lighting wire/GI pipes/HDPE pipe/Structural Steel	III				BIS licensee / ISI marked with valid CML number		A		
27.	GI steel rigid conduit/ epoxy conduit	III				BIS licensee with valid CML number		A		

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NB:
Under Sub Supplier approval status as per NTPC column:
A: mean that vendor for this item is acceptable to NTPC.
Under QP / INSPN CATEGORY column:

CAT-I : For these items the Quality Plans approved by NTPC & 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 basis of verification 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 basis of certificate of conformance by the main supplier.
@ : Vendors acceptance is subject to sub-QR clearance.
Note-1- Approval conditions attached to above identified vendors, as applicable shall be adhered to.
Note-2 – List of NTPC acceptable galvanizers

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एनटीपीसी NTPC	PROJECT :Patratu STPP (2X660 MW) PACAKGE :EPC Sub Package: Electrical Equipment Supply & Erection CONTRACTOR : M/S BHEL CONT. NO. CS-9585-001-2	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR Contractor-M/S BHEL	REF NO : 9585-001-QOE-R-01 REVISION NO. 00 DATE 24th April 2017

Sl. No.	ITEM	QP / INS CAT.	QP No:- 9578-001-QVE-	QP SUB. SCH.	QP APPL SCHEDULE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHEDULE	REMARKS

1. M/s M J Engg,Delhi 2. M/s Jamna Metal,Delhi 3. M/s A.V. Engg, Kolkata 4. M/s Inar Profiles, Vishakapatnam 5. M/s Anand Udyog, Mumbai 6. M/s Techno Engg,Chandigarh 7. M/S Steelite Engg, Mumbai	8. M/s National Galvanizer, Kolkata 9. M/s Unistar Galvanizer, Kolkata 10. M/s B.P. Project. Kolkata 11. M/s Bajaj Pune 12. M/s Electrocare Industries, Mumbai 13. M/s B.G. Shirke, Pune 14. M/s Gurpreet Galvanizer, Hyderabad 15. M/s Sigma, Mumbai	16. M/s Radhakrishnan Shetty, Chennai 17. Karamtara Mumbai 18.Poona Galvanizers Pune 19. Neha Galvanizer- Kolkata 20. Unitech galvanizers- Hoogly 21. Gurpreet galvanizers- Hyderabad 22- DMP Projects- Kolkata	*Additional galvanizer/s , if any , proposed by manufacturer through main contractor during detailed engineering shall be reviewed & assessed by NTPC as per the merits of the case.*

Note-3 : VDE / CE / UL / CSA MARKING FOR PRODUCT QUALITY: SELF CERTIFICATION/VALID CERTIFICATION FROM THIRD PARTY AGENCY OR BIS APPROVAL LETTER WITH CML NO. FOR PRODUCT QUALITY SHALL BE SUBMITTED FOR NTPC's INFORMATION

NTPC

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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.
	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

ANNEXURE-IV

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)

LOAD DATA (ELECTRICAL)	JOB NO.	434	ORIGINATING AGENCY		PEM (ELECTRICAL)
	PROJECT TITLE	3x800MW PATRATU STPP	NAME		DATA FILLED UP ON
	SYSTEM	LIME DOSING/FEEDING SYSTEM	SIGN.		DATA ENTERED ON
	DEPTT. / SECTION	MAUX	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE

CABLE LISTTING FORMAT

CABLE ID	FROM	TO	PURPOSE	CABLE SCOPE (BHEL PEM/VENDOR)	REMARKS	CABLE SIZE	PATH CABLE NO

CLAUSE NO.	Bidder's Name ……..	एनटीपीसी NTPC

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	

CLAUSE NO.	Bidder's Name ……..	
	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	

CLAUSE NO.	Bidder's Name ……..	
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.**	

CLAUSE NO.	Bidder's Name ……..	
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)	

CLAUSE NO.	Bidder's Name ……..	
	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	

SECTION-I
SUB-SECTION-C4

C&I SPECIFICATION FOR
LIME FEEDING/ DOSING SYSTEM

INDEX

S. No.	DESCRIPTION
1	TITLE SHEET
2	INDEX SHEET
3	C&I SPECIFIC TECHNICAL REQUIREMENTS
4	GENERAL TECHNICAL SPECIFICATION
5	LIST OF DOCUMENTS/DELIVERABLES
6	MEASURING INSTRUMENTS (PRIMARY & SECONDARY)
7	DATA SHEETS FOR MOTORISED VALVE ACTUATOR
8	SIGNL EXCHANGE BETWEEN DRIVES & DCS
9	DRIVE AND INSTRUMENT INTERFACE DIAGRAM
10	INSTRUMENT CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY
11	QUALITY ASSURANCE
12	TYPE TEST REQUIREMENT
13	INSTRUMENT STUB DETAILS
14	INSTRUMENT INSTALLATION DRAWING
15	SUB VENDOR LIST
16	FORMAT FOR PROVENNESS CERTIFICATE

C&I SPECIFIC TECHNICAL REQUIREMENT
FOR DCS BASED
LIME FEEDING/DOSING SYSTEM

Specific Technical Requirements (C&I):

1. LIME FEEDING/DOSING SYSTEM (LDS) shall be operated from DCS (BHEL's scope).

2. The Contractor shall provide complete Instrumentation for control, monitoring and operation of entire WWS except marked as BHEL's scope in P&ID attached in specification. 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.

3. The make/model of various instruments/items/systems shall be as per NTPC approved vendor list. No commercial and delivery implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

4. All instruments and control elements shall be terminated on JB/LCP in field. JB/LCP is 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 mtrs) and trunk cable.

5. For cable scope refer to electrical scope between BHEL and vendor defined in electrical specification.

6. Bidder to provide mandatory spares as per mandatory spares list.

7. Electrical Actuators with integral starter shall be provided for all on/off and inching type valves along with necessary interface units for linking to corresponding Control System as applicable, typical Hook-up diagram of drives is included for reference.

8. The specifications for instruments mentioned in the specification are minimum requirements. The detail specifications shall be finalized during detail engineering.

9. 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.

10. 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.

11. 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.

12. 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.

13. 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. The make/model of various instruments/items/systems shall be as per customer/BHEL approved vendor list. No commercial and delivery implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

14. 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/ analyser installation not covered in the same shall be subject to customer and BHEL approval during detailed engineering.

15. 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.

16. Bidder to provide temperature sensor along with temperature transmitter for HT drives i.e. Pump and Motor for BRG and winding temp measurement.

17. 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.

18. 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.

19. Bidder to furnish electrical load/UPS load data during detailed engineering. 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.

20. 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.

21. Local control panel if any required for operation shall be in bidder scope.

22. The solenoid operated valves/Dampers/Gate shall have a limit switch for open/close feedback. Solenoid Valve shall be rated for 24V Dc only.

23. All field instruments enclosure shall be IP65 local panel/cabinet enclosure shall be IP 55, unless otherwise specified.

24. Diaphragm seal shall be provided with Instruments having contact with corrosive media.

25. Redundancy of sensors shall be provided by bidder

    (i) Triple redundancy for all Analog and binary inputs required for protection of system/drives.
    (ii) For all other control functions dual redundancy of the sensors shall be provided by the bidder.

26. Double root valve shall be provided for all pressure tapings where the pressure exceeds 40kg/cm2.

27. Use of process actuated switch shall be avoided unless unavoidable.

28. 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

29. Instrument installation shall be as per the attached "Standard Hook-up diagram of instrument."
30. 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.
31. In case of any conflict and repetition of clauses in the specification, BHEL discretion will prevail.
32. Measuring instruments (primary & secondary), analysers offered for this package shall have at least one year's satisfactory operation in one power station having unit rating of 200 MW or above. Provenness certificate shall be provided as per the attached format (Annexure - 1).

33. All the outdoor field instruments such as analysers/transmitters/meters etc. shall be provided with suitable Free standing cabinet(s)/panel/rack so that the equipments are protected against rain/ sunlight etc.

34. 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.

35. Analyzers shall be under bidder's scope. Comprehensive Annual Maintenance Contract (AMC) for three (03) years after warranty period shall be provided by the contractor for analyser instruments. Details enclosed under C&I specification. (Annex-2)

GENERAL TECHNICAL SPECIFICATION CONTROL & INSTRUMENTATION

FORM NO. PEM-6666-0

BHEL	**SPECIFICATION FOR CONTROL & INSTRUMENTATION FOR AUX PACKAGES**	SPECIFICATION NO. **PE-TS-434-571-A102**
		VOLUME
		SUB SECTION
		REV. NO. / DATE :
		SHEET / OF

GENERAL REQUIREMENT

1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems.

2.0 The quantity of instruments for auxiliary system shall be as per tender P &ID wherever provided 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.

3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by the employer' during detail engineering.

4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc for external connection including spare contacts shall be wired out to suitably located junction boxes.

5.0 The customer specification attached as Specific Technical Requirement will supercede the Data sheets, if there is any mismatch.

LIST OF DOCUMENTS/DELIVERABLES

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT			
Sl. No.	**DRAWING NO.**	**DRAWING/DOCUMENT TITLE**	**CATEGORY**
1	PE-V4-434-145-I901	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM WITH SET POINTS	A
2	PE-V4-434-145-I902	CONTROL SCHEME/LOGIC DIAGRAM (TO BE IMPLEMENTED IN DDCMIS)	A
3	PE-V4-434-145-I903	HMI PICTURES/PLANT SCHEMATICS	A
4	PE-V4-434-145-I904	INSTRUMENT SCHEDULE WITH SET POINTS	A
5	PE-V4-434-145-I905	I/O LIST (ANALOG & BINARY)	A
6	PE-V4-434-145-I906	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	A
7	PE-V4-434-145-I907	FIELD JB/LIE/LIR,DRIVES TERMINATIONS	A
8	PE-V4-434-145-I908	DATASHEETS FOR INSTRUMENTS, JBs, etc.	A
9	PE-V4-434-145-I909	QUALITY PLANS (INSTRUMENTS, VMS, etc.)	A
10	PE-V4-434-145-I910	INSTRUMENT HOOK-UP DRAWING	A
11	PE-V4-434-145-I911	THERMOWELL SIZING CALCULATION	A
12	PE-V4-434-145-I913	CABLE SCHEDULE & INTERCONNECTION	A
13	PE-V4-434-145-I914	ANNUNCIATION & SOE LIST	A

NOTES:
ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TECHNICAL IMPLICATION.

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.

MEASURING INSTRUMENTS (PRIMARY & SECONDARY) & SPECIFICATION FOR ELECTRONIC TRANSMITTERRS

CLAUSE NO.	TECHNICAL REQUIREMENTS
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.

CLAUSE NO.	TECHNICAL REQUIREMENTS

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.	Accuracy	± 0.1% of calibrated span (minimum)
3.	Output signal range	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol)
4.	Turn down ratio (minimum)	10:1 for vacuum/very low pressure applications (i.e. pressure <= 200 mmWC) 5:1 for very high pressure application (i.e. pressure >= 200 Kg/cm2) 30:1 for other applications
5.	Stability	± 0.1% of calibrated span for six months for Ranges up to and including70 Kg/cm² ± 0.25% of calibrated span for six months for Ranges more than 70 Kg/cm²
6.	Zero and span drift	+/- 0.015% per deg.C at max span +/-0.11% per deg.C at min. Span
7.	Load impedance	500 ohm (minimum)
8.	Housing	Weather proof as per IP-65, metallic housing with durable corrosion resistant coating
9.	Over Pressure	150% of max. Operating pressure
10.	Connection (Electrical)	Plug and socket type
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. -2 valve manifold for absolute & Gauge pressure transmitters, 3-valve and 5 valve manifold for DP/Level/Flow applications. The valve manifold shall be non integral type (except Fuel Oil area).

		-For hazardous area, explosions proof enclosure as described in NEC article 500 Mounting: 2 inch pipe mounting.
14.	Diagnostics & display	Self-Indicating feature and digital display on transmitter
15.	Power supply	24V DC ± 10%.
16.	Adjustment/calibration/maintenance	From hand held HART calibrator/ centralized PC based system (as applicable).

Notes

- For primary air/ secondary air/flue gas applications, DP type transmitters shall be provided for pressure measurement.
- 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.

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 & Material	(i) Coaxial probe of SS316/316L. If required, probe shall be 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/ centralized PC based system (as applicable).
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).

CLAUSE NO.	TECHNICAL REQUIREMENTS	

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/ centralized PC based system (as applicable). .
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.

CLAUSE NO.	TECHNICAL REQUIREMENTS

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. No.	Features		Essential/Minimum Requirements
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.

2) For boiler metal temperature applications, considering the location of installations and response time, manufacturer's standard and proven specification for metal temperature measurement can also be accepted subject to employer's approval. The manufacturer shall submit adequate supporting documents for establishing their standard and proven practice.

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 **Not Used**

3.06.0 **TEMPERATURE TRANSMITTER (TT)**

Following types of 2-wire (loop powered) temperature transmitter (directly powered from 4-20mA input cards of DDCMIS/PLC) shall be provided. The temperature transmitter shall be fully compatible with thermocouples and RTDs being provided by the contractor. Temperature compensation of the thermocouples shall be performed in the temperature transmitter itself.

a. Single Input Head mounted Temperature Transmitter

These shall be suitable for mounting in the head of temperature element itself. Temperature transmitter and associated temperature element shall be factory fitted.

b. Single Input DIN-rail mounted Temperature Transmitter

These shall be suitable for mounting on DIN-rails in JBs. The specifications of the JBs shall be same as indicated in Subsection INST CABLE with additional DIN-rails and IP 65 Protection class. This temperature transmitter shall be the ones which are

especially designed for DIN-rail mounting with IP 20 protection class. These shall have terminals for input/output provided on front side when mounted on DIN-rail. Head mounted temperature transmitter with clamps to make it suitable for DIN-rail mounting shall not be acceptable under this category.

c. Dual-input Temperature Transmitter With **integral** Indicator:

These shall be suitable for mounting on pipes/ support. Both elements of the duplex thermocouple/ RTD shall be wired to a single transmitter. Integral indicator shall be provided with these transmitters. These transmitters shall have bump less change over facility to second sensor in case first sensor fails .This change-over is to be alarmed. Protection class shall be IP65 minimum.

d. Common requirements for each of the above type of temperature transmitters.

Output	:	2-wire (power supply from input card of Control System) with 4-20mA output with superimposed HART protocol signal.
Input	:	Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K & R types (input type to be selectable at site through HART terminal).
Isolation	:	Min. 500 V AC.
EMC compatibility	:	As per EN 61326.
Operating ambient temperature	:	0 to 85 deg C (without indicator). 0 to 70 deg C (with indicator).
Power supply		24V DC +/- 10%.
Accessories		Mounting arrangements including clamps etc.
Composite Accuracy (Refer note 2)	(i)	For head mounted and DIN-rail mounted types: RTD =<0.4% of 0-250 deg C span T/C-K type =<0.4% of 0-600 deg C span T/C-R type =<0.4% of 0-1000 deg C span CJC accuracy (for thermocouples) shall be =< 1 deg C
	(ii)	For dual-input type: 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

e. Field bus compatible temperature transmitters

Temperature transmitters of this category shall be field mounting type & shall be capable of withstanding operating ambient temperature upto 85 deg C. These modules shall be connected to DDCMIS through field bus such as Profibus, Foundation Field bus etc directly from the transmitter. Maximum Number of inputs per such temperature transmitter shall be eight. These shall be mounted in cabinets/enclosures/JBs in non-AC areas.

As an alternate, these signals from temperature transmitters can be connected to DDCMIS through standard remote I/O modules of the DCS, in which case, the temperature transmitter signals will be acquired through 4-20mA input modules in the remote I/O cabinet for connecting to DDCMIS through remote I/O bus.

Air conditioned panel shall be provided for remote I/O.

Notes ***(Common for a) to d) above):-***

1. In case of failure (open or burn-out) of RTD/thermocouple, temp. Transmitter shall provide low temperature output.
2. Composite Accuracy is to be calculated as summation of all applicable accuracies of temp transmitter, for converting sensor input to output in 4-20 mA (e.g., basic accuracy, digital accuracy, D/A 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/ temp 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 are to be interchangeable (i.e. can be used for either RTD or thermocouple) and composite accuracy shall be met for each type of input specified in (i) & (ii).

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8. Should support primary and secondary mean values of user defined time interval.

9. Should have data backup facilities

10. Should have the facilities for calculation of Arithmetic mean values, average ½ hr, 1 hr, 2 hrs, 3 hrs, 4 hrs, 8 hrs, 12 hrs, 24 hrs, weekly monthly and yearly

11. Minimum, Median, percentile, Maximum, standard deviation frequency analysis and cumulative frequency analysis

12. Calculation of pollution load and Wind Roses

13. Reports of daily, weekly, annual and user defined period

14. Reports of Pollution load and Wind Roses, frequency analysis, and calibration

15. Should have the facilities of the following chart types:

- Line & column chart
- Simple 3 D, line & column chart
- Polar diagram and 3 D perspective column chart

11.03.03 **Data Communication System**

Each AAQMS station shall be connected to Central data Acquisition station through a two way wireless communication link. This shall allow for wireless transmission of data periodically to individual and central DAS & do the necessary communication between stations. Bidders shall determine the optimal antenna type required to achieve data transfer rate between all wireless access points. Contractor shall use for this purpose, approved and standard equipment like antennas and/or amplification devices etc required to achieve the above and shall provide agreement of technical support and support availability.

Contractor shall obtain necessary approval for Licenses authorizing the use of communication equipment specified frequencies.

12.00.00 **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.
	Viscosity range of Fluid	0-500cst for HFO

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.

13.00.00 SPECIFICATION FOR FLOW ELEMENTS

13.01.00 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.
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.

CLAUSE NO.	TECHNICAL REQUIREMENTS

13.02.00 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.
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.

13.03.00 **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

CLAUSE NO.	TECHNICAL REQUIREMENTS

	Root valve size	1 inch
	Impulse pipe of same material up to root valve	Required
	Tapping	3 Nos. of tappings for each Venturi as per ISO 5167-4:2003
	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.

13.04.00 **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.

14.00.00 POSITIVE DISPLACEMENT TYPE FLOW TRANSMITTERS

The Bidder shall provide positive displacement type flow transmitters for fuel oil flow measurement, suitable for the fuel oil being used for the project, i.e., keeping in view the pressure, temperature and viscosity of the fuel oil.

The meter shall be a volumetric meter type consisting of two meshing oval wheels driven by the fluid. Each revolution of the oval wheels shall displace a precisely known volume of the fluid from inlet to outlet. The housing/measuring chamber and oval wheels shall be of 316 SS.

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The measurement accuracy of the transmitter shall be better than +0.2%.

The transmitter shall provide suitable 4-20mA dc output signal for control and indication/recording. Converters if necessary shall be provided to generate the 4-20mA signal.

A local indicator of fuel oil flow shall also be provided. The instrument shall be calibrated in Tons/hr.

Suitable strainer shall be provided before the transmitter for the protection of oval wheel meters against foreign matter contained in the fuel oil.

The exact model no. and type of material being used, etc., shall be subject to Employer's approval during detailed engineering without any price repercussion to Employer.

15.00.00 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.

16.00.00 **NOT USED**

17.00.00 **SOLENOID VALVES**

Solenoid valves shall fulfil the following requirements:

a. Type 2/3/4 way SS 316/Forged Brass (depending on the application subject to Employer's approval during detailed Engg.)

b. Power supply : 24 V DC $\pm$ 10%.

c. Plug and socket electrical connection.

d. Insulation : Class 'H'

18.00.00 **REVERSE ROTATION INDICATOR (RRI)**

Reverse rotation indicator comprising of proximity sensors, processing electronics with output of 4-20mA (corresponding to speed) interconnecting cables, speed display in rpm,

CLAUSE NO.	TECHNICAL REQUIREMENTS

normal, reverse indication and required channel alarm contact shall be provided. The contact rating shall be 60VDC, 6VA (or more if required by Control system). The exact details of the RRI shall be strictly as approved by Employer during detailed engineering. The power supply of RRI is to be arranged by the Bidder

19.00.00 **WATER SYSTEM RELATED SPECIAL INSTRUMENTS (DM PLANT, CPU PLANT, PT PLANT, ETC)** as Applicable for LIME FEEDING/DOSING

19.01.00 **ANALYSER INSTRUMENTS:**

For Technical specification of Cation/Specific Conductivity, pH, Sodium, Silica, Turbidity, Total Dissolved Solids (TDS) and Concentration analysers, please refer Specification of Analysers, Part-B, Sub-section IIIC-13, SWAS chapter of this specification.

19.02.00 **Residual Chlorine Analyser**

a An automatic chlorine residual analyser of amperometric type shall be provided alongwith the chlorinating plant for monitoring the residual chlorine content of cooling water. The analyser shall be suitable for accurate residual measurement in open/closed systems. The measurement accuracy shall not be affected by presence of treatment chemicals as chromates, phosphates, de-former highly polluted water, change in temperature etc.

b The analyser shall comply with the following specification requirements, as a minimum

(i)	Indicator	:	Provision of LC display in the panel of analyser.
(ii)	Range	:	0 to 20.0 mg/L (ppm)
(iii)	Accuracy	:	2% or better
(iv)	Sensitivity	:	0.01 mg/1
(v)	Output signal	:	4-20mA DC isolated output,
(vi)	Alarm annunciation	:	High and low alarms to be provided on panel and shall be field adjustable.
(vii)	Calibration	:	Zero and span adjustment facility to be provided. Final calibration adjustments of the analyser to be done at site and duly verified by titration. Temperature compensation range 0 to 50degC.
(x)	Mounting	:	The analyser shall be suitable for field mounting conform to protection class IP-55.
(xii)	Electrodes	:	Platinum/Gold and copper electrodes shall be provided with cell cleaning system.

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

19.03.00 All the outdoor field instruments such as analysers/transmitters/meters etc. shall be provided with suitable Free standing cabinet(s)/panel/rack so that the equipments are protected against rain/ sunlight etc.

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19.04.00 Parshall Flume

The Bidder shall provide all the control and Instrument devices including primary sensors, transmitters, flow indicator cum integrator / totaliser and shall include all required accessories for the flow measurement of raw water through the clarifier. The system shall be of reputed make and acceptable to the owner.

Level measurement shall be based on ultrasonic/radon technology. The flow compensation is to be implemented in the transmitter itself. The transmitter shall provide 4-20 mA DC in direct proportion to flow and shall be able to drive a load impedance of 500 ohms minimum

Accuracy shall be +/- 1 % or better.

All the mounting hardware and accessories required for erection and commissioning of the same are to be provided by the contractor. Mounting fittings material shall be SS316. All weather canopy is to be provided for electronics/sensor to protect the same from rain/ sunlight etc.

The Type makes and models no. shall be subject to Owner's approval.

19.05.00 Electronic Flow-Meter

The electronic flow meter shall include flow sensor and flow indicator cum integrator / totaliser and shall include all required accessories for satisfactory operation. The flow meter shall be based on full bore electromagnetic principle and shall be electronic type of proven design, make and model acceptable to the owner.

The Bidder shall submit all necessary technical literature and details of selection criteria of the instrument offered to substantiate the model selected. The Bidder shall also furnish list of similar installation along with feed back on satisfactory performance of the instruments.

The flow meter shall meet or exceed the following requirement :

(a)	Output	:	4-20 mA DC Isolated output
(b)	Accuracy	:	± 0.5% of calibrated span or better *
(c)	Repeatability	:	± 0.2% of calibrated span or better
(d)	Power Supply	:	240V AC ± 10%, 50 HZ ± 5%/ 24 V DC, to be arranged by the contractor.
(f)	Protection class	:	IP-55
(e)	Flow tube		SS304
(f)	liner		Hard Rubber

The flow meter shall provide local indication for instantaneous flow. It should also be possible to get local display for daily and monthly discharge. The flow meter shall indicate totaliser/ integrator to get the daily and monthly discharge as stated above.

20.00.00 AC PLANT RELATED SPECIAL INSTRUNMENTS

20.01.00 HUMIDITY SENSOR

Sensor	:	Capacitance type
Accuracy	:	+/-3% R.H
Range	:	0-100% R.H
Output	:	4-20 ma

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21.00.00	**Limit switches** For offsite plant application Limit switches shall be gold plated with high conductivity and non corrosive type. Contact rating shall be sufficient to meet the requirement of DDCMIS subject to a minimum of 60 V, 6 VA rating. Protection class shall be IP 55. For main plant application limit switches are to be provided as per contractor standard and proven practice.

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 and material	Bourdon for high pressure, Diaphragm/Bellow for low pr. Of 316 SS	Mercury in steel for below 450°C and inert gas actuated for above 450°C of SS bulb and capillary.	Tempered * toughened Borosilicate gauge glass steel armoured reflex or transparent type.
2	Body material	Die-cast aluminium	Die-cast aluminium	Forged carbon steel/304 SS
3	Dial size	150mm	150 mm	Tubular covering entire range
4	End connection	1/2 inch NPT (M)	3/4" NPT (M)	Process connection as per ASME PTC and drain/vent 15 NB
5	Accuracy	±1% of span	± 1% of span	± 2%
6	Scale	Linear, 270° arc graduated in metric units	Linear, 270° arc graduated in °C	Linear vertical
7	Range selection	Cover 125% of max. of scale	Cover 125% of max. of scale	Cover 125% of max. of scale
8	Over range test	Test pr. for the assembly shall be1.5 to the max. Design pr. at 38°C.		
9	Housing	Weather and dust proof as per IP-55	Weather and dust proof as per IP-55	CS/304 SS leak proof
10	Zero/span adjustment	Provided	Provided	--
11	Identification	Engraved with service legend or laminated phenolic name plate		

12	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.
13	Material of Bourdon/ movement	316 SS / 304 SS	316 SS / 304 SS	

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.

22.00.00

22.01.00 COMMON REQUIREMENTS FOR ALL ANALYSERS

Sno	Features	Minimum Requirement
1.	Output signals	Analog 4-20 mA DC galvanically isolated.
2.	Zero & span Adjustment	To be provided with range selection facility
3.	Ambient temp	50 degC
4.	Sample Temperature	40 degC
5.	Indication	Digital Alphanumeric Display of reading in engineering units shall be provided.

6.	Type of Electronics	Microprocessor based with self-diagnostic
7.	Calibration	Manual
8.	Others	All interconnection tubing and cabling between sensor and analyzer / analyzer panel etc to be provided. All chemical reagents required for EQMS analyzers for entire AMC period is to be supplied in phased manner depending on shelf life.
9.	Location of the Temp & flow measurement	Effluent Treatment plant outlet (Exact location to be decided by contractor in consultation with site)
10.	Location of the Analyser cabinet/enclosure	
11.	Accessories	All the accessories required for mounting the sensor/analyser are to be provided
12.	Digital Signal Transmission	Each analyser shall have a provision for bidirectional soft connectivity over Modbus/RS232/RS485 with employer's central cloud server in addition to 4-20 ma connectivity to DDCMIS.
13.	Compliance to standards	CPCB's (Central Pollution control Board) latest regulatory requirement prevailing at the time of execution of the contract.

22.02.00

22.03.00 **pH ANALYSER**

Type	Cell flow through sample
Measuring Range	0-14 units of pH
Temperature Compensation	Automatic
Power	To be arranged by the contractor.
Accuracy	<= +/- 1 %

3.00.00 **SPECIFICATION OF ANALYSERS**

3.01.00 Field proven reputed international make microprocessor based monitors/analyzers with LCD display and with necessary fault diagnostic features shall be employed. All analysers shall provide 4-20mA output signal capable of driving a load impedance of 500Ohms minimum. The type, size, capacity, material, make, model and other specification details of the rest of the SWAS system like coolers, gauges/switches, sample pipes, filter, pressure reducing elements, grab sampling arrangement, valves & fittings, panels etc. shall be as decided during detailed engineering stage and shall be subject to Employer's approval. The power supply to all the analysers/ monitors shall be supplied by Contractor from his UPS system with all necessary switches, fuses, wiring/cabling and other required accessories etc. for distribution to individual requirements.

Minimum specifications of analysers					
Requirements	**Conductivity**	**PH**	**Phosphate**	**Chloride**	**Turbidity**
Type	For Hotwell, Two removable Type of Cells, For Others, Continuous Flow Through Type	Cell Flow Through sample	Colorimetric	Continuous Flow Through Type with Chloride & Sulphate Responsive Electrodes	Light reflection principle
Accuracy	≤ ± 1%	≤ ± 1%	≤ ± 5% of reading	≤ ± 5%	≤ 2% for range 0-50 NTU, ≤ 5% for range 50 – 200 NTU

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Response Time (90 % of Full Scale)	≤ 5 sec.		≤ 16 min.		≤ 5 min.
Range	0-1, 0-10, 0-100 micro-mho/cm (freely programmable) for Specific Conductivity. 0-1 micro-mho/cm log scale for Cation conductivity	6-11 pH freely programmable	0-10 ppm freely programmable	0-1000 ppb freely programmable	0 – 100, 0-200 MTU, programmable
Temperature Compensation	Automatic/	Automatic	Automatic	Automatic	
Sample Flow			50-150 ml/min		
No. of Streams	Single	Single	Single	Single	

Minimum specifications of analysers …….continued

Requirements	**Hydrazine**	**Silica**	**Sodium**	**Dissolved O2**	**Total Iron (Fe)**
Type	Automatic Continuous Electrochemical Type	Continuous Colorimetric Type	Continuous Flow Through sample	Continuous Flow Through sample	Continuous Flow Through sample
Accuracy	≤ ± 5%	≤ ± 5% of reading	≤ ± 10% of reading	≤ ± 5% of reading	<±5 % of reading or ±0.005 ppm
Response Time (90 % of Full Scale)	≤ 3 min.	≤ 15 min. (including sample switching)	≤ 4 min.	≤ 30 sec.	≤ 15 min. (including sample switching)
Stability	Calibration Once in a Month		Calibration Once in a Month		

CLAUSE NO.	TECHNICAL REQUIREMENTS
4.00.00	**SAMPLE PIPING SYSTEM**
4.01.00	This shall include piping, fittings, valves and accessories from tapping point upto SWAS conditioning panel located in SWAS room on as required basis. All sample piping shall be 3/4" NB seamless type of material ASTM A213 TP 316 H, conforming to ANSI B36.19. The schedule number shall be suitable for the particular application.
4.02.00	All fittings shall be socket welding type and of material ASTMA182 F316H conforming to ANSI B 16.11.
4.03.00	Single and multi tubes shall run with the minimum number of changes in direction. Suitable identification tags shall be provided for easy check up and for proper connections.
4.04.00	The valves to be used in sample piping shall be of stainless steel conforming to ASTM A182. The pressure temperature ratings shall be as per ANSI B16.34. The valve design shall be such that the seats can be reconditioned and stem and disc can be replaced without

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removing valve body from the line. The specification of End size, Pressure class, Type, End preparation, Body, etc. for different type of valves are specified in SWAS table in Clause No. 4.06.00 of Subsection IIIC-09, Section-VI, Part-B.

4.05.00 **Material Specifications for Sample Pipe Lines**

The piping to be furnished and installed for water and steam analysis system shall be as indicated below:

	Piping System	Material
1.	Piping from the sample inlet bulk head fittings to the shut off valves	Stainless steel, ASTM A 213, Type 316H, 16 BWG tubing
2.	Piping for the high pressure samples and sample blow down piping	Stainless steel, ASTM A 213, Type 316 H. 14 BWG tubing
3.	Blow down header	Stainless steel, ASTM A 312, Type 304 Schedule 160
4.	Miscellaneous drains receiver holder	Stainless steel, ASTM A 312, Type 304 Schedule 40
5.	Piping from the shut-off valves to the terminal points including branch piping and the closed cooling water grab sample piping	Stainless steel, ASTM A 213, Type 316 H, 16 BWG tubing
6.	Closed cooling water piping except grab sample and water purge line	Carbon steel, ASTM A 53 Gr. A, Schedule 40.
7.	Sample through drain piping and waste header piping	Carbon steel, ASTM A 53 Gr. A, Schedule 40.
8.	Purge air piping/tubing and filling valves	Brass/Copper

4.06.00 **SWAS Valve Table:**

S. No.	Service / Location	End Size	Pr. Class	Type	End Preparation	Body	Make (as specified or equivalent)
1	Sample Shut off valve	0.38	6000	Globe	SW	316SS	Thiedig
2	Sample blow down valve	0.38	6000	Ball valve	SW	316SS	Thiedig
3	Solenoid valve	--	--	2 way	--	316SS	ASCO
4	Pr. reducing Valve	0.38	--	Needle	Tube	316SS	Thiedig
5	Safety relief Valve	0.25	3000	Relief	Tube	316SS	Nupro
6	PI and FI isolation valve	0.25	3000	Needle	Tube	316SS	Whiety
7	Back pr. regulating valve	0.25	300	C.W.	SCR	316SS	Cono. flow H30XT-

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							HAXXXG
8	Grab	0.25	300	3-way	Tube	316SS	Whiety
9	Quick	--	--	ball	--	316SS	Hancock Walther
10	Individual P.C. and S.C. inlet & outlet valve					316SS	Hancock/ ACKER MANN
11	P.C. I\L & O\L header & chilled water I\L & O\L isolation valve	--	--	Gate	--	316SS	Hancock
12	Safety relief valve at each PC & SC and cooling water header	--	--	Relief	--	316SS	Baldota
13	High Pressure reducing valve	--	--	--	--	316SS	--
14	Isolation valve before primary cooler	--	--	Needle	Tube	316SS	Whiety

5.00.00

KKS PHILOSOPHY

KKS NUMBERING PHILOSOPHY

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

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

X	X	X	A	A	Y	Y	B	B	B

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

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

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

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

DOCUMENT TITLE

KKS NUMBERING PHILOSOPHY

3 x 800 MW PVUNL PATRATU TPP PHASE-I

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.

CLAUSE NO.	TECHNICAL REQUIREMENTS
	CONTROL VALVES, ACTUATORS & ACCESSORIES
1.00.00	**CONTROL VALVES, ACTUATORS & 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.
1.01.03	For special type of control valves such as combined pressure and temperature control valves for Aux PRDS application, separator drain control valves, refer to the corresponding mechanical sections.
1.01.04	Specification for control valves in this Sub-section has to be read in conjunction with other relevant Sub-sections of this specification.
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 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 for application such as SH Spray Control, RH spray Control, Heavy Oil Heating, pressurizing and Control system, HP/LP heater Emergency level control, Emergency Make-up to condenser hotwell, GSC minimum flow, Deaerator Drain to Condenser Hotwell, Condensate spill to condensate reserve tank, condenser normal make-up and valve gland sealing supplying pressure control, CEPS minimum flow control, **BFP circulation control valve** shall have permissible leakage rate as per leakage Class V. All other control valves shall have leakage rate as per leakage Class-IV **as per ANSI / FCI /70.2,2006 or equivalent**.

CLAUSE NO.	TECHNICAL REQUIREMENTS

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 except for few cases as per contractor's standard and proven practice subject to employer's approval.

1.02.06 Control valves for steam and water application shall be provided with rangability of 30:1 for all services except for applications wherein control valves are envisaged to be operated in lower range like Reheater spray and superheater spray system wherein control valve with rangability of 50:1 shall be provided

2.00.00 VALVE CONSTRUCTION

2.01.00 All valves shall be of globe 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

Sr. No.	Service	Body material	Trim Material
1	Non-corrosive, non-flashing and non-cavitation service except DM water	Carbon steel ASTM-A216 Gr. WCB for design fluid temperature below 275 Deg. C Alloy steel ASTM-A217Gr. WC6 for design fluid temperature above 275 Deg. C and upto 400 Deg. C Alloy steel ASTM-A217Gr. WC9 for design fluid temperature above 400 Deg. C	316SS stellited with stellited faced guide posts and bushings.
2.	Severe flashing/cavitation services	Alloy steel ASTM-A217 Gr. WC9	440 C

CLAUSE NO.	TECHNICAL REQUIREMENTS

3.	Low flashing/cavitation service	Alloy steel ASTM-A217 Gr. WC6	17-4 PH SS
4.	DM water service	316 SS	316 SS

NOTE: (a) Valve body rating shall meet the process pressure and temperature requirement as per ANSI B16.34.

(b) Severe flashing / cavitation services includes as a minimum all control valves whose downstream piping is connected to condenser or flash tank.

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.

Contractor shall ensure that all required measures like proper selection of anti-corrosive/erosive material along with durable epoxy coating with polyurethane finish shall be provided for all the C&I equipment/ devices being supplied in this contract, which are mounted in non-AC areas (prone to sea water environment corrosion / erosion) like measuring instruments, control valves & actuators, JBs, LIEs / LIRs, impulse pipes, sample pipes, fittings, conduits, cable trays and accessories, local control panels, erection hardware items etc. Contractor shall furnish their comprehensive proposal regarding the anti-corrosion/ erosion measures for protection against sea water environment which shall be finalized during detailed engineering subject to Employer's 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 finalized 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 except for pressure and temperature control valve for auxiliary PRDS application (electro-hydraulic / pneumatically operated) and separator drain control valve (electro-hydraulic type).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.

CLAUSE NO.	TECHNICAL REQUIREMENTS

6.00.00 **CONTROL VALVE ACCESSORY DEVICES**

6.01.00 All pneumatic actuated control valve accessories such as air locks, hand wheels/hand-jacks, limit switches, microprocessor based electronic 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 ELECTRONIC POSITIONER**

1	Electrical	a) Input Demand 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	Position sensing, 4-20 mA output signal to be provided for control system.
2	Environment	a) Operating temp.	(-)30 To 80 Deg. C
		b) Humidity	0-95 %
		c) Protection class	IP-65 Minimum
3	Software for Configuration and Diagnostics	Software	Software shall meet the requirements for Configuration, Diagnostics, Calibration and Testing of the actuator.
		Diagnostic/Test features	Advanced diagnostic features like Stroke counter or Travel counter, Leakage in actuators, Valve Signature analysis, Step Response test, Valve friction /Jamming detection etc to be provided.
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.	Remote & Local Calibration, Auto & Manual Calibration shall be possible.	
6	Operating Range	Full range/ Split range.	
7	Modes	Valve Action	Direct / Reverse Valve Action

		Flow Characterization	Possible to fit Valve Characteristic Curves- Linear , Equal percentage etc.
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 & actuators selected/ Boosters to be supplied, if required.
		Air pressure	To suit the air supply pressure/quality available.
		Process connection	¼" NPT
10	Performance	Characteristic deviation	<=0.5 % of span.
		Ambient temp effect	<=0.01 %/ deg C or better.
10	EMC & CE Compliance	Required to International Standard like EN/IEC.	EN50081-2 & EN50082 or equivalent.
11	Accessories	In-built Operator Panel	Display with push buttons for configuration and display on the positioner itself (Password protected/Hardware lock).
		Hand Held Hart Calibrator	Universal Hart Calibrator to be provided (for quantity, refer Part-A: Contract quantities of the specification).
		Press Gauge Block	For supply & output pressures, Air Filter Regulator and other accessories shall be provided on as required basis for making system complete.
		Electrical Cable Entry	1/2'"NPT, side or bottom entry to avoid water

			ingress.
		Valves Mounting Assembly	For Sliding Stem/Rotary/Single acting/Double acting actuators on as required basis

*** Note**:

The HART signals shall be picked up from marshalling terminals of DDCMIS (SG/TG DDCMIS as well as BOP DDCMIS), as applicable. The details of the above mentioned HART management system specification are mentioned in HART system (Annexure IIIC-02C to DDCMIS).

The positioners shall be monitored from this HART management system .To achieve this, Bidder shall provide the necessary software to achieve the functionalities described above under " Software for Configuration and Diagnostics", and this software shall be loaded in the HART management system.

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/ FCI 70.2 standard 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: Please refer Cl No. 1.00.00 & 3.00.00 OF Sub-section- IIIC-10 (Type test requirements), Control Valves.

Bidder shall furnish all the control valves under this main plant package as finalized 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 – B-23

VFD

CLAUSE NO.	TECHNICAL REQUIREMENTS

1.00.00 CODES AND STANDARDS

DC Reactor	IEC: 60289
Motor	IS: 4722/IS: 325/IEC: 60034/NEMA 30 & 31
Transformer	IEC: 60076/IS: 2026, IEC: 61378
Dry transformer	IS: 11171
VFD	IEC: 60034/ IEC: 61800
Harmonics & EM compatibility	IEEE: 519/IEC: 61000
Contactor/Switches/Fuses etc.	IEC: 60947, IS: 13947

2.00.00 OPERATING CONDITIONS

2.01.00 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% shall be considered.

2.02.00 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.

2.03.00 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.

2.04.00 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 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 and upto 1500 KW : Medium Voltage, Three Phase AC

Note: The voltage level mentioned above is the Nominal Voltage which is fed to the motor from the VFD.

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.

2.05.00 For Power Cables & Control Cables, please refer technical specification given elsewhere in the document.

CLAUSE NO.	TECHNICAL REQUIREMENTS
3.00.00	**SYSTEM DESCRIPTION**
3.01.00	The VFD System shall include the following equipment for each drive. a) Power/control panels consisting of line converters, inverters and control system for drive including complete control & protection of drive and the motor. b) VFD transformer on the source side, as per system requirement. c) Breaker/Contactor on the VFD/Motor/Transformer/CT/PT/Meters/Bypass (if applicable) side with complete Control, Protection and Diagnostics features of the VFD, as per system requirement. d) Bypass Arrangement of the VFD system if specified. e) DC air core reactor or capacitor, as per the system requirement. f) Inverter Duty Motor suitable for VFD application g) Power & control cables and cabling as required under the scope of supply in the technical specifications.
4.00.00	**GENERAL REQUIREMENTS**
4.01.00	**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.
4.02.00	**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.
4.03.00	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.
4.04.00	The offered equipment shall be with state of art technology and proven field track record. No prototype equipment shall be offered.
4.05.00	The VFD model offered shall be from the existing VFD model series in the regular manufacturing range of the manufacturer. Along with the offer the Vendor shall submit the supply record and satisfactory performance record for **2 (two)** years running of the offered VFD supplied in India or abroad.
4.06.00	The VFD manufacturer shall ensure the proper coordination of their VFD with the Driven Motor and the Employer`s system. All the Motors which are to be driven by VFDs will be of Inverter duty type. The VFD operation shall have no inherent detrimental impact on the Motors/ cables & employer`s system.
4.07.00	Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least for 15 years from the date of supply. After this period, if vendor

CLAUSE NO.	TECHNICAL REQUIREMENTS
	discontinues the production of spare parts, vendor shall give at least twelve (12) months' notice prior to such discontinuation so that owner may order his requirements of spares in one lot. The offered VFD manufacturer should have their maintenance service & spares supply network in India to provide quick maintenance service & Spares supply support. The vendor shall indicate the source for supply of spares & Maintenance service location in India.
5.00.00	**TECHNICAL AND OPERATIONAL REQUIREMENTS**
5.01.00	The system shall be designed to deliver the motor input current and torque for the complete speed torque characteristics of the driven equipment, with maximum input supply voltage and frequency variation. The system shall be suitable for the load characteristics and the operational duty of the driven equipment.
5.02.00	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.
5.03.00	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
5.04.00	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.
5.05.00	The compliance shall be verified by the contractor by Harmonic studies conducted with maximum and minimum fault level, cable capacitance, system equipment reactance etc. Finally, the compliance shall be verified by the field measurements of harmonics at the PCC with and without VFDs operation.
5.06.00	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.
5.07.00	The system shall be suitable to maintain speed variation within range 10-110% with speed set accuracy of +1% of rated maximum speed and steady state regulation of +0.5% of rated speed as per system requirement.
5.08.00	The VFD System shall maintain a power factor of 0.95 (minimum) from 25 % to 100 % of rated speed.
5.09.00	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.
6.00.00	**VFD COMPATIBILITY WITH THE MOTOR**
6.01.00	For MV VFD Drives, to ensure that there are no problems with motor heating, VFD output current waveform, as measured at the motor, shall be inherently sinusoidal at nominal loads,

CLAUSE NO.	TECHNICAL REQUIREMENTS
	with a total harmonic current and voltage distortion within acceptable/standard limits. VFD utilizing output transformers are not acceptable.
6.02.00	The system design shall not have any inherent output harmonic resonance in the operating speed range.
6.03.00	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.
7.00.00	**BYPASS ARRANGEMENT (OPTIONAL, IF SPECIFIED)**
7.01.00	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.
7.02.00	Comprehensive motor protection scheme for protection and control for operation VFD during bypass mode shall be finalized during detailed engineering.
8.00.00	**STANDBY VFD ARRANGEMENT (OPTIONAL, IF SPECIFIED)**
8.01.00	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.
9.00.00	**EFFICIENCY**
9.01.00	Efficiency (Drive only) shall be minimum 98% for both MV VFD and LV VFD. Overall efficiency shall be minimum 96.5% for both MV and LV 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.
9.02.00	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.
10.00.00	**COOLING SYSTEM**
10.01.00	The VFD shall be designed to operate indoor under temperature range of 0 deg C to 50 deg C and relative humidity of 95%.
10.02.00	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.
10.03.00	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.
10.04.00	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

CLAUSE NO.	TECHNICAL REQUIREMENTS
	proper operation of the air cooling system. If the fan fails, the system must generate the alarm/trip for the fan failure.
11.00.00	**VFD TRANSFORMER:**
11.01.00	Type: Out door, Mineral oil filled ONAN type or Indoor natural air-cooled Dry type, Three phase unit, rectifier/converter duty type transformer.
11.02.00	Transformer shall be suitable for operation with non-sinusoidal wave shape and DC components under normal and abnormal conditions of the system without exceeding the temperature.
11.03.00	Suitable Design Margin as per applicable standards shall be taken for purpose of sizing of the transformer.
11.04.00	All other components, technical parameters shall be as per applicable IEC/IS.
12.00.00	**POWER CONVERTER:**
12.01.00	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.
12.02.00	The converter shall be co-ordinated with the transformers. The converter shall be able to withstand a three phase short circuit current until interrupted by normal breaker operation.
12.03.00	Adequate short circuit and over voltage protection shall be provided for the converter and inverter system.
12.04.00	All power converter devices shall include protective devices, snubber networks and dv/dt networks as required.
12.05.00	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.
12.06.00	All power diodes shall be of silicon type with minimum VBO rating at 2.5 times the rated operating voltage.
12.07.00	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.
12.08.00	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.
13.00.00	**OUTPUT FILTER (AS APPLICABLE):**
13.01.00	Output/ du/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.
14.00.00	**DC LINK CAPACITOR (AS APPLICABLE):**
14.01.00	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

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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.

15.00.00 ENCLOSURE

15.01.00 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.

15.02.00 The cable entry shall be from the bottom of the panel and a removable bolted un-drilled gland plate.

15.03.00 All Panels shall be of dust-proof and vermin-proof construction and shall be provided with a degree of protection of IP: 4X as per IS/IEC 60947.

15.04.00 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.

15.05.00 Each panel shall be provided with illuminating lamp, space heater with switch fuse and variable setting thermostat.

16.00.00 PAINTING

Paint shade shall be as follows

a)	VFD transformer	:	RAL 9002 (Grey), 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)
d)	VFD reactor enclosure	:	RAL 5012 (Blue), legend in black letter

17.00.00 BREAKER/CONTACTOR

17.01.00 **Type:** Shall be SF6 or Vacuum type or air-break restrike free, stored energy operated and with electrical anti-pumping features.

17.02.00 These shall be electrically operated, mechanically latched type & shall have protection against over load, all AC/DC transients and voltage surges etc. Electronic control module shall be electrically isolated.

17.03.00 All other components, technical parameters shall be as per applicable IEC/IS.

18.00.00 MOTORS

18.01.00 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.

18.02.00 Motors shall also meet the requirements mentioned in subsection for motors and relevant IS/IEC.

CLAUSE NO.	TECHNICAL REQUIREMENTS
18.03.00	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.
18.04.00	Motor insulation shall be designed to accept the applied voltage waveform, within the Vpeak and dv/dt limits as per IEC-61800.
18.05.00	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.
19.00.00	**CABLES & CABLING**
19.01.00	All the power cable for the VFD System shall have sufficient current capacity and shall be suitably sized to meet the load demand on the motor.
19.02.00	VFD Manufacturer shall submit cable sizing & selection criteria of drive cables including grounding/ earthing philosophy to address all the key issues such as EM Noise emissions, Common mode noise, voltage reflections, stray capacitances etc., for owner`s review and approval.
19.03.00	Cables shall be suitable for laying on racks, in ducts, trenches, conduits and underground buried installation with chances of flooding by water. The instrumentation and other control cables susceptible to interference shall be routed separately from the Power Cables.
19.04.00	For other control/instrumentation Cables and other components, technical parameters shall be as per applicable IEC/IS/Mentioned Elsewhere in the specifications.
20.00.00	**CONTROL AND PERFORMANCE REQUIREMENTS**
20.01.00	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.
20.02.00	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.
20.03.00	Provision shall be kept for exchange of information between different VFD control system parameters thru PLC/DDCMIS.
20.04.00	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.
20.05.00	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.
20.06.00	User-friendly licensed software for operation and fault diagnostic shall be loaded in the drive system panel before commissioning.
21.00.00	**PROTECTION FEATURES**
21.01.00	The system offered shall incorporate adequate protection features, 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.
21.02.00	Under VFD Bypass Mode (if applicable) all the electrical protections related to the Motor shall remain applicable.
22.00.00	**CONTROL FEATURES**
22.01.00	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
22.02.00	**DIAGNOSTIC FEATURES**
22.02.01	The VFD shall include a microprocessor/PLC based digital diagnostic system which monitors its own control functions and displays faults and operating conditions.
22.02.02	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

CLAUSE NO.	TECHNICAL REQUIREMENTS
	electronics (firmware) for the diagnostics / display shall be taken care of by the manufacturer for this purpose.
22.03.00	**SERVICEABILITY / MAINTAINABILITY**
22.03.01	Front Access: VFD system should be designed for front access only. Manufacturer shall state in his proposal if rear access is provided.
22.03.02	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.
22.03.03	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.
23.00.00	**STORAGE AND PRESERVATION**
23.01.00	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. Vendor shall submit powering requirement (if any) during storage.
24.00.00	**TESTS**
24.01.00	**ROUTINE TESTS** All acceptance and routine tests as per the specification and standard IEC -61800-2 and IEC 61800-4 shall be carried out.
24.02.00	**TYPE TESTS** The Contractor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the 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. 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 under this contract free of cost to the Employer and submit the reports for approval.
24.02.01	**LIST OF TYPE TESTS** a) VFD panels (For LV VFD) i. Rated Current/ Output ii. Temperature rise test iii. Surge withstand capability test iv. Noise level test v. Power Loss Determination Test vi. Power factor measurement.

vii. Degree of Protection Test

viii. EMC Test

b) VFD Panels (For MV VFD)

i. Rated Current/ Output

ii. Current Sharing

iii. Voltage Division

iv. Temperature rise test

v. Surge withstand capability test

vi. Noise level test

vii. Power Loss Determination Test

viii. Power factor measurement.

ix. Degree of Protection Test

c) AC/DC Reactor (If applicable)

i. Lightning impulse test

ii. Heat run test

iii. Short time current test

iv. Noise level test

d) Induction motors

i. As per requirements mentioned in subsection for motor.

e) VFD transformers

i. As per requirements mentioned in subsection for Transformer/ IEC 60076/IS 2026

DATA SHEETS FOR MOTORISED VALVE ACTUATOR

FORM NO. PEM-6666-0

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	**SPECIFICATION NO. PE-TS-434-571-A102**
		REV. NO. 01 DATE: 11.05.2018
		SHEET 1 OF 4

Data Sheet A & B

	DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL*	* PROJECT	3 x 800 MW PATRATU TPP
	OFFER REFERENCE	
	* TAG NO. SERVICE	
	* DUTY	☐ ON / OFF ☐ INCHING
	* LINE SIZE (inlet/outlet): MATERIAL	
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY
	* OPENING / CLOSING TIME	
	* WORKING PRESSURE	
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, IP:55
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 90% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. **FOR INCHING /REGULATING SERVICE - 150 STARTS/HR MINIMUM.**
HANDWHEEL	* REQUIRED	■ YES ☐ NO
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.	
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT-INCLUSIVE OF **I.S.** TOLERANCE
	ACTUATOR APPLICABLE WIRING DIAGRAM	■ ENCLOSED (BIDDER TO CONFIRM) A: ☐ DRG. NO. 3-V-MISC-24227 R00 B: ☐ DRG. NO. 3-V-MISC-24550 R00 C: ☐ DRG. NO. 3-V-MISC-24283 R00 D: ☐ DRG. NO. 4-V-MISC-90271 R11 E: ☐ For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram
	COLOUR SHADE	■ BLUE (RAL 5012) ENAMEL ☐ .....
	PAINT TYPE **(## Refer Notes)**	☐ ENAMEL ☐ EPOXY ☐ .....
	SHAFT RPM	BIDDER TO SPECIFY
	OLR SET VALVE	BIDDER TO SPECIFY
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY
	@ PWR SUPP TO MTR / STARTER	415V +/- 10 % , 3PH,3 W, AC 50 HZ +/- 5 %
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ■ 110 V AC/24V DC

829742/2022/PS-PEM-MAX

FORM NO. PEM-6666-0

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR	SPECIFICATION NO. PE-TS-434-571-A102
		REV. NO. 01 / DATE: 11.05.2018
		SHEET 2 OF 4

Data Sheet A & B

	DATA SHEET-A (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	MOTOR BEARING WITH 2 EARTH TERMINALS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI FRICTION	
	@ ENCLOSURE CLASS OF MOTOR	IP 67 FOR OUTDOOR & IP 55 FOR INDOOR(TOTALLY ENCLOSED SELF VENTILATED)	
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B	
	@ WINDING TEMP PROTECTION	■ THERMOSTAT (3 Nos.,1 IN EACH PHASE) ☐ ----------	
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED	
INTEGRAL STARTER	INTEGRAL STARTER	■ REQUIRED ☐ NOT REQUIRED	
	TYPE OF SWITCHING DEVICE	■ CONTACTORS ☐ THYRISTORS	
	TYPE	■CONVENTIONAL ☐ SMART (NON-INTRUSIVE)	
	IF SMART	(NOT APPLICABLE)	
	a) SERIAL LINK INTERFACE	☐ INTEGRAL ☐ FIELD MOUNTED	
	b) SERIAL LINK PROTOCOL	☐ FOUNDATION FIELD-BUS ☐ PROFI-BUS ☐ DEVICE NET ☐.....	
	c) SERIAL LINK MEDIA	☐ TWISTED PAIR Cu-CBL ☐ CO-AXIAL Cu-CBL ☐ OFC	
	d) HAND HELD PROGRAMMER	☐ REQUIRED ☐ NOT REQUIRED	
	e) TYPE OF HAND HELD PROGRAMMER	☐ BLUETOOTH ☐ INFRARED ☐.....	
	f) MASTER STATION	☐ REQUIRED ☐ NOT REQUIRED	
	g) MASTER STN INTRFACE WITH DCS	☐ MODBUS ☐ TCP/IP	
	h) DETAILS OF SPECIAL CABLE	☐ ENCLOSED ☐ NOT REQUIRED	
	STEP DOWN CONT. TRANSFORMER	■ REQUIRED	
	OPEN / CLOSE PB	■ REQUIRED ☐ NOT REQUIRED	
	STOP PB	■ REQUIRED ☐ NOT REQUIRED	
	INDICATING LAMPS	■ REQUIRED ☐ NOT REQUIRED	
	LOCAL REMOTE S/S	■REQUIRED ☐ NOT REQUIRED	
	STATUS CONTACTS FOR MONITORING	■ REQUIRED ☐ NOT REQUIRED	
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)	
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	■ INTERPOSING RELAY ☐ OPTO COUPLER ☐ EITHER	
	QUANTITY	■ 2 NOs. ☐ 3 NOs.	
	DRIVING VOLTAGE	■ 20.5 – 24V DC ☐ _____V DC	
	DRIVING CURRENT	■ 125mA MAX ☐ _____mA MAX	
	LOAD RESISTANCE	■ > 192 ohms - <25 k ohms ☐ > _____ohms - < _____ohms	
TORQUE SWITCH (Not Applicable for Smart Actuator) **($$ Refer Notes)**	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN / CLOSE	■1 No. ☐2Nos. / ■1 No. ☐2Nos	
	CONTACT TYPE	2 NO + 2 NC	
	RATING	5A 240V AC AND 0.5A 220V DC	
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE	
	ACCURACY	+3% OF SET VALUE	
LIMIT SWITCH (Not Applicable for Smart Actuator) ($$	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN : INT : CLOSE	☐1 No ■2 Nos. : : ☐1 No. ■2Nos.	
	CONTACT TYPE	2 NO + 2 NC	

FORM NO. PEM-6666-0

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	**SPECIFICATION NO. PE-TS-434-571-A102**
		REV. NO. 01 / DATE: 11.05.2018
		SHEET 3 OF 4

Data Sheet A & B

DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

Refer Notes)	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC	
Limit switches shall be silver plated with high conductivity and non-corrosive type. Contact rating shall be sufficient to meet the requirement of control system subject to a minimum of 60 V, 6 VA rating. Protection class shall be IP 55.			

POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty applications)	■ REQUIRED ☐ NOT REQUIRED	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	☐ELECTRONIC (2 WIRE) R/I CONVERTER ■ ELECTRONIC (2 WIRE) CONTACTLESS INDCUTIVE TYPE ,EXTERNAL 24 V DC OPERATED ,SUITABLE FOR STABILISED 4-20 mA SIGNAL	
	SUPPLY	■ 24V DC ☐	
	OUTPUT	■ 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	230V AC,1 PH.,50 Hz	
	@ POWER SUPPLY (INTEGRAL)	POWER SUPPLY DERIVED FROM MAIN POWER SUPPLY AVAILABLE AT ACTUATOR END.	
	@ RATING		
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	■ IP 68 @☐.....	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET(9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	■ REQUIRED ☐ NOT REQUIRED☐ ■ 2 NOS. PRE WIRED ☐ ----------	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:----------	
	@ SPACE HEATER CABLE GLAND	SIZE:----------	
	OTHER CONTROL CABLE GLANDS-1	2 NOS SUITABLE FOR 4P,0.5SQ MM	
	OTHER CONTROL CABLE GLAND	1 No. for BFV of CW PUMP(Cable size 2Px1.5mm2)	

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	**SPECIFICATION NO. PE-TS-434-571-A102**
		REV. NO. 01 DATE: 11.05.2018
		SHEET 4 OF 4

Data Sheet A & B

DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.

NOTES:

1. **SCOPE**: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
2. **CODES & STANDARDS**: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATION STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:
   IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722
3. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
4. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
5. THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION.THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
6. THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.
7. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.

$$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.

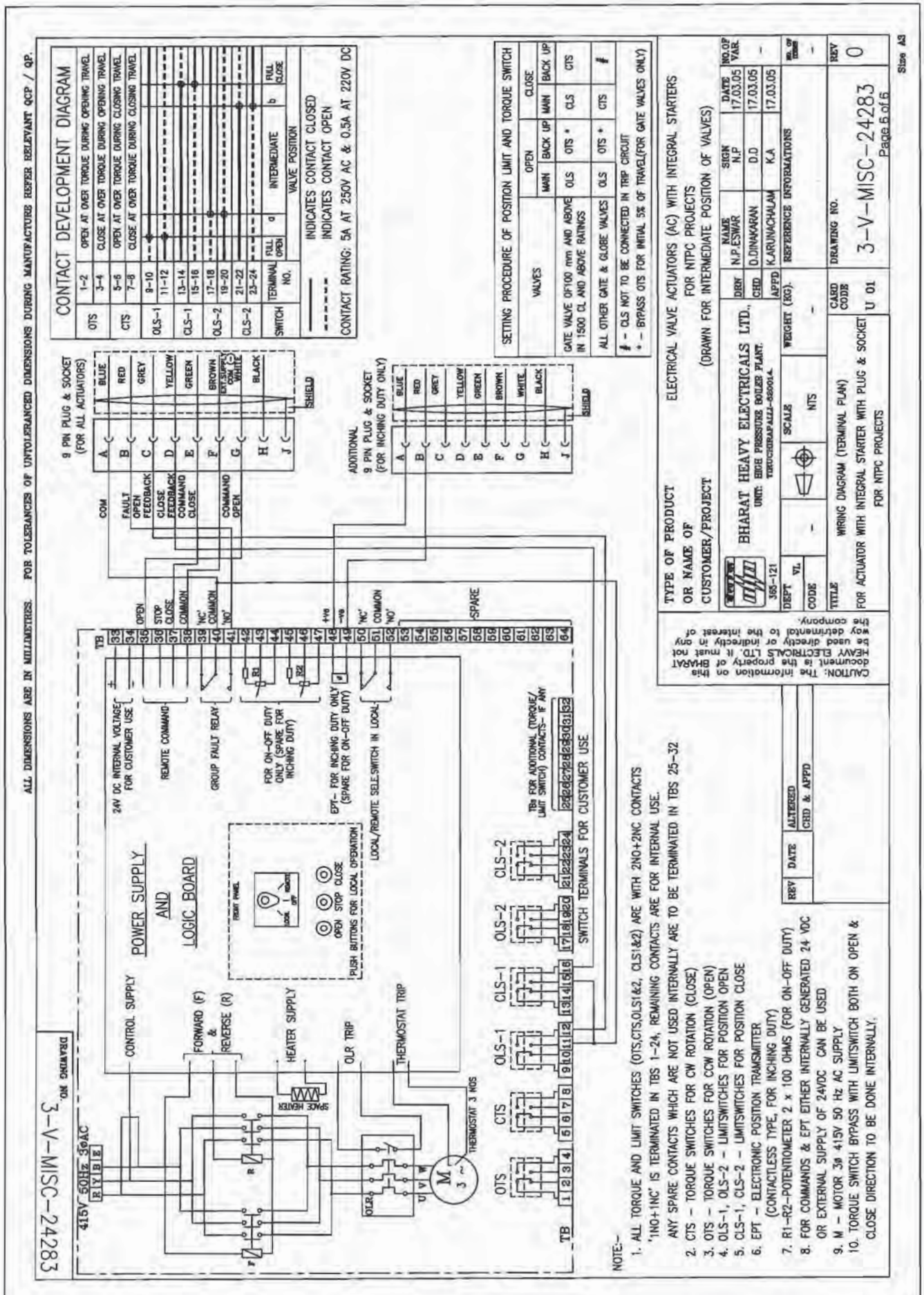
EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.

8. IT SHALL BE POSIIBLE TO OPERATE THE ACTUATOR LOCALLY. LOCKABLE LOCAL/REMOTE SELECTION SHALL BE PROVIDED ON THE ACTUATOR.
9. POSITION INDICATOR SHALL BE PROVIDED FOR 0 TO 100 % TRAVEL
10. WIRING SHALL BE SUITABLE VOLTAGE GRADE COPPER WIRE.

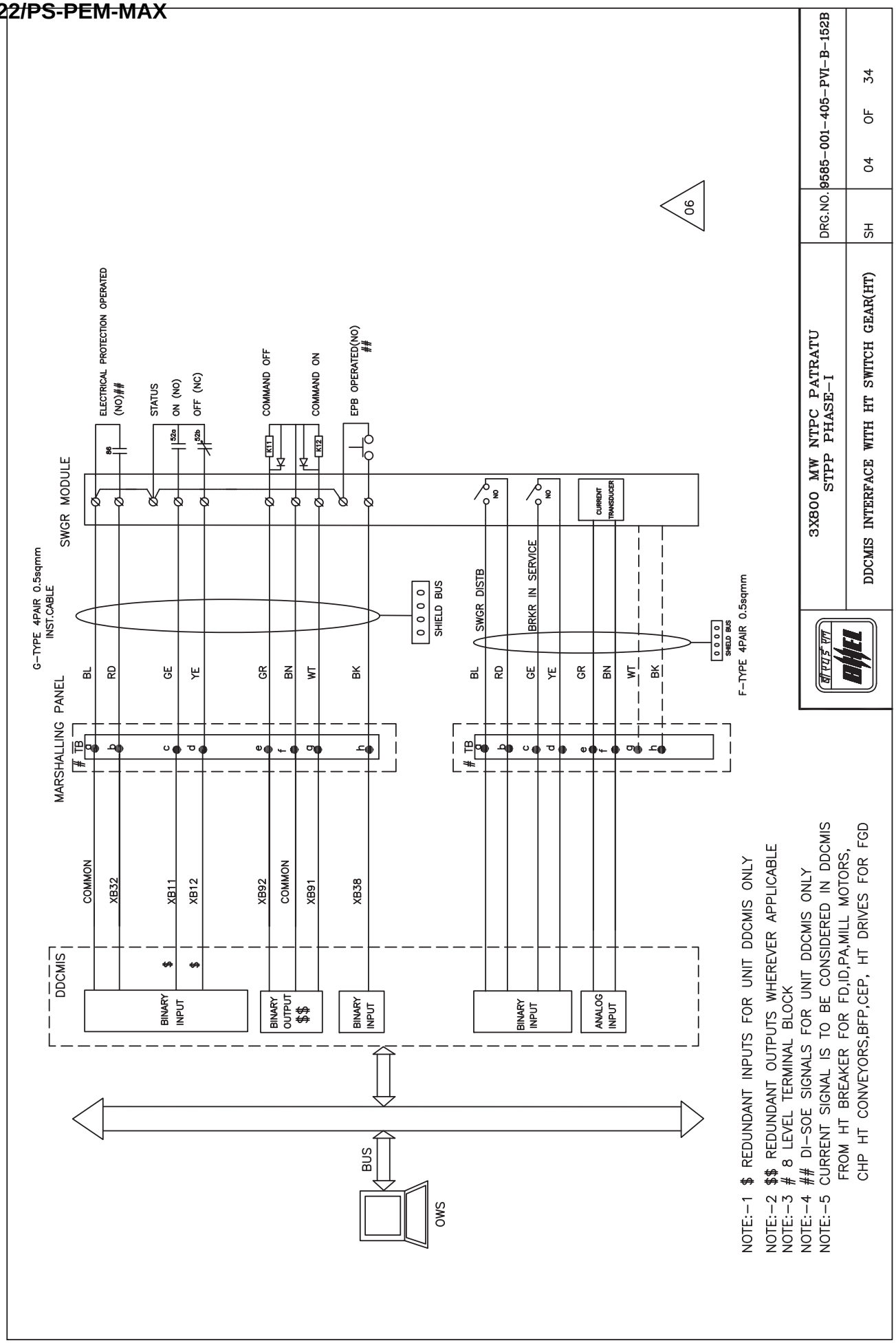
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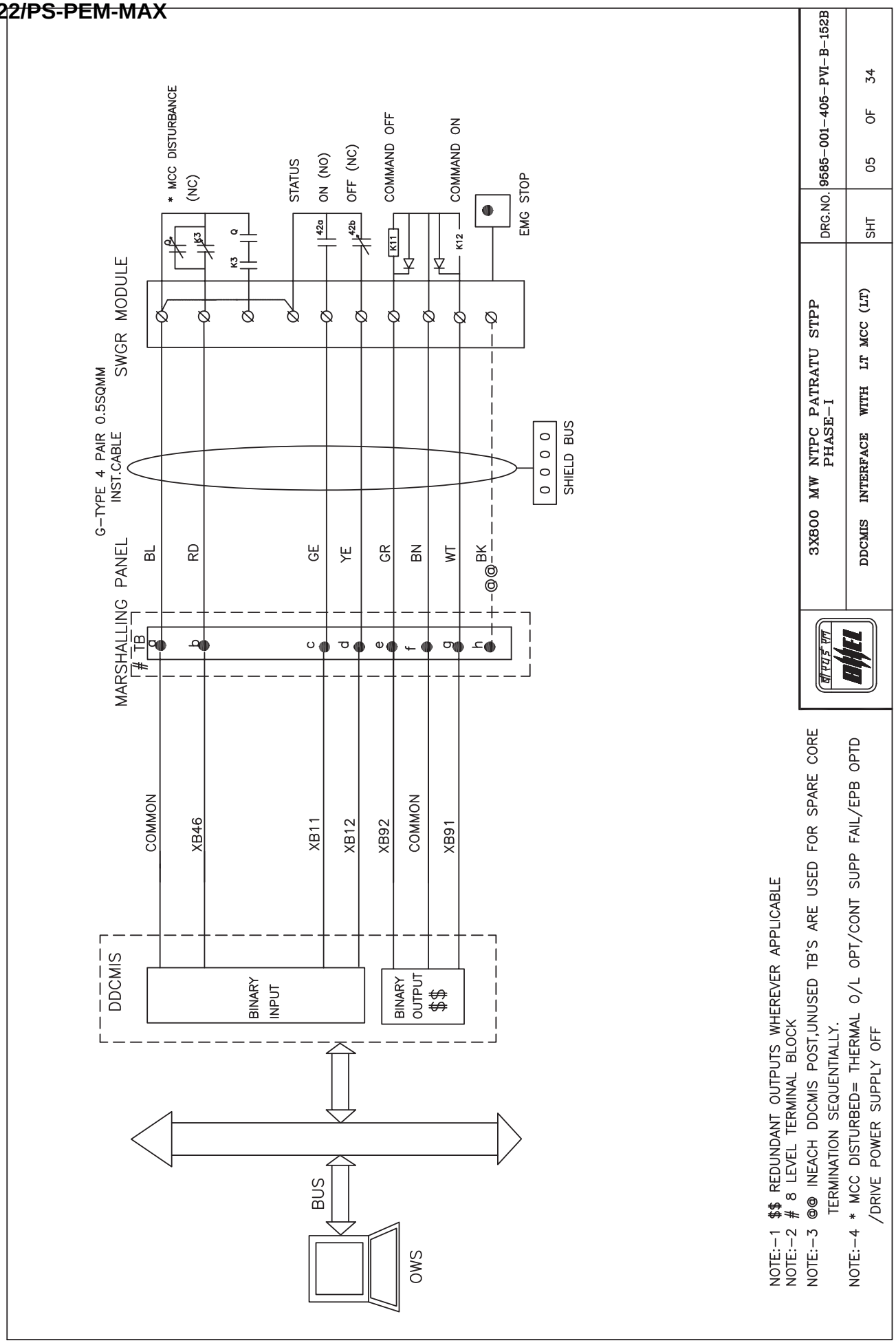
	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
NAME	Madhav gupta	Mayank kesharwani	Bharat Singh	NAME
SIGNATURE				SIGNATURE
DATE	01.03.02018 01.	03.2018	01.03.2018	DATE

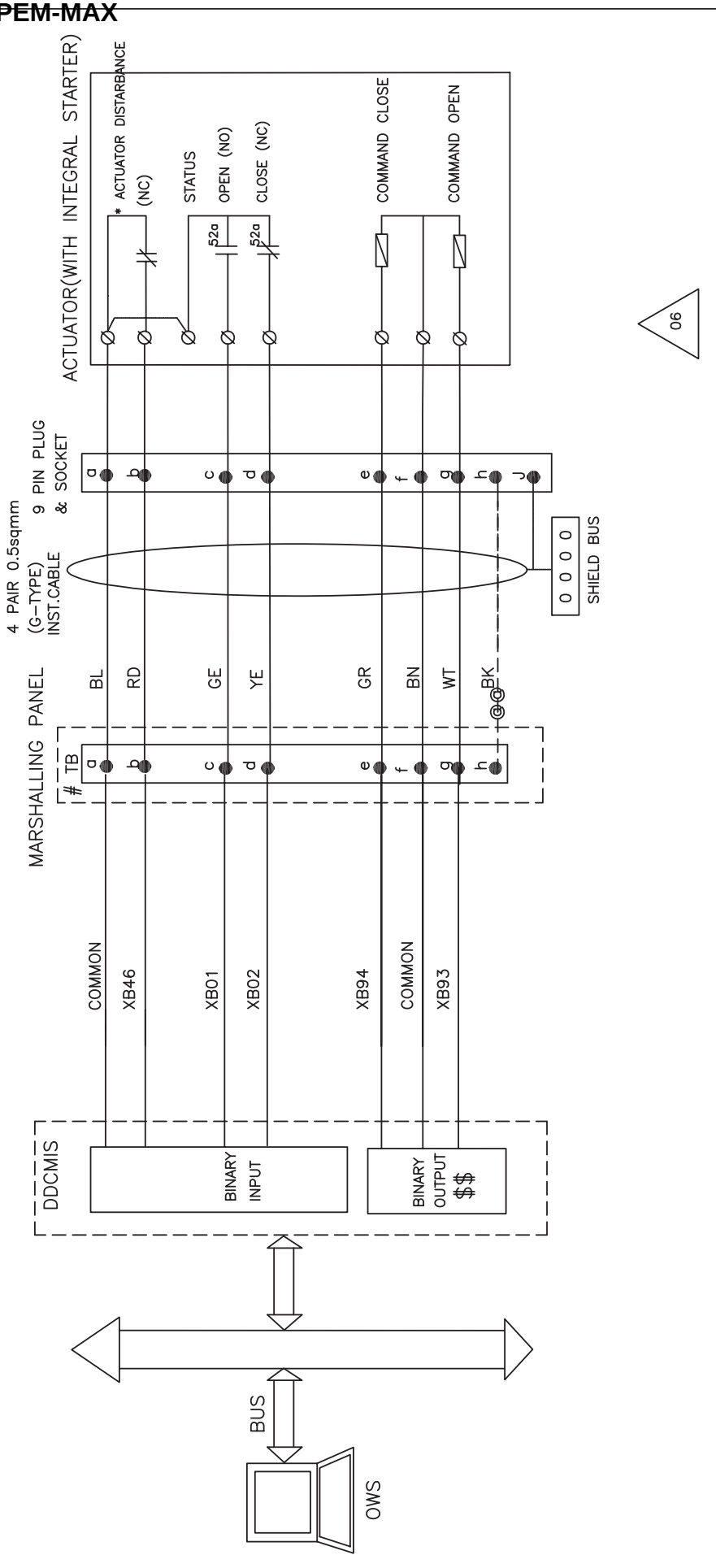
NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @= TO BE FILLED BY ES

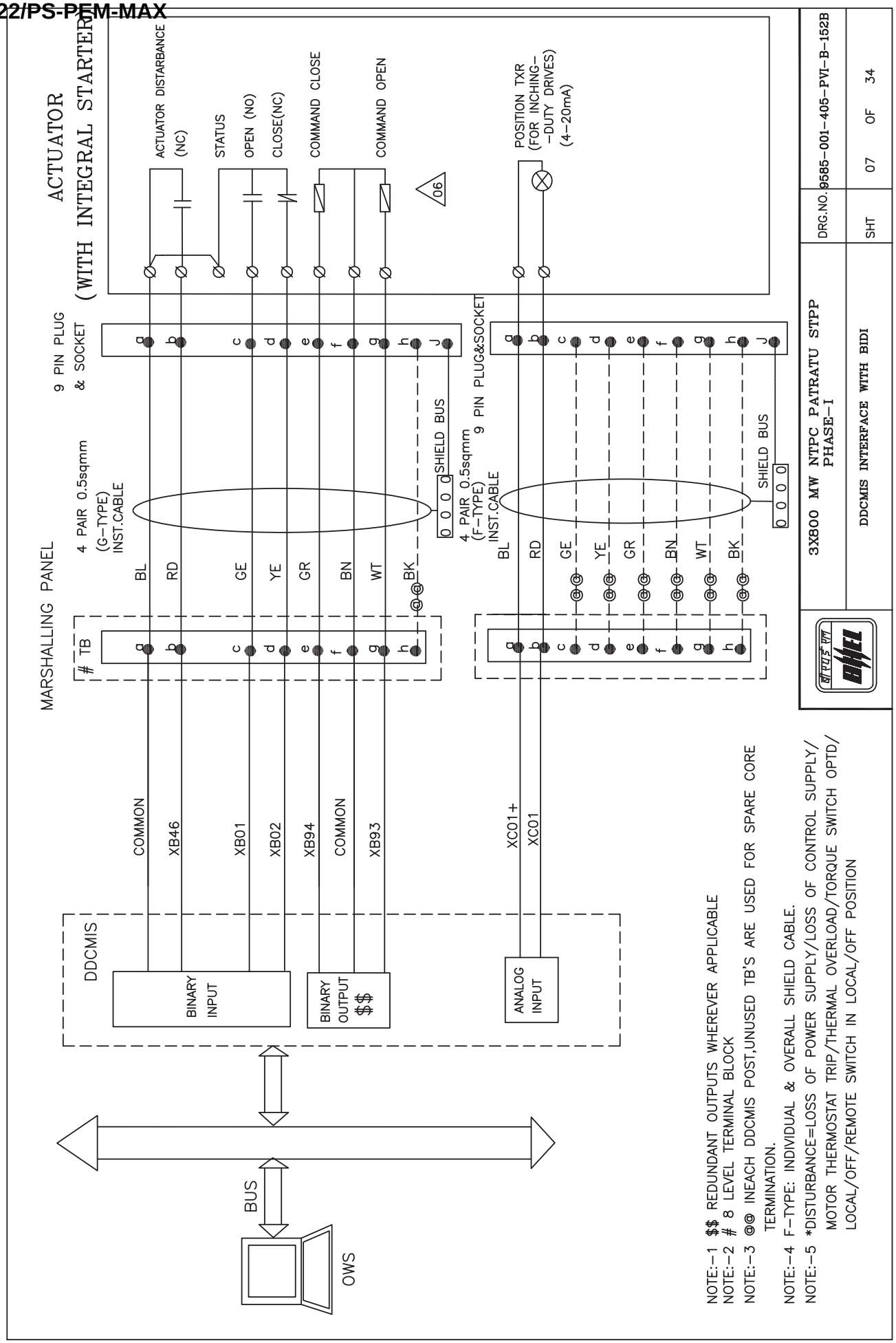

ALL DIMENSIONS ARE IN MILLIMETRES. FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER RELEVANT QCP / QP.
DRAWING NO. 3-V-MISC-24283
CONTACT DEVELOPMENT DIAGRAM
OTS 1-2 OPEN AT OVER TORQUE DURING OPENING TRAVEL
3-4 CLOSE AT OVER TORQUE DURING OPENING TRAVEL
CTS 5-6 OPEN AT OVER TORQUE DURING CLOSING TRAVEL
7-8 CLOSE AT OVER TORQUE DURING CLOSING TRAVEL
OLS-1 9-10 11-12
CLS-1 13-14 15-16
OLS-2 17-18 19-20
CLS-2 21-22 23-24
SWITCH TERMINAL NO. FULL OPEN a INTERMEDIATE b FULL CLOSE
VALVE POSITION
INDICATES CONTACT CLOSED
INDICATES CONTACT OPEN
CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC
9 PIN PLUG & SOCKET (FOR ALL ACTUATORS)
COM BLUE
FAULT OPEN FEEDBACK RED
CLOSE FEEDBACK GREY
COMMAND CLOSE YELLOW
COMMAND OPEN GREEN
BROWN
EXT SUPPLY COM (-) WHITE
BLACK
SHIELD
ADDITIONAL 9 PIN PLUG & SOCKET (FOR INCHING DUTY ONLY)
SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH
VALVES
OPEN: MAIN, BACK UP
CLOSE: MAIN, BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS: OLS, OTS *, CLS, CTS
ALL OTHER GATE & GLOBE VALVES: OLS, OTS *, CTS, #
- CLS NOT TO BE CONNECTED IN TRIP CIRCUIT
* - BYPASS OTS FOR INITIAL 5% OF TRAVEL(FOR GATE VALVES ONLY)
TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT
ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS FOR NTPC PROJECTS
(DRAWN FOR INTERMEDIATE POSITION OF VALVES)
BHARAT HEAVY ELECTRICALS LTD.
UNIT: HIGH PRESSURE BOILER PLANT, TIRUCHIRAPALLI-620014
365-121
DRW N.P.ESWAR SIGN N.P DATE 17.03.05
CHD D.DINAKARAN D.D 17.03.05
APPD K.ARUNACHALAM K.A 17.03.05
DEPT VL
CODE -
TITLE WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER WITH PLUG & SOCKET FOR NTPC PROJECTS
SCALE NTS
WEIGHT (KG). -
CARD CODE U 01
DRAWING NO. 3-V-MISC-24283
Page 6 of 6
REV 0
REFERENCE INFORMATIONS
NO. OF ITEMS -
NO. OF VAR. -
REV DATE ALTERED
CHD & APPD
CAUTION: The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company.
Size A3
415V 50Hz 3ΦAC
R Y B E
TB
24V DC INTERNAL VOLTAGE FOR CUSTOMER USE
REMOTE COMMAND
GROUP FAULT RELAY
FOR ON-OFF DUTY ONLY (SPARE FOR INCHING DUTY)
EPT- FOR INCHING DUTY ONLY (SPARE FOR ON-OFF DUTY)
LOCAL/REMOTE SELE.SWITCH IN LOCAL
PUSH BUTTONS FOR LOCAL OPERATION
OPEN STOP CLOSE
TBs FOR ADDITIONAL (TORQUE/ LIMIT SWITCH) CONTACTS- IF ANY
SPARE
SWITCH TERMINALS FOR CUSTOMER USE
CONTROL SUPPLY
POWER SUPPLY AND LOGIC BOARD
FORWARD (F) & REVERSE (R)
HEATER SUPPLY
SPACE HEATER
OLR TRIP
THERMOSTAT TRIP
THERMOSTAT 3 NOS
OTS CTS OLS-1 CLS-1 OLS-2 CLS-2
M 3~
NOTE:-
1. ALL TORQUE AND LIMIT SWITCHES (OTS,CTS,OLS1&2, CLS1&2) ARE WITH 2NO+2NC CONTACTS '1NO+1NC' IS TERMINATED IN TBS 1-24, REMAINING CONTACTS ARE FOR INTERNAL USE. ANY SPARE CONTACTS WHICH ARE NOT USED INTERNALLY ARE TO BE TERMINATED IN TBS 25-32
2. CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE)
3. OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN)
4. OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN
5. CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE
6. EPT - ELECTRONIC POSITION TRANSMITTER (CONTACTLESS TYPE, FOR INCHING DUTY)
7. R1-R2-POTENTIOMETER 2 x 100 OHMS (FOR ON-OFF DUTY)
8. FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
9. M - MOTOR 3Φ 415V 50 Hz AC SUPPLY
10. TORQUE SWITCH BYPASS WITH LIMITSWITCH BOTH ON OPEN & CLOSE DIRECTION TO BE DONE INTERNALLY.

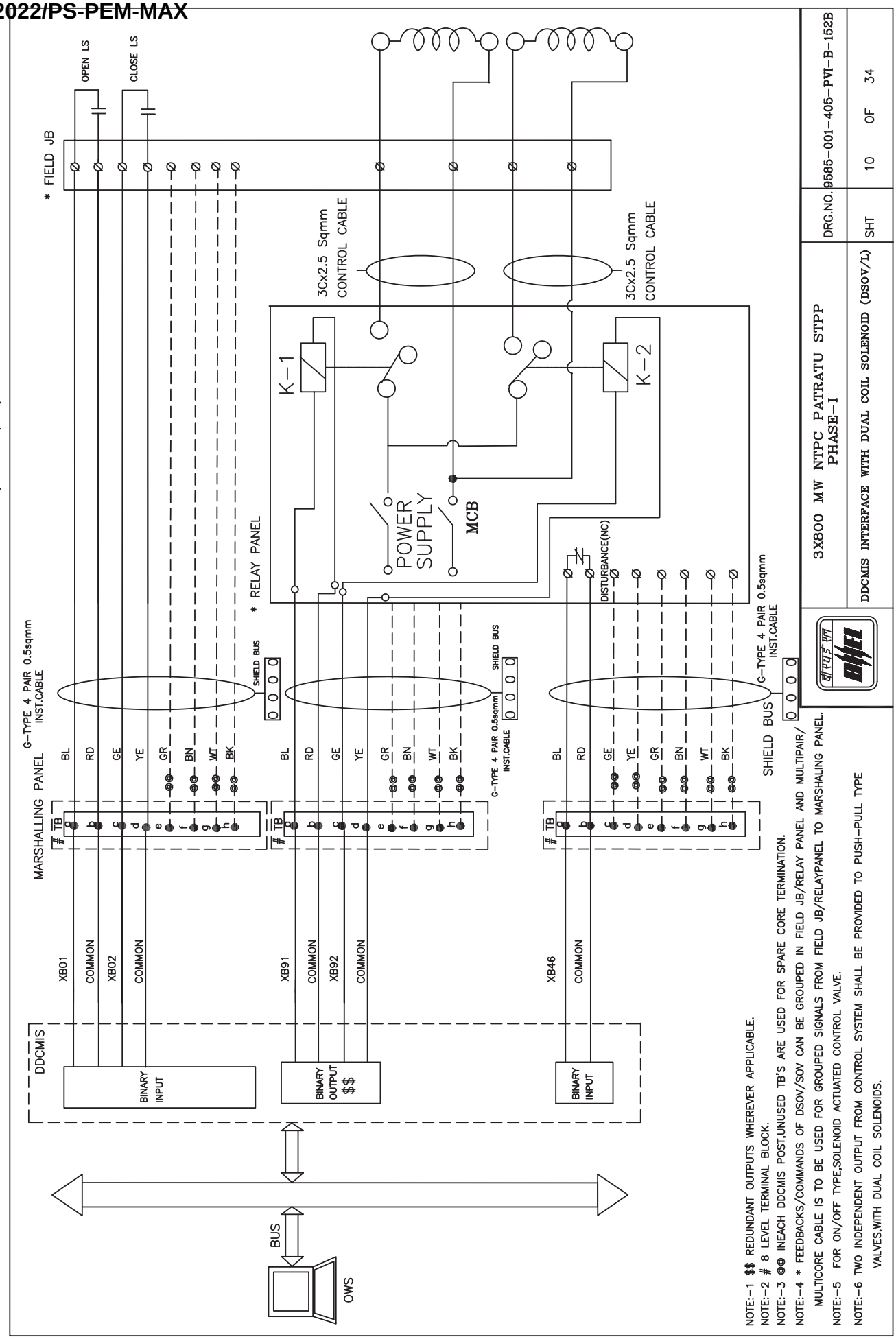
SIGNL EXCHANGE BETWEEN DRIVES & DCS

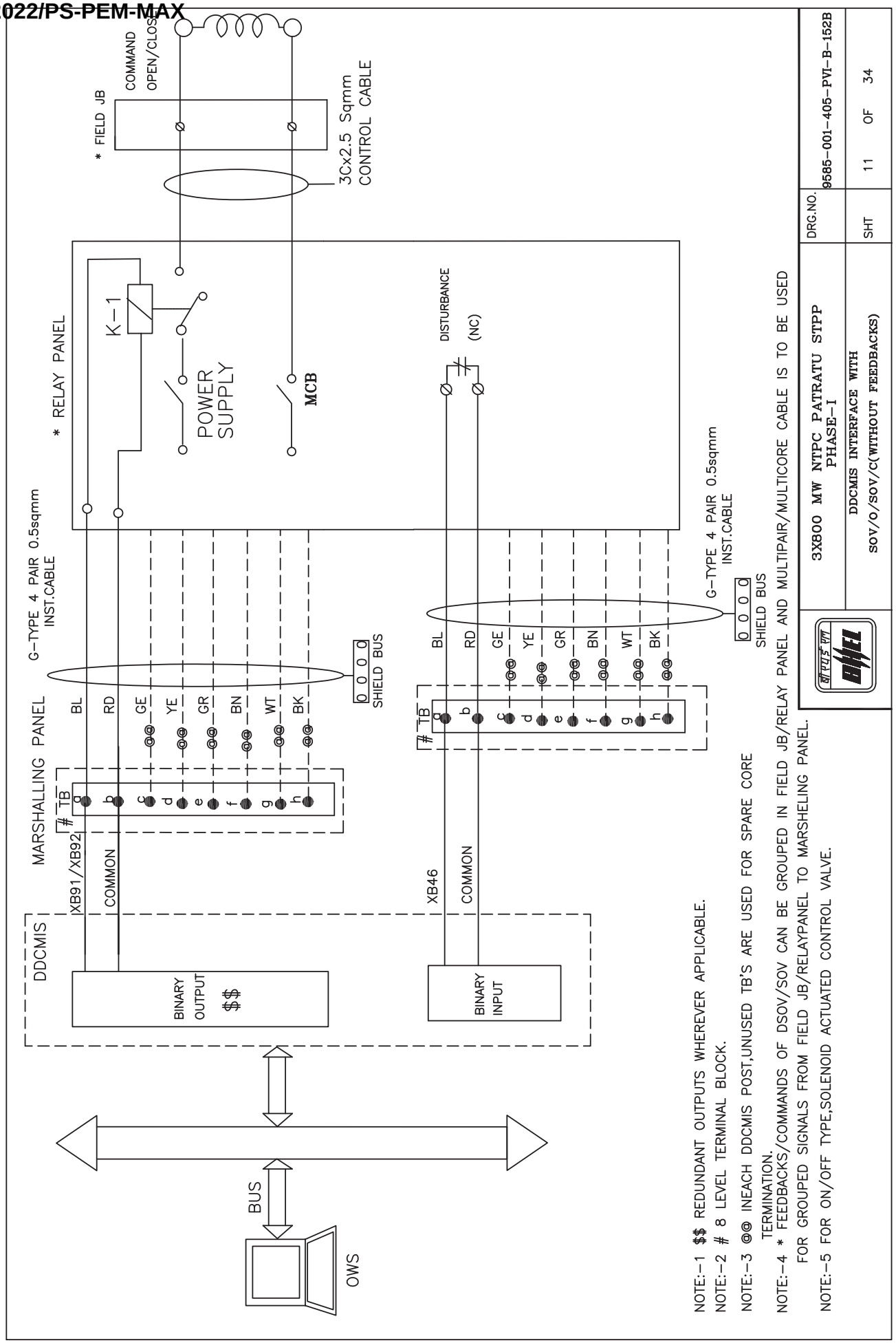

DDCMIS INTERFACE WITH HT SWITCH GEAR (HT)
SWGR MODULE
ELECTRICAL PROTECTION OPERATED (NO)##
STATUS
ON (NO)
OFF (NC)
COMMAND OFF
COMMAND ON
EPB OPERATED(NO) ##
86
52a
52b
KT1
KT2
SHIELD BUS
SWGR DISTB
BRKR IN SERVICE
CURRENT TRANSDUCER
NO
G-TYPE 4PAIR 0.5sqmm INST.CABLE
F-TYPE 4PAIR 0.5sqmm
MARSHALLING PANEL
TB
BL
RD
GE
YE
GR
BN
WT
BK
COMMON
XB32
XB11
XB12
XB92
XB91
XB38
DDCMIS
BINARY INPUT
BINARY OUTPUT
ANALOG INPUT
BUS
OWS
06
3X800 MW NTPC PATRATU
STPP PHASE-I
DDCMIS INTERFACE WITH HT SWITCH GEAR(HT)
DRG.NO. 9585-001-405-PVI-B-152B
SH 04 OF 34
NOTE:-1 $ REDUNDANT INPUTS FOR UNIT DDCMIS ONLY
NOTE:-2 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-3 # 8 LEVEL TERMINAL BLOCK
NOTE:-4 ## DI-SOE SIGNALS FOR UNIT DDCMIS ONLY
NOTE:-5 CURRENT SIGNAL IS TO BE CONSIDERED IN DDCMIS FROM HT BREAKER FOR FD,ID,PA,MILL MOTORS, CHP HT CONVEYORS,BFP,CEP, HT DRIVES FOR FGD

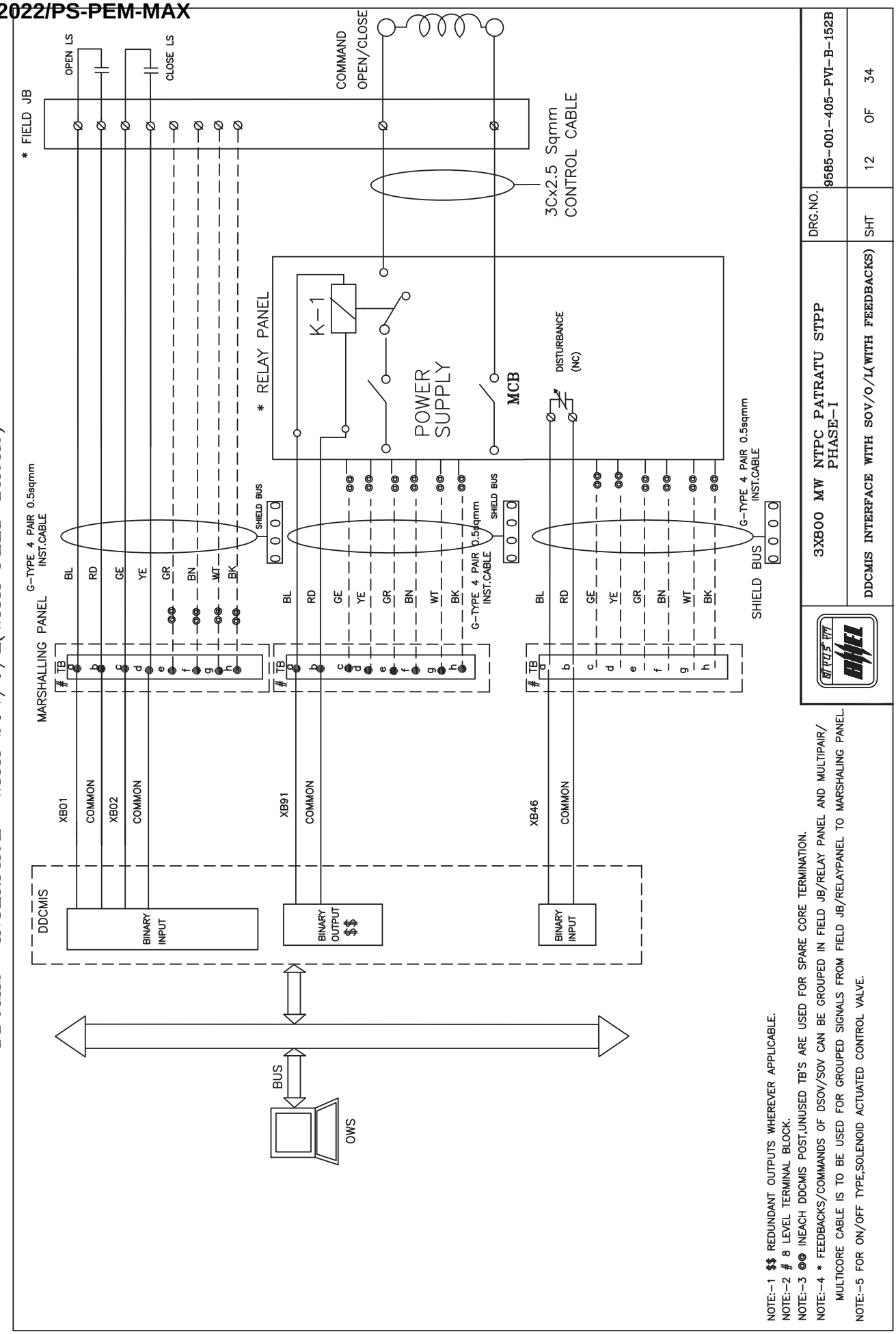

DDCMIS INTERFACE WITH LT MCC (LT)
* MCC DISTURBANCE (NC)
STATUS
ON (NO)
OFF (NC)
COMMAND OFF
COMMAND ON
EMG STOP
K3
K11
K12
42a
42b
G-TYPE 4 PAIR 0.5SQMM INST.CABLE
SWGR MODULE
MARSHALLING PANEL
TB #
BL
RD
GE
YE
GR
BN
WT
BK
@@
0 0 0 0
SHIELD BUS
COMMON
XB46
XB11
XB12
XB92
COMMON
XB91
DDCMIS
BINARY INPUT
BINARY OUTPUT $$
BUS
OWS
NOTE:-1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION SEQUENTIALLY.
NOTE:-4 * MCC DISTURBED= THERMAL O/L OPT/CONT SUPP FAIL/EPB OPTD /DRIVE POWER SUPPLY OFF
3X800 MW NTPC PATRATU STPP PHASE-I
DDCMIS INTERFACE WITH LT MCC (LT)
DRG.NO. 9585-001-405-PVI-B-152B
SHT 05 OF 34

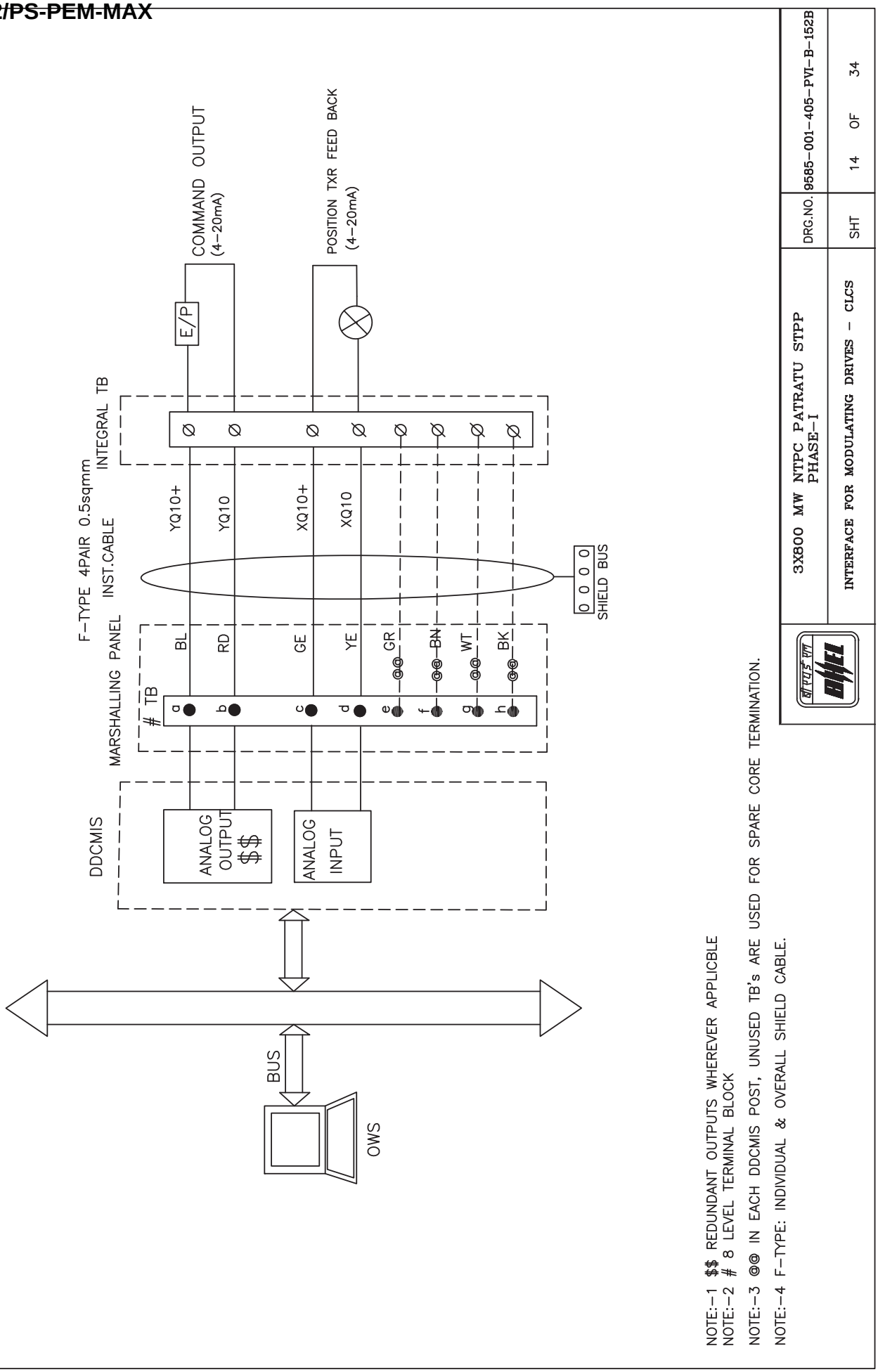

DDCMIS INTERFACE WITH BID/MOV/MOD
ACTUATOR(WITH INTEGRAL STARTER)
* ACTUATOR DISTARBANCE (NC)
STATUS
OPEN (NO)
CLOSE (NC)
COMMAND CLOSE
COMMAND OPEN
52a
52a
4 PAIR 0.5sqmm (G-TYPE) INST.CABLE
9 PIN PLUG & SOCKET
SHIELD BUS
0 0 0 0
MARSHALLING PANEL
TB
BL
RD
GE
YE
GR
BN
WT
BK
@@
DDCMIS
COMMON
XB46
XB01
XB02
XB94
COMMON
XB93
BINARY INPUT
BINARY OUTPUT $$
BUS
OWS
06
3X800 MW NTPC PATRATU STPP PHASE-I
DDCMIS INTERFACE WITH BID
DRG.NO. 9585-001-405-PVI-B-152B
SHT 06 OF 26
NOTE:-1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.
NOTE:-4 * DISTURBANCE=LOSS OF POWER SUPPLY(1PHASE/3PHASE)/LOSS OF CONTROL SUPPLY/MOTOR THERMOSTAT TRIP/THERMAL OVER LOAD/ TORQUE SWITCH OPERATED, LOCAL/OFF/REMOTE SWITCH IN LOCAL/OFF POSITION

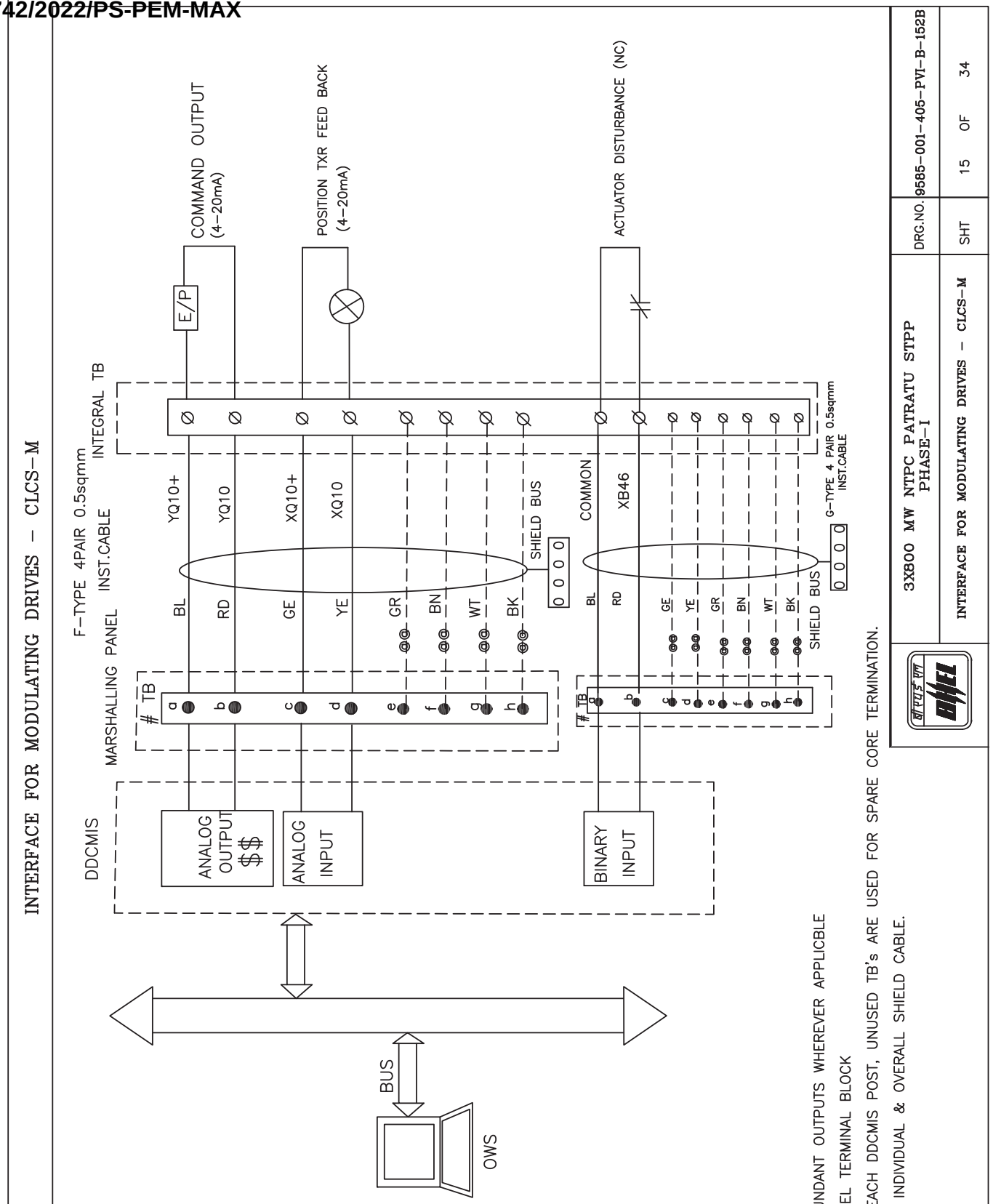

DDCMIS INTERFACE WITH BIDI/MODI/MOVI
ACTUATOR
(WITH INTEGRAL STARTER)
ACTUATOR DISTARBANCE (NC)
STATUS
OPEN (NO)
CLOSE(NC)
COMMAND CLOSE
COMMAND OPEN
POSITION TXR (FOR INCHING-DUTY DRIVES) (4-20mA)
06
9 PIN PLUG & SOCKET
4 PAIR 0.5sqmm (G-TYPE) INST.CABLE
SHIELD BUS
4 PAIR 0.5sqmm (F-TYPE) INST.CABLE
9 PIN PLUG&SOCKET
SHIELD BUS
MARSHALLING PANEL
TB
BL
RD
GE
YE
GR
BN
WT
BK
DDCMIS
BINARY INPUT
BINARY OUTPUT $$
ANALOG INPUT
COMMON
XB46
XB01
XB02
XB94
COMMON
XB93
XC01+
XC01
BUS
OWS
3X800 MW NTPC PATRATU STPP PHASE-I
DDCMIS INTERFACE WITH BIDI
DRG.NO. 9585-001-405-PVI-B-152B
SHT 07 OF 34
NOTE:-1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.
NOTE:-4 F-TYPE: INDIVIDUAL & OVERALL SHIELD CABLE.
NOTE:-5 *DISTURBANCE=LOSS OF POWER SUPPLY/LOSS OF CONTROL SUPPLY/ MOTOR THERMOSTAT TRIP/THERMAL OVERLOAD/TORQUE SWITCH OPTD/ LOCAL/OFF/REMOTE SWITCH IN LOCAL/OFF POSITION

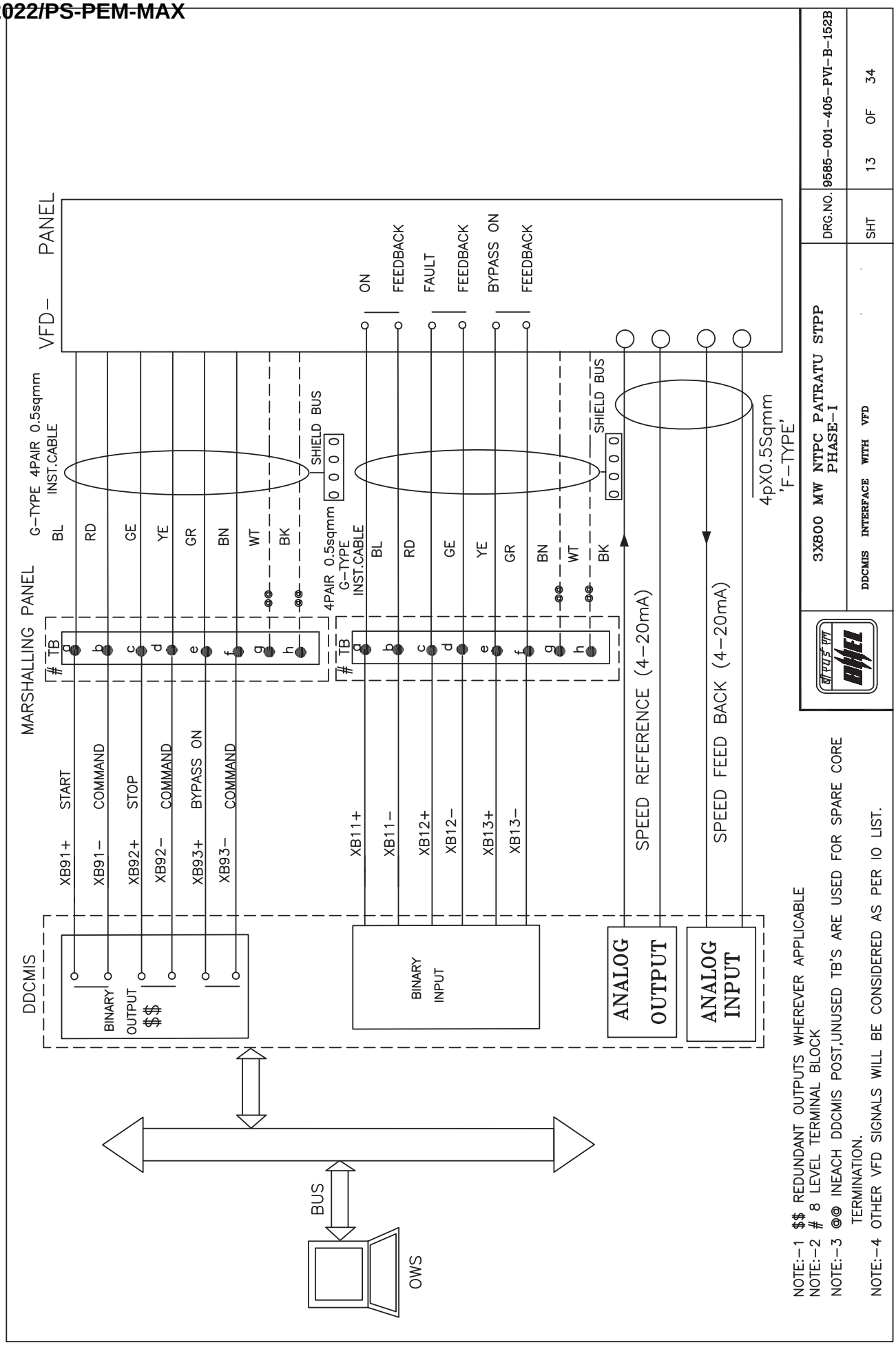

DDCMIS INTERFACE WITH DUAL COIL SOLENOID (DSOV/L)
3X800 MW NTPC PATRATU STPP
PHASE-I
DDCMIS INTERFACE WITH DUAL COIL SOLENOID (DSOV/L)
DRG.NO. 9585-001-405-PVI-B-152B
SHT 10 OF 34
BHEL
OPEN LS
CLOSE LS
* FIELD JB
3Cx2.5 Sqmm CONTROL CABLE
3Cx2.5 Sqmm CONTROL CABLE
K-1
K-2
POWER SUPPLY
MCB
* RELAY PANEL
DISTURBANCE(NC)
G-TYPE 4 PAIR 0.5sqmm INST.CABLE
SHIELD BUS
MARSHALLING PANEL
BL RD GE YE GR BN WT BK
XB01 COMMON XB02 COMMON
XB91 COMMON XB92 COMMON
XB46 COMMON
DDCMIS
BINARY INPUT
BINARY OUTPUT $$
BUS
OWS
NOTE:-1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE.
NOTE:-2 # 8 LEVEL TERMINAL BLOCK.
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.
NOTE:-4 * FEEDBACKS/COMMANDS OF DSOV/SOV CAN BE GROUPED IN FIELD JB/RELAY PANEL AND MULTIPAIR/ MULTICORE CABLE IS TO BE USED FOR GROUPED SIGNALS FROM FIELD JB/RELAYPANEL TO MARSHALING PANEL.
NOTE:-5 FOR ON/OFF TYPE,SOLENOID ACTUATED CONTROL VALVE.
NOTE:-6 TWO INDEPENDENT OUTPUT FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH-PULL TYPE VALVES,WITH DUAL COIL SOLENOIDS.


DDCMIS INTERFACE WITH SOV/O/SOV/C(WITH OUT FEEDBACKS)
* FIELD JB
COMMAND OPEN/CLOSE
3Cx2.5 Sqmm CONTROL CABLE
* RELAY PANEL
K-1
POWER SUPPLY
MCB
DISTURBANCE (NC)
G-TYPE 4 PAIR 0.5sqmm INST.CABLE
SHIELD BUS
MARSHALLING PANEL
TB
XB91/XB92
COMMON
XB46
DDCMIS
BINARY OUTPUT $$
BINARY INPUT
BUS
OWS
BL
RD
GE
YE
GR
BN
WT
BK
NOTE:-1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE.
NOTE:-2 # 8 LEVEL TERMINAL BLOCK.
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.
NOTE:-4 * FEEDBACKS/COMMANDS OF DSOV/SOV CAN BE GROUPED IN FIELD JB/RELAY PANEL AND MULTIPAIR/MULTICORE CABLE IS TO BE USED FOR GROUPED SIGNALS FROM FIELD JB/RELAYPANEL TO MARSHELING PANEL.
NOTE:-5 FOR ON/OFF TYPE,SOLENOID ACTUATED CONTROL VALVE.
3X800 MW NTPC PATRATU STPP PHASE-I
DDCMIS INTERFACE WITH SOV/O/SOV/C(WITHOUT FEEDBACKS)
DRG.NO. 9585-001-405-PVI-B-152B
SHT 11 OF 34

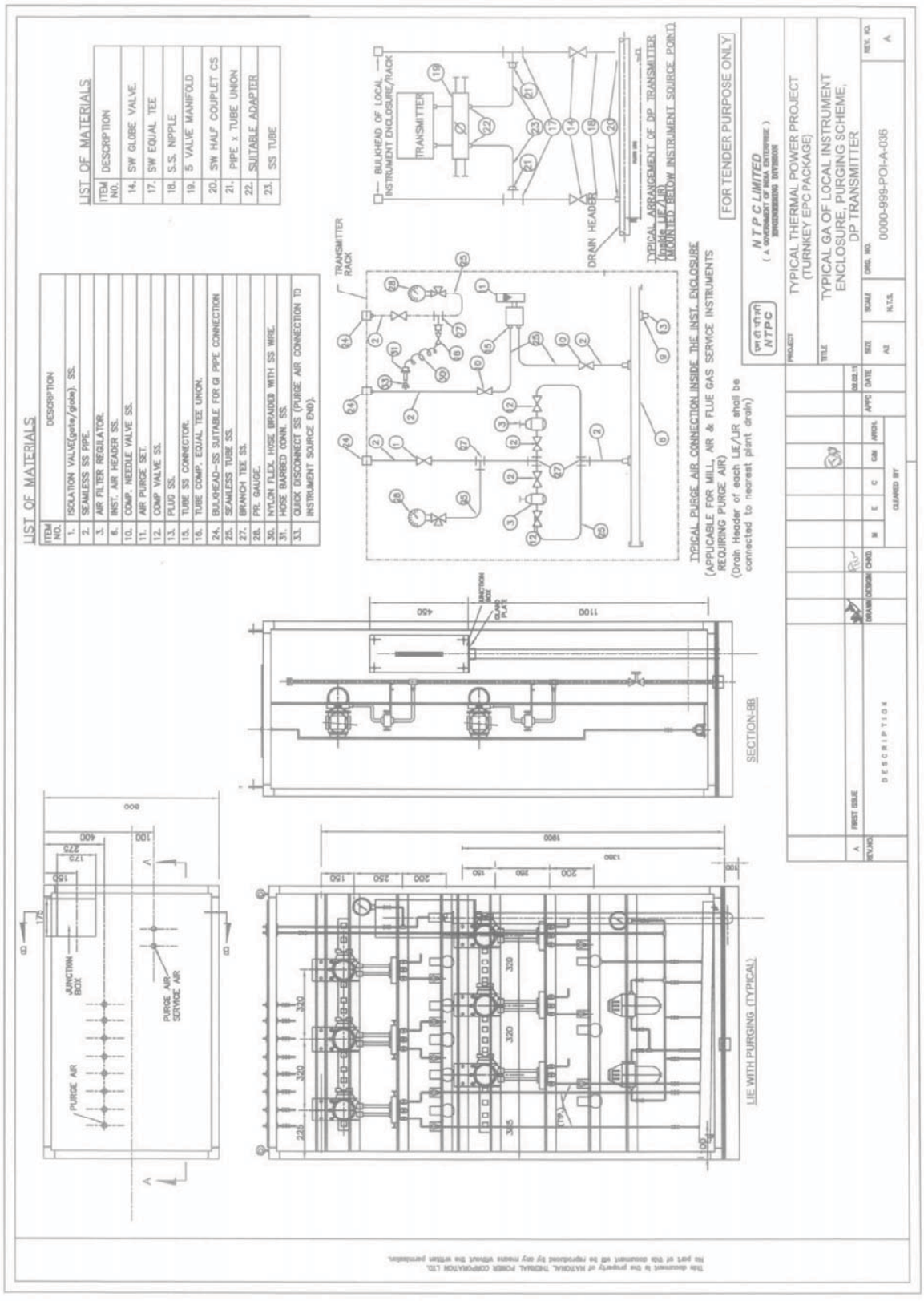

DDCMIS INTERFACE WITH SOV/O/L(WITH FEED BACKS)
* FIELD JB
OPEN LS
CLOSE LS
COMMAND OPEN/CLOSE
3Cx2.5 Sqmm CONTROL CABLE
* RELAY PANEL
K-1
POWER SUPPLY
MCB
DISTURBANCE (NC)
G-TYPE 4 PAIR 0.5sqmm INST.CABLE
SHIELD BUS
MARSHALLING PANEL
BL
RD
GE
YE
GR
BN
WT
BK
XB01
XB02
XB91
XB46
COMMON
DDCMIS
BINARY INPUT
BINARY OUTPUT $$
BUS
OWS
NOTE:-1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE.
NOTE:-2 # 8 LEVEL TERMINAL BLOCK.
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.
NOTE:-4 * FEEDBACKS/COMMANDS OF DSOV/SOV CAN BE GROUPED IN FIELD JB/RELAY PANEL AND MULTIPAIR/ MULTICORE CABLE IS TO BE USED FOR GROUPED SIGNALS FROM FIELD JB/RELAYPANEL TO MARSHALING PANEL.
NOTE:-5 FOR ON/OFF TYPE,SOLENOID ACTUATED CONTROL VALVE.
3X800 MW NTPC PATRATU STPP PHASE-I
DDCMIS INTERFACE WITH SOV/O/L(WITH FEEDBACKS)
DRG.NO. 9585-001-405-PVI-B-152B
SHT 12 OF 34

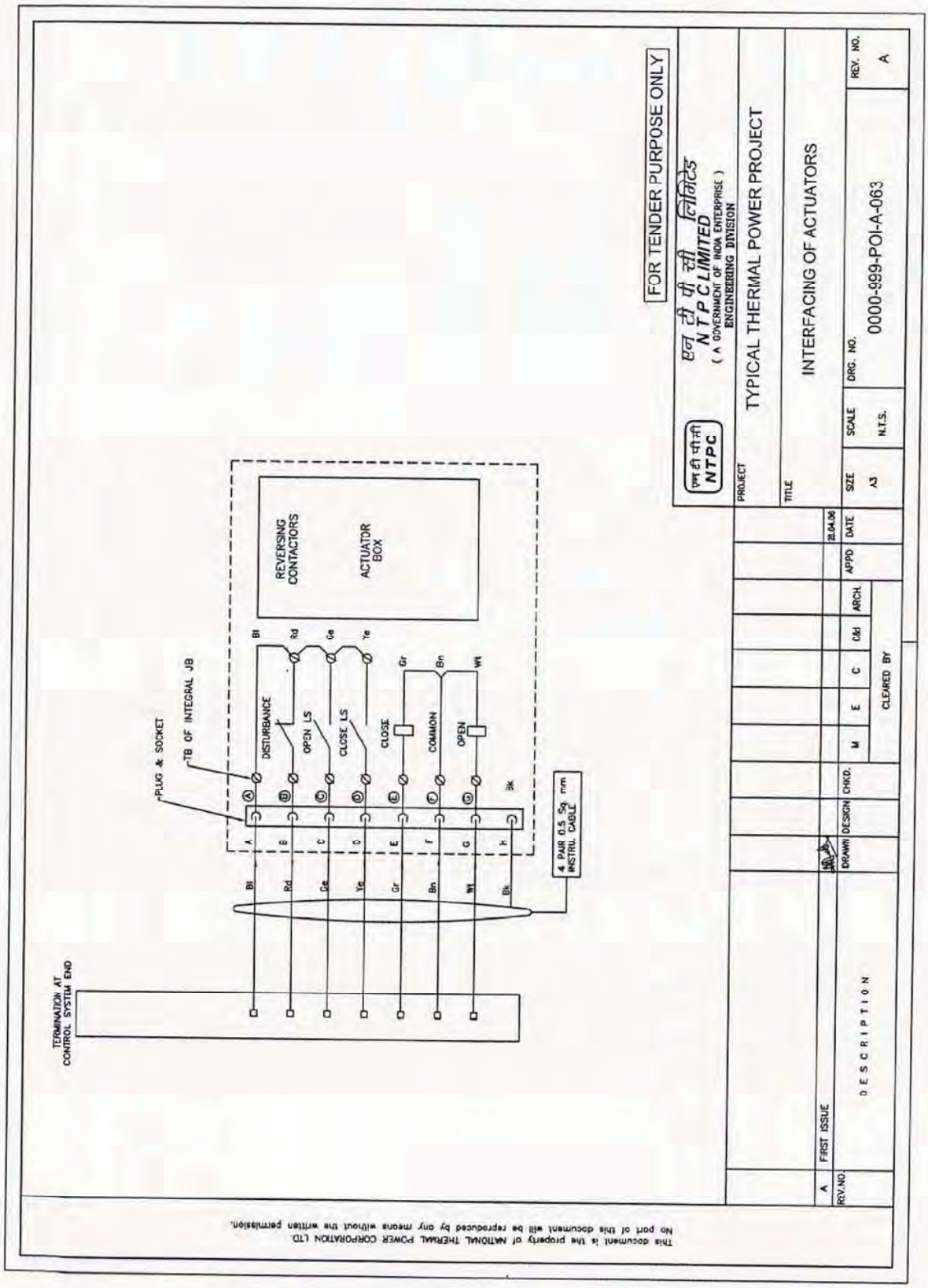

INTERFACE FOR MODULATING DRIVES – CLCS
COMMAND OUTPUT (4–20mA)
POSITION TXR FEED BACK (4–20mA)
E/P
INTEGRAL TB
F–TYPE 4PAIR 0.5sqmm INST.CABLE
MARSHALLING PANEL
TB
YQ10+
YQ10
XQ10+
XQ10
BL
RD
GE
YE
GR @@
BN @@
WT @@
BK @@
a
b
c
d
e
f
g
h
SHIELD BUS
0 0 0 0
DDCMIS
ANALOG OUTPUT $$
ANALOG INPUT
BUS
OWS
NOTE:–1 $$ REDUNDANT OUTPUTS WHEREVER APPLICBLE
NOTE:–2 # 8 LEVEL TERMINAL BLOCK
NOTE:–3 @@ IN EACH DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.
NOTE:–4 F–TYPE: INDIVIDUAL & OVERALL SHIELD CABLE.
3X800 MW NTPC PATRATU STPP PHASE–I
INTERFACE FOR MODULATING DRIVES – CLCS
DRG.NO. 9585–001–405–PVI–B–152B
SHT 14 OF 34

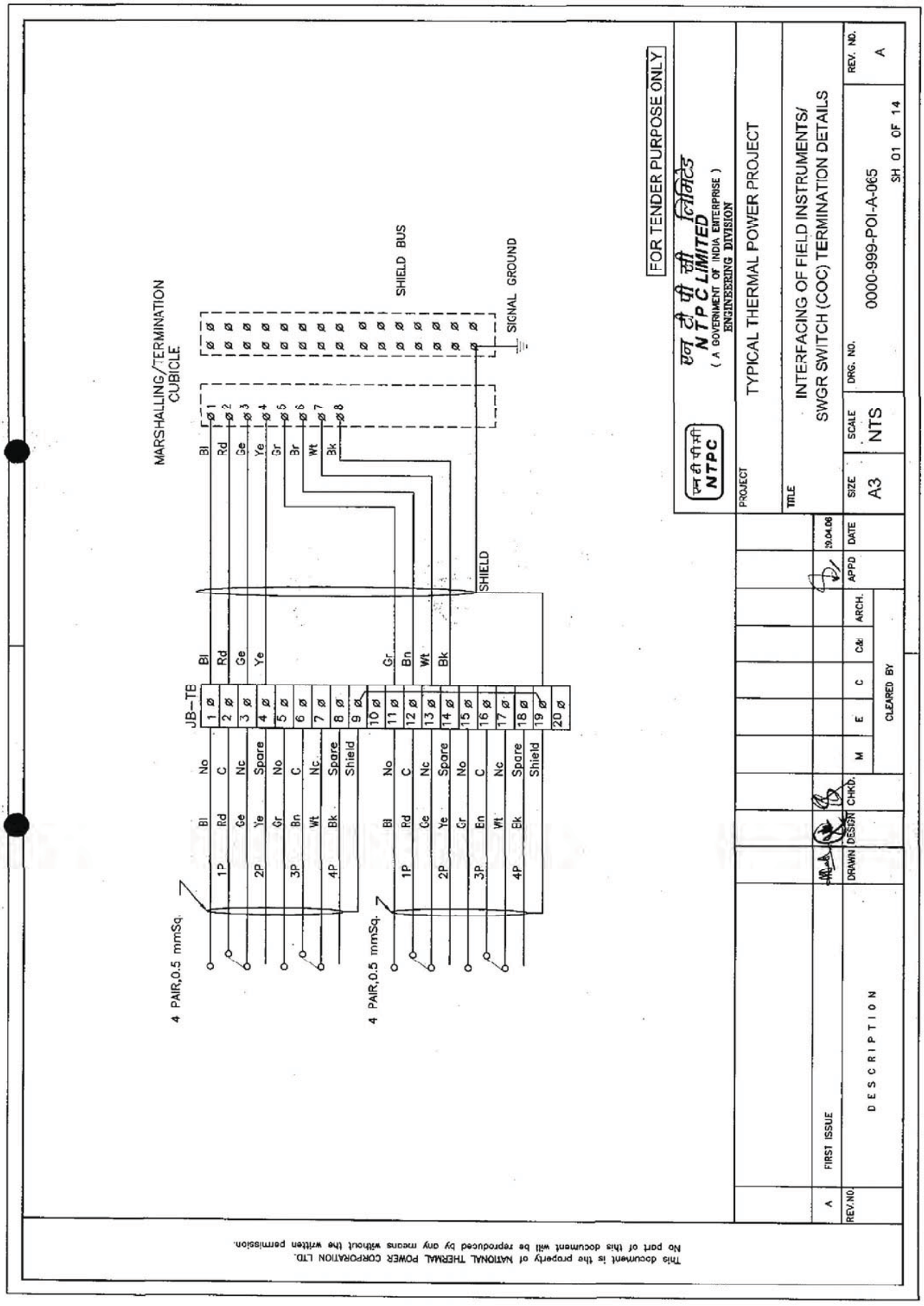

INTERFACE FOR MODULATING DRIVES – CLCS–M
COMMAND OUTPUT (4–20mA)
POSITION TXR FEED BACK (4–20mA)
ACTUATOR DISTURBANCE (NC)
E/P
INTEGRAL TB
F–TYPE 4PAIR 0.5sqmm INST.CABLE
MARSHALLING PANEL
TB
YQ10+
YQ10
XQ10+
XQ10
SHIELD BUS
COMMON
XB46
BL
RD
GE
YE
GR
BN
WT
BK
G–TYPE 4 PAIR 0.5sqmm INST.CABLE
DDCMIS
ANALOG OUTPUT $$
ANALOG INPUT
BINARY INPUT
BUS
OWS
NOTE:–1 $$ REDUNDANT OUTPUTS WHEREVER APPLICBLE
NOTE:–2 # 8 LEVEL TERMINAL BLOCK
NOTE:–3 @@ IN EACH DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.
NOTE:–4 F–TYPE: INDIVIDUAL & OVERALL SHIELD CABLE.
3X800 MW NTPC PATRATU STPP PHASE–I
INTERFACE FOR MODULATING DRIVES – CLCS–M
DRG.NO. 9585–001–405–PVI–B–152B
SHT 15 OF 34

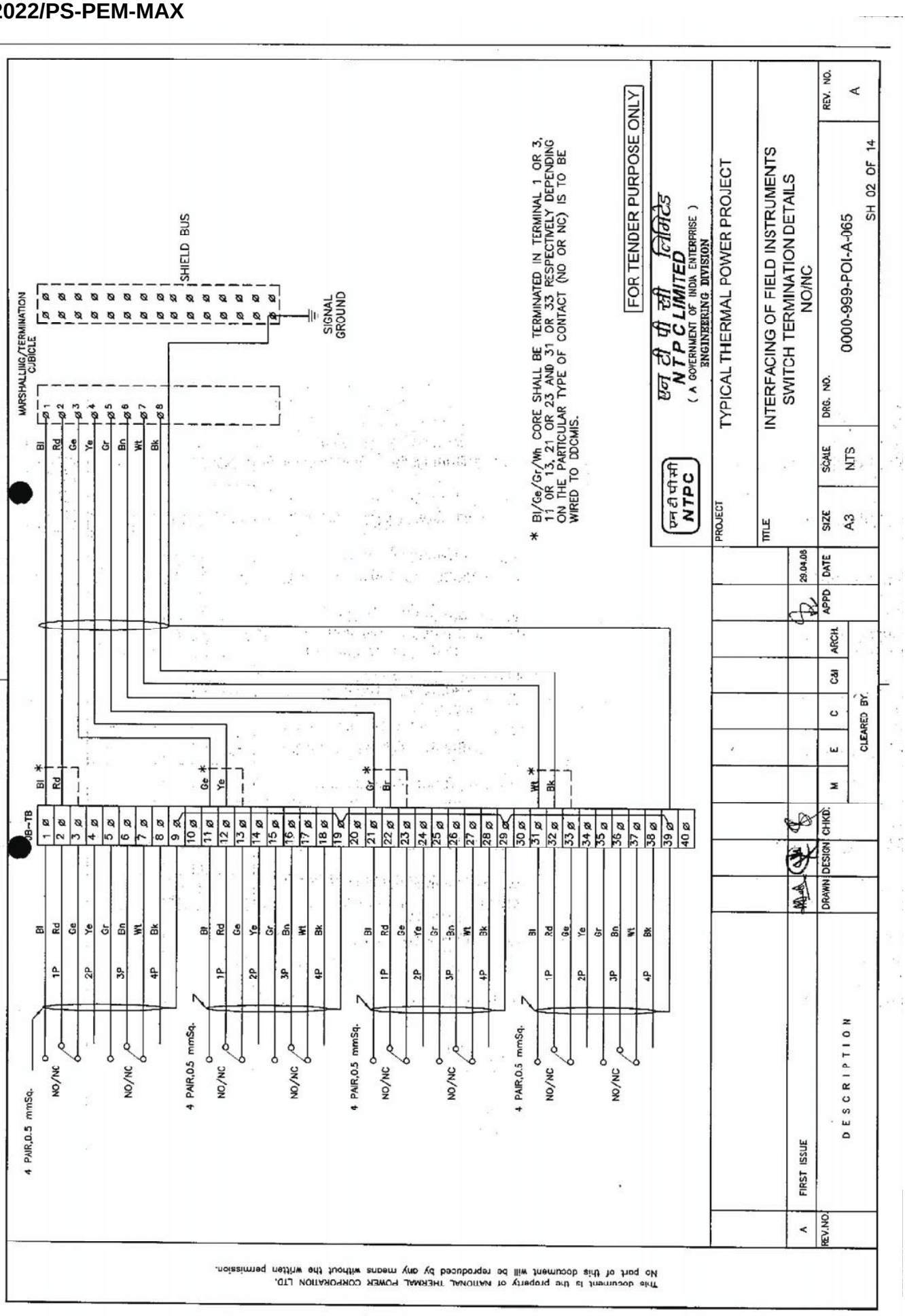

DDCMIS INTERFACE WITH VFD
VFD– PANEL
MARSHALLING PANEL
G–TYPE 4PAIR 0.5sqmm INST.CABLE
4PAIR 0.5sqmm G–TYPE INST.CABLE
SHIELD BUS
4pX0.5Sqmm 'F–TYPE'
DDCMIS
BINARY OUTPUT $$
BINARY INPUT
ANALOG OUTPUT
ANALOG INPUT
XB91+ START
XB91– COMMAND
XB92+ STOP
XB92– COMMAND
XB93+ BYPASS ON
XB93– COMMAND
XB11+
XB11–
XB12+
XB12–
XB13+
XB13–
ON
FEEDBACK
FAULT
FEEDBACK
BYPASS ON
FEEDBACK
SPEED REFERENCE (4–20mA)
SPEED FEED BACK (4–20mA)
BUS
OWS
3X800 MW NTPC PATRATU STPP PHASE–I
DDCMIS INTERFACE WITH VFD
DRG.NO. 9585–001–405–PVI–B–152B
SHT 13 OF 34
NOTE:–1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:–2 # 8 LEVEL TERMINAL BLOCK
NOTE:–3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.
NOTE:–4 OTHER VFD SIGNALS WILL BE CONSIDERED AS PER IO LIST.

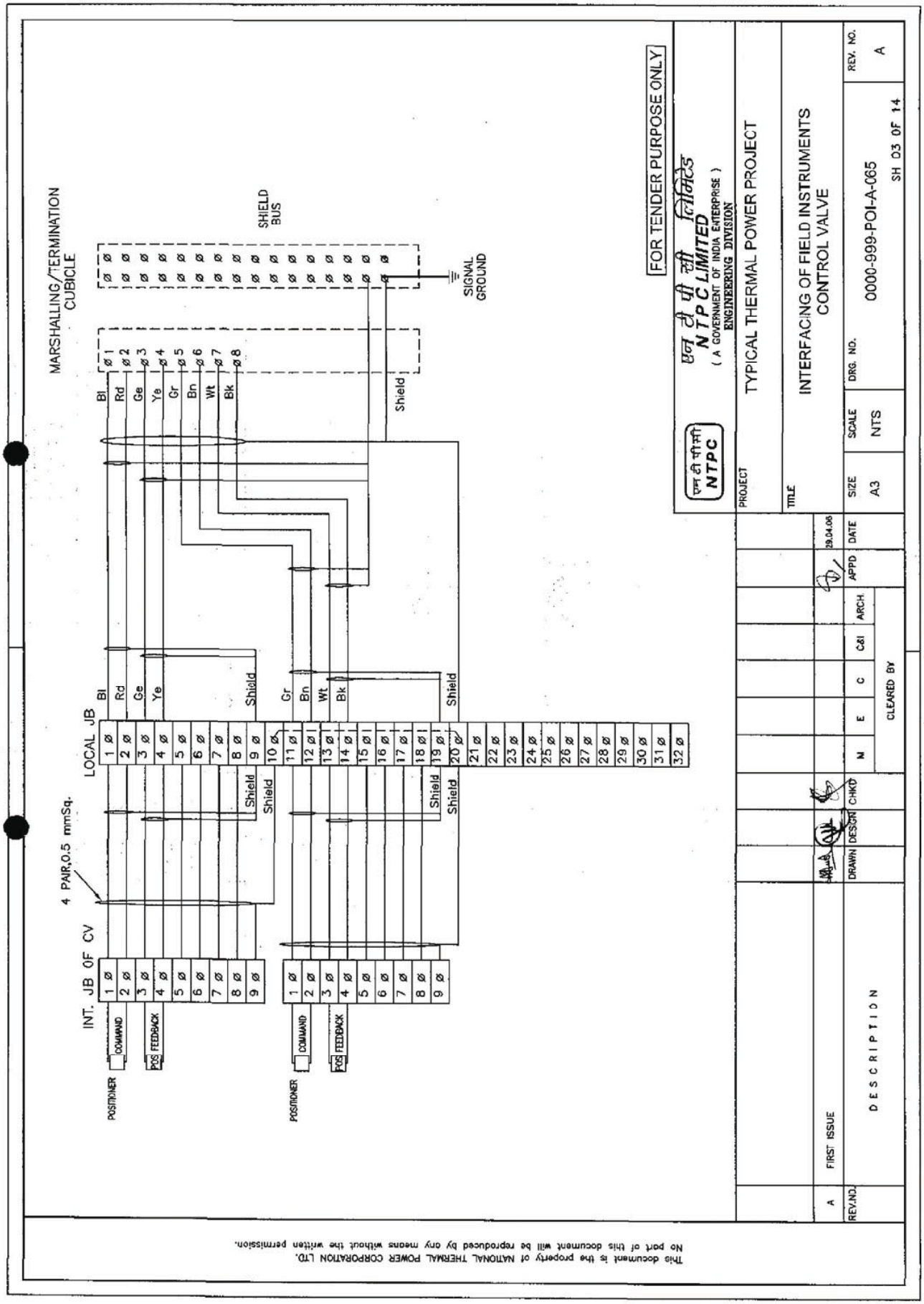
DRIVE & INSTRUMENT INTERFACE DIAGRAM


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
BULKHEAD OF LOCAL INSTRUMENT ENCLOSURE/RACK
TRANSMITTER
DRAIN HEADER
TYPICAL ARRANGEMENT OF DP TRANSMITTER (SIDE LIE/AIR MOUNTED BELOW INSTRUMENT SOURCE POINT)
TRANSMITTER RACK
TYPICAL PURGE AIR CONNECTION INSIDE THE INST. ENCLOSURE
(APPLICABLE FOR MILL AIR & FLUE GAS SERVICE INSTRUMENTS REQUIRING PURGE AIR)
(Drain Header of each LIE/AIR shall be connected to nearest plant drain)
FOR TENDER PURPOSE ONLY
NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
PROJECT
TYPICAL THERMAL POWER PROJECT
(TURNKEY EPC PACKAGE)
TITLE
TYPICAL GA OF LOCAL INSTRUMENT ENCLOSURE, PURGING SCHEME, DP TRANSMITTER
SIZE A2
SCALE N.T.S.
DRG. NO. 0000-999-POI-A-006
REV. NO. A
SECTION-BB
LIE WITH PURGING (TYPICAL)
JUNCTION BOX
PURGE AIR
PURGE AIR SERVICE AIR
FIRST ISSUE
DESCRIPTION
CLEARED BY
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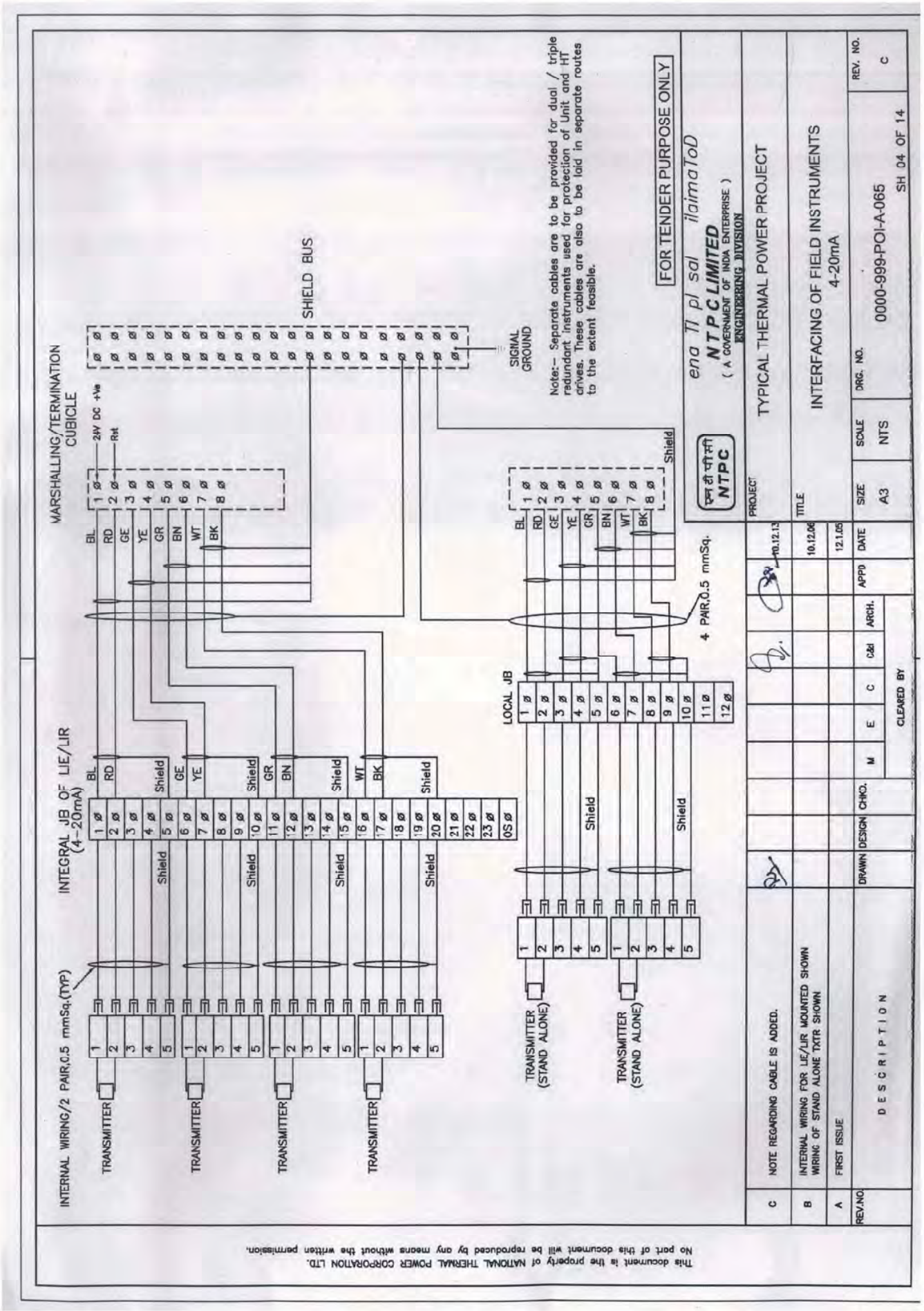

FOR TENDER PURPOSE ONLY
एन टी पी सी लिमिटेड
NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION
PROJECT
TYPICAL THERMAL POWER PROJECT
TITLE
INTERFACING OF ACTUATORS
SIZE A3
SCALE N.T.S.
DRG. NO. 0000-999-POI-A-063
REV. NO. A
REVERSING CONTACTORS
ACTUATOR BOX
PLUG & SOCKET
TB OF INTEGRAL JB
DISTURBANCE
OPEN LS
CLOSE LS
CLOSE
COMMON
OPEN
4 PAIR 0.5 Sq mm INSTRU. CABLE
TERMINATION AT CONTROL SYSTEM END
CLEARED BY
DESCRIPTION
FIRST ISSUE
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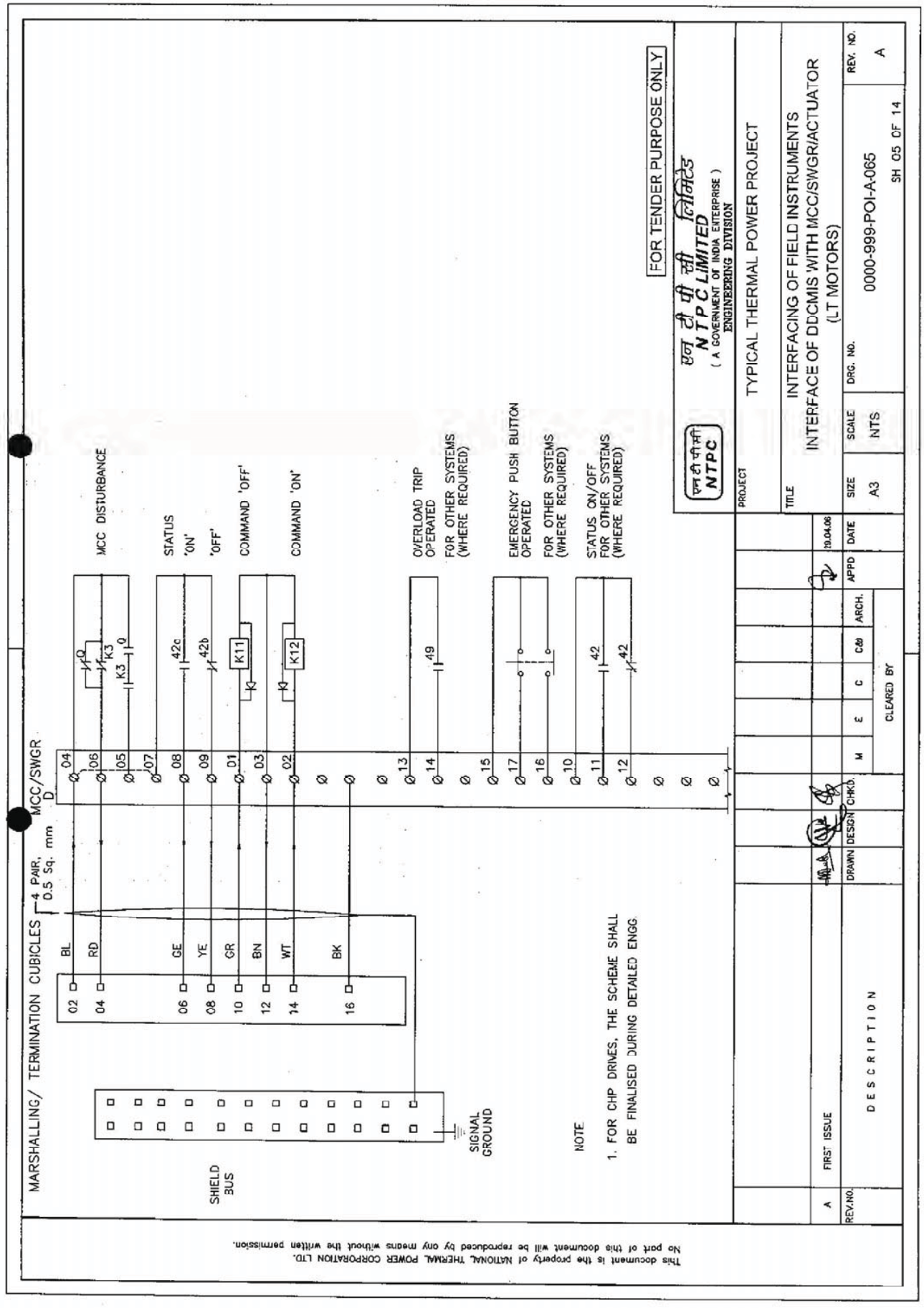

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NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION
एन टी पी सी
NTPC
PROJECT
TYPICAL THERMAL POWER PROJECT
TITLE
INTERFACING OF FIELD INSTRUMENTS/
SWGR SWITCH (COC) TERMINATION DETAILS
SIZE
A3
SCALE
NTS
DRG. NO.
0000-999-POI-A-065
SH 01 OF 14
REV. NO.
A
MARSHALLING/TERMINATION
CUBICLE
SHIELD BUS
SIGNAL GROUND
SHIELD
JB-TB
4 PAIR,0.5 mmSq.
4 PAIR,0.5 mmSq.
1P
2P
3P
4P
Bl
Rd
Ge
Ye
Gr
Br
Wt
Bk
Bn
No
C
Nc
Spare
Shield
REV.NO
DESCRIPTION
DRAWN
DESIGN
CHKD.
CLEARED BY
APP'D
DATE
19.04.06
FIRST ISSUE
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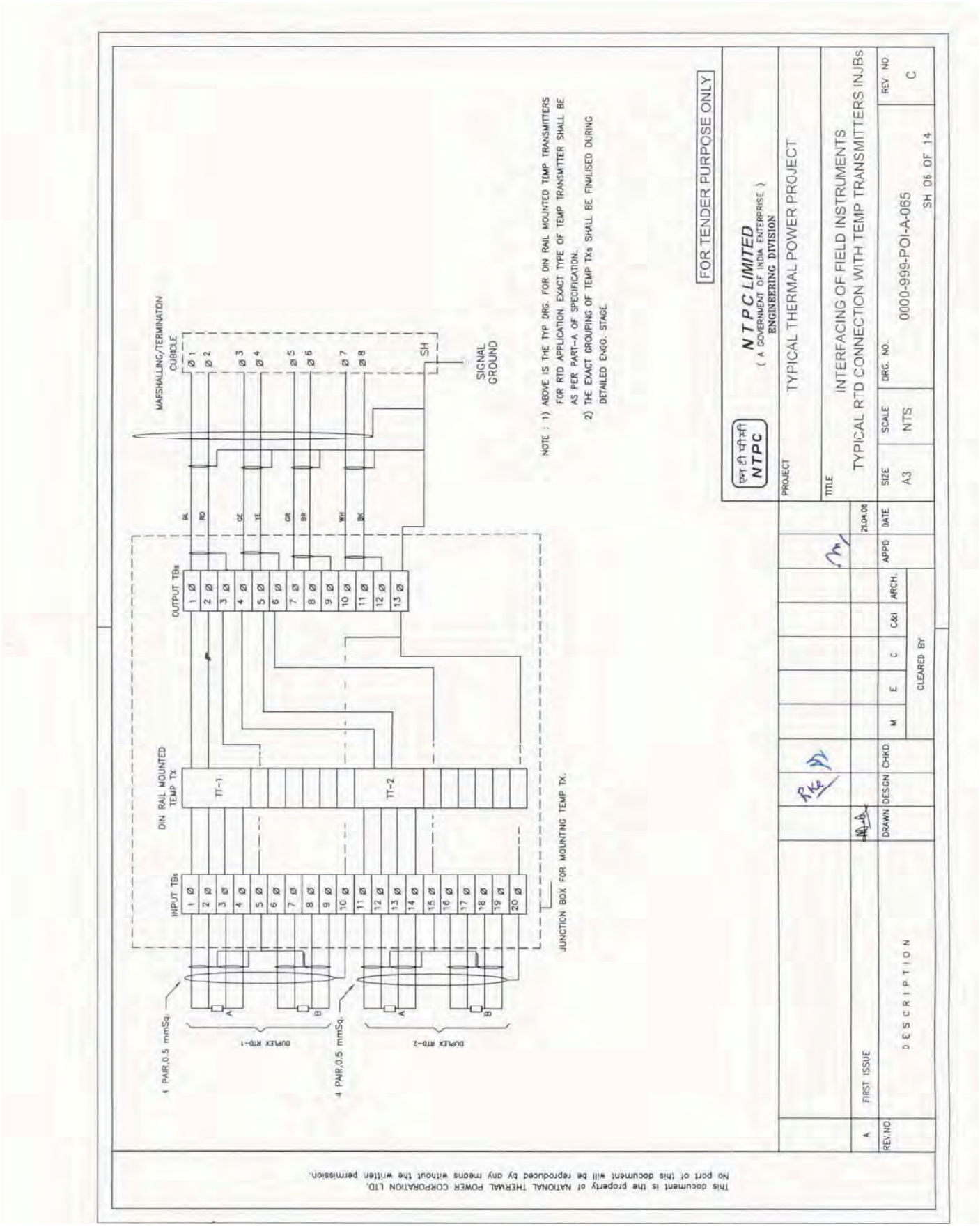

FOR TENDER PURPOSE ONLY
NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION
PROJECT
TYPICAL THERMAL POWER PROJECT
TITLE
INTERFACING OF FIELD INSTRUMENTS
SWITCH TERMINATION DETAILS
NO/NC
SIZE A3
SCALE NTS
DRG. NO. 0000-999-POI-A-065
REV. NO. A
SH 02 OF 14
* Bl/Ge/Gr/Wh CORE SHALL BE TERMINATED 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.
MARSHALLING/TERMINATION CUBICLE
SHIELD BUS
SIGNAL GROUND
4 PAIR,0.5 mmSq.
NO/NC
DESCRIPTION
FIRST ISSUE
DRAWN
DESIGN
CHKD.
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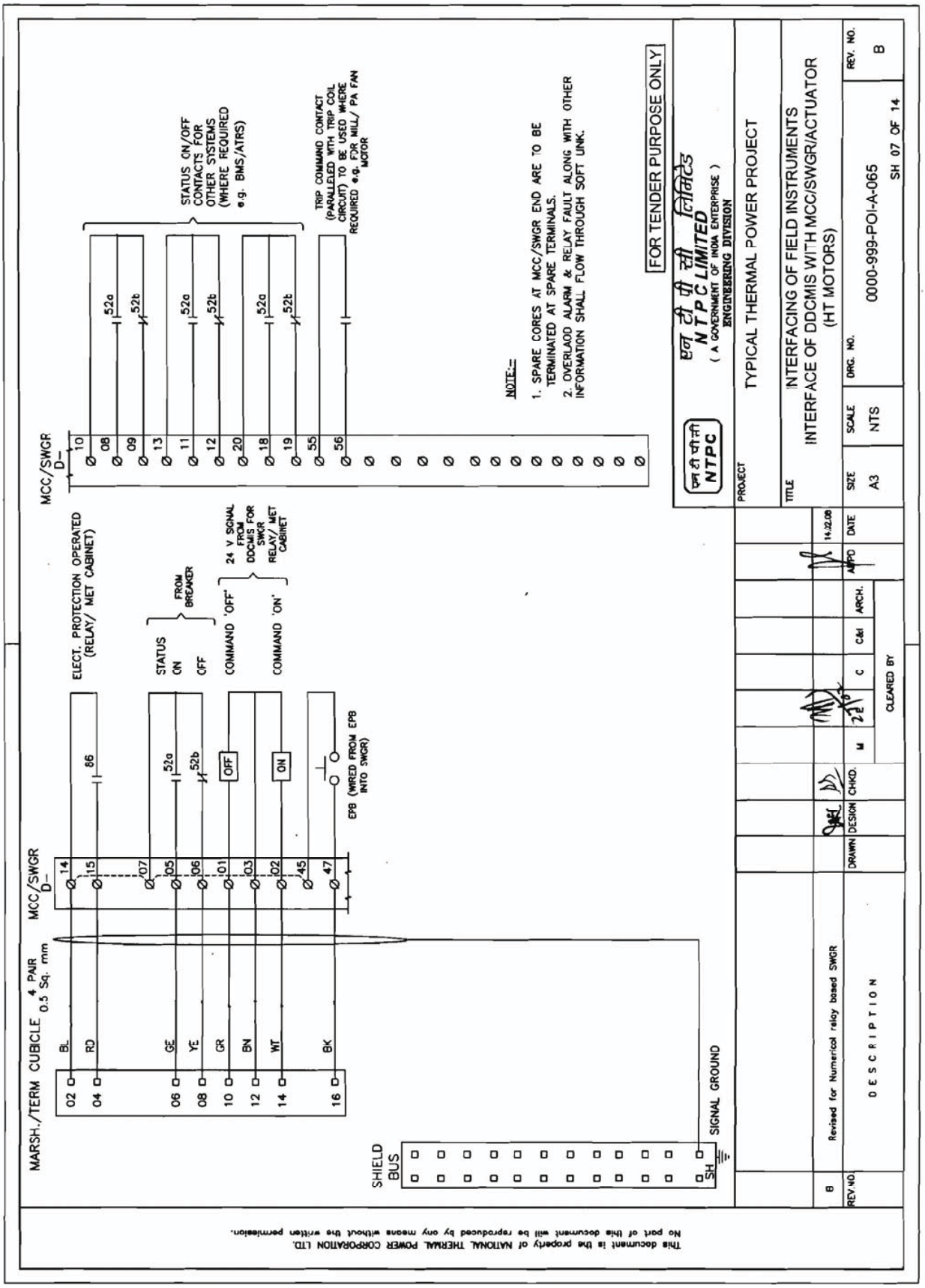

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NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION
एन टी पी सी
NTPC
PROJECT
TYPICAL THERMAL POWER PROJECT
TITLE
INTERFACING OF FIELD INSTRUMENTS
CONTROL VALVE
SIZE
A3
SCALE
NTS
DRG. NO.
0000-999-POI-A-065
SH 03 OF 14
REV. NO.
A
MARSHALLING/TERMINATION CUBICLE
SHIELD BUS
SIGNAL GROUND
LOCAL JB
INT. JB OF CV
4 PAIR,0.5 mmSq.
Bl
Rd
Ge
Ye
Gr
Bn
Wt
Bk
Shield
COMMAND
FEEDBACK
POSITIONER
POS
DESCRIPTION
FIRST ISSUE
DRAWN
DESIGN
CHKD
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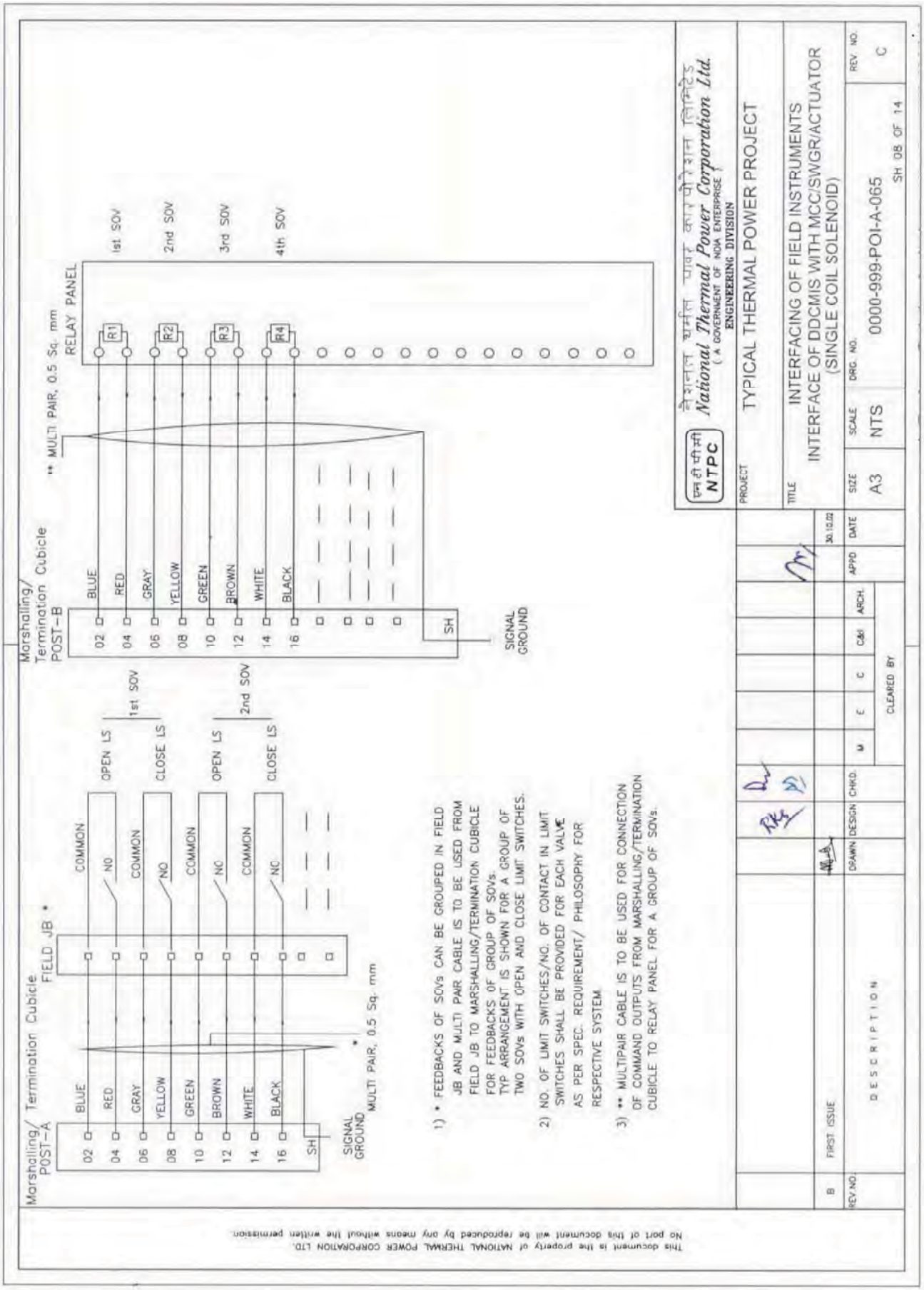
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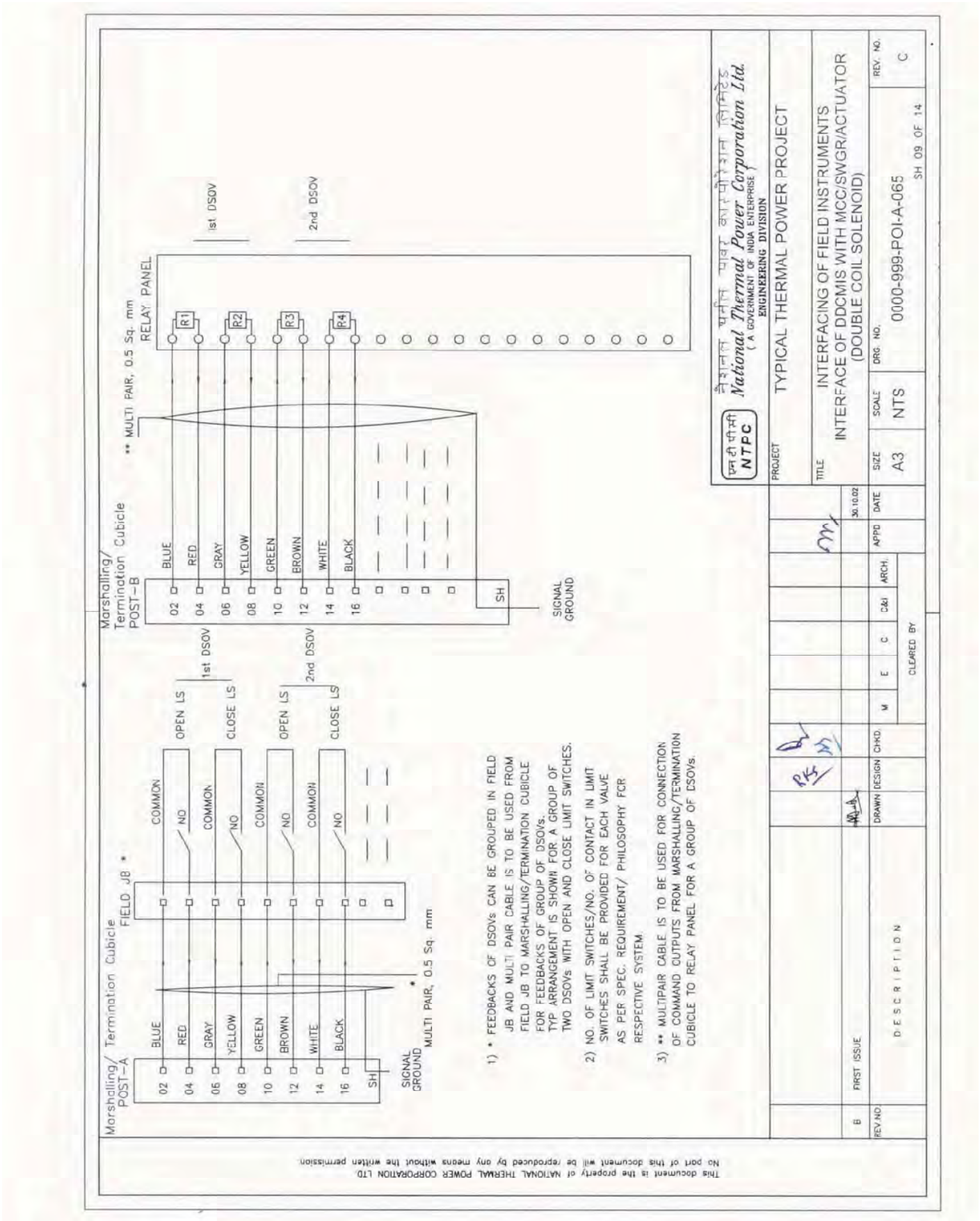


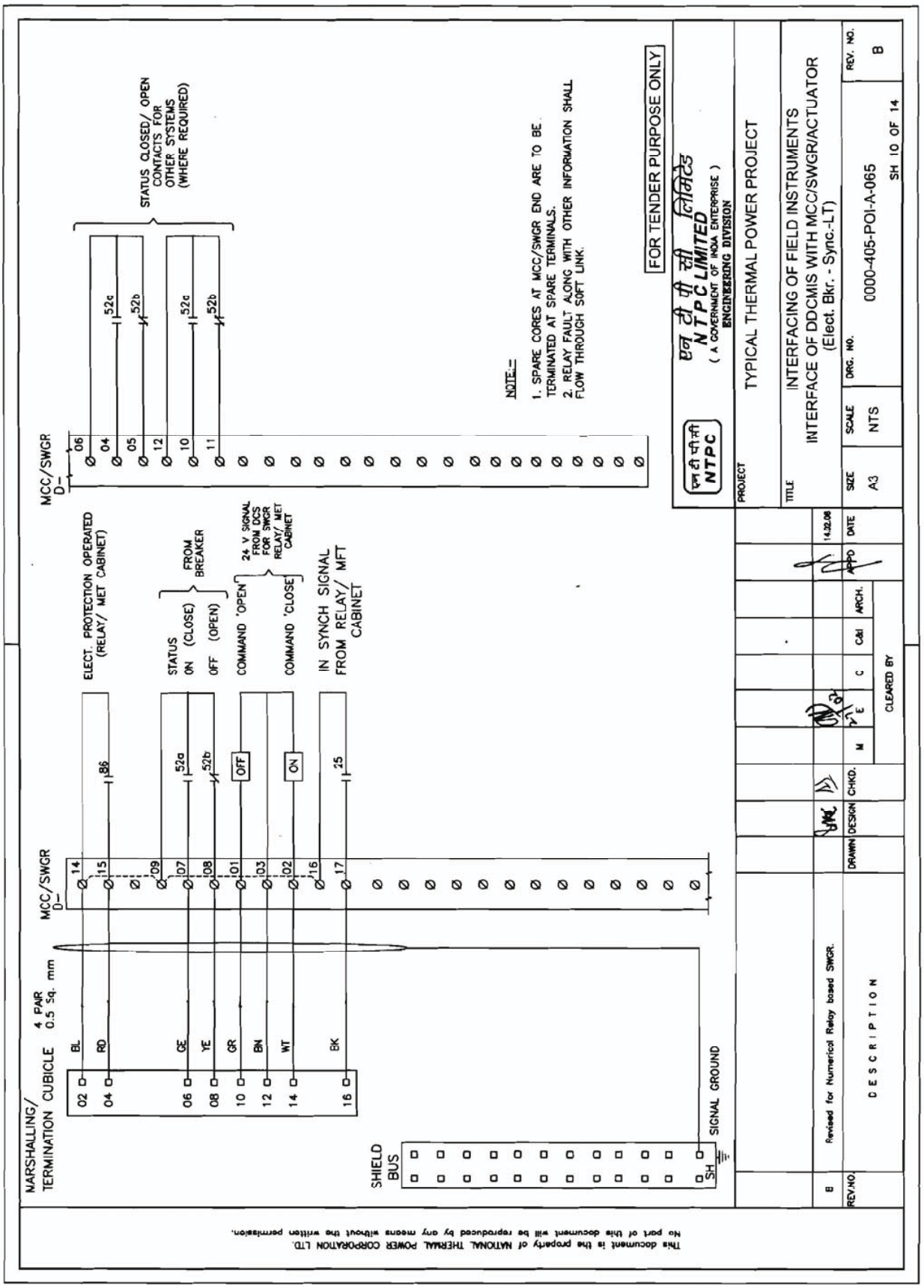

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ENGINEERING DIVISION
PROJECT
TYPICAL THERMAL POWER PROJECT
TITLE
INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR
(LT MOTORS)
SIZE A3
SCALE NTS
DRG. NO. 0000-999-POI-A-065
REV. NO. A
SH 05 OF 14
MARSHALLING/ TERMINATION CUBICLES
MCC/SWGR
4 PAIR, 0.5 Sq. mm
MCC DISTURBANCE
STATUS 'ON'
'OFF'
COMMAND 'OFF'
COMMAND 'ON'
OVERLOAD TRIP OPERATED
FOR OTHER SYSTEMS (WHERE REQUIRED)
EMERGENCY PUSH BUTTON OPERATED
FOR OTHER SYSTEMS (WHERE REQUIRED)
STATUS ON/OFF FOR OTHER SYSTEMS (WHERE REQUIRED)
BL
RD
GE
YE
GR
BN
WT
BK
SHIELD BUS
SIGNAL GROUND
NOTE
1. FOR CHP DRIVES, THE SCHEME SHALL BE FINALISED DURING DETAILED ENGG.
DESCRIPTION
FIRST ISSUE
DRAWN
DESIGN
CHKD.
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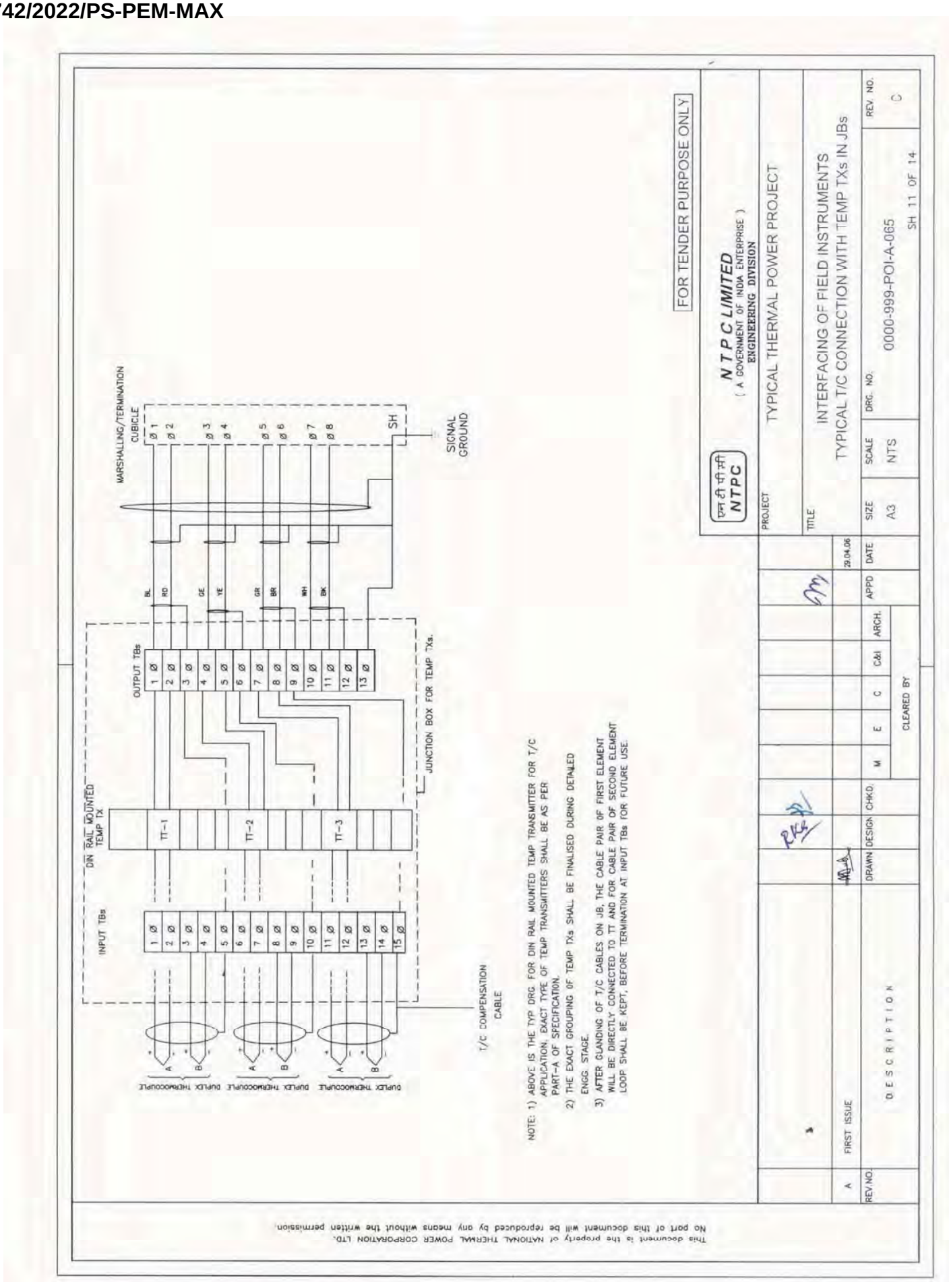

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ENGINEERING DIVISION
PROJECT
TYPICAL THERMAL POWER PROJECT
TITLE
INTERFACING OF FIELD INSTRUMENTS
TYPICAL RTD CONNECTION WITH TEMP TRANSMITTERS INJBs
SIZE A3
SCALE NTS
DRG. NO. 0000-999-POI-A-065
REV. NO. C
SH 06 OF 14
NOTE : 1) ABOVE IS THE TYP DRG. FOR DIN RAIL MOUNTED TEMP TRANSMITTERS FOR RTD APPLICATION. EXACT TYPE OF TEMP TRANSMITTER SHALL BE AS PER PART-A OF SPECIFICATION.
2) THE EXACT GROUPING OF TEMP TXs SHALL BE FINALISED DURING DETAILED ENGG. STAGE.
MAFSHALLING/TERMINATION CUBICLE
SIGNAL GROUND
DIN RAIL MOUNTED TEMP TX
INPUT TBs
OUTPUT TBs
TT-1
TT-2
JUNCTION BOX FOR MOUNTING TEMP TX.
4 PAIR,0.5 mmSq.
DUPLEX RTD-1
DUPLEX RTD-2
REV.NO
DESCRIPTION
DRAWN
DESIGN
CHKD
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MARSH./TERM CUBICLE
MCC/SWGR
D–
4 PAIR 0.5 Sq. mm
ELECT. PROTECTION OPERATED (RELAY/ MET CABINET)
STATUS
ON
OFF
FROM BREAKER
COMMAND 'OFF'
COMMAND 'ON'
24 V SIGNAL FROM DDCMIS FOR SWGR RELAY/ MET CABINET
EPB (WIRED FROM EPB INTO SWGR)
SHIELD BUS
SIGNAL GROUND
STATUS ON/OFF CONTACTS FOR OTHER SYSTEMS (WHERE REQUIRED e.g. BMS/ATRS)
TRIP COMMAND CONTACT (PARALLELED WITH TRIP COIL CIRCUIT) TO BE USED WHERE REQUIRED e.g. FOR MILL/ PA FAN MOTOR
NOTE:–
1. SPARE CORES AT MCC/SWGR END ARE TO BE TERMINATED AT SPARE TERMINALS.
2. OVERLAOD ALARM & RELAY FAULT ALONG WITH OTHER INFORMATION SHALL FLOW THROUGH SOFT LINK.
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(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION
PROJECT
TYPICAL THERMAL POWER PROJECT
TITLE
INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR
(HT MOTORS)
SIZE A3
SCALE NTS
DRG. NO. 0000-999-POI-A-065
SH 07 OF 14
REV. NO. B
B Revised for Numerical relay based SWGR
DESCRIPTION
DRAWN DESIGN CHKD. M C C&I ARCH. APPD DATE
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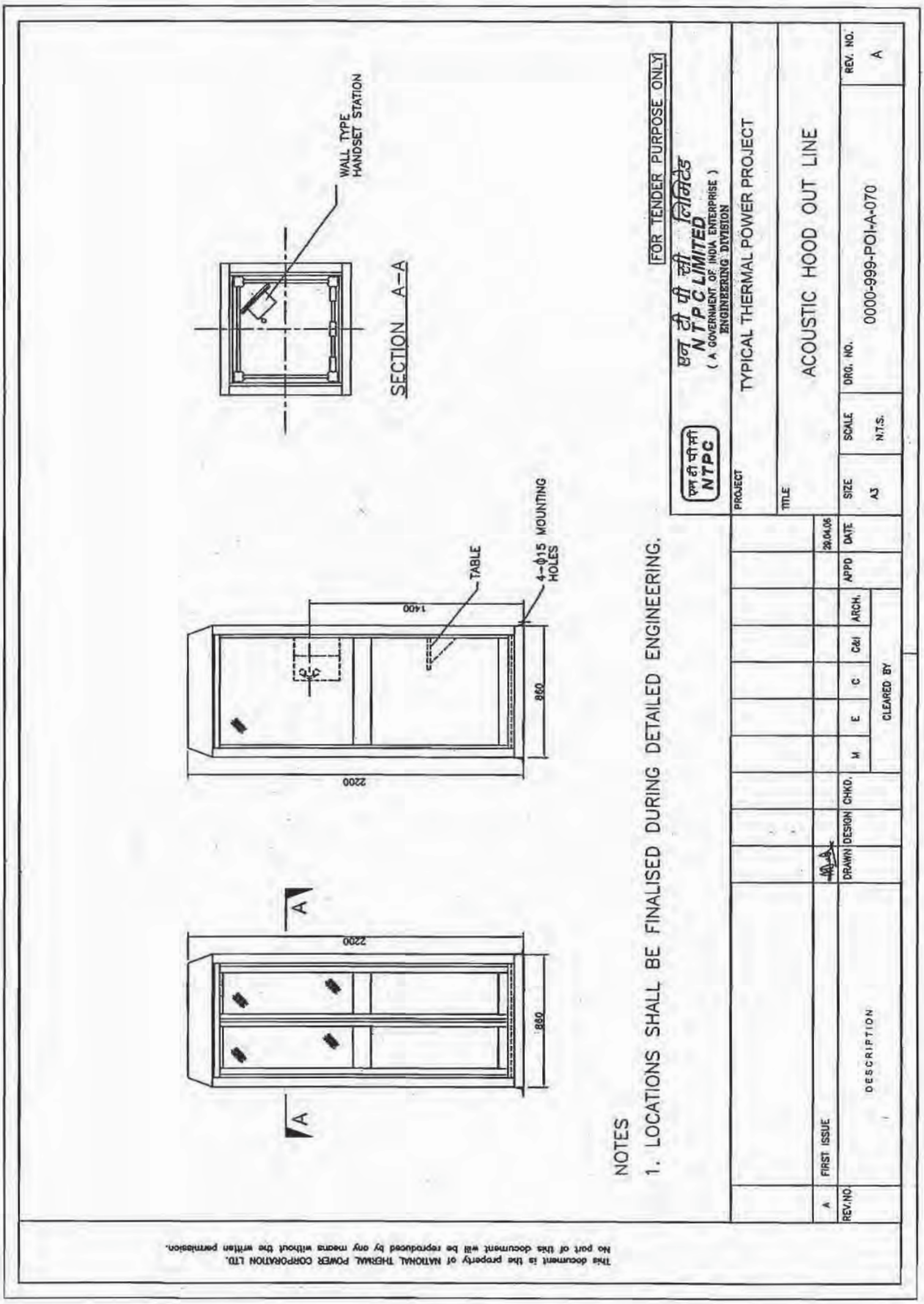

Marshalling/ Termination Cubicle
POST-A
FIELD JB *
BLUE
RED
GRAY
YELLOW
GREEN
BROWN
WHITE
BLACK
SH
02
04
06
08
10
12
14
16
COMMON
NO
NC
OPEN LS
CLOSE LS
1st SOV
2nd SOV
SIGNAL GROUND
* MULTI PAIR, 0.5 Sq. mm
Marshalling/ Termination Cubicle
POST-B
** MULTI PAIR, 0.5 Sq. mm
RELAY PANEL
R1
R2
R3
R4
1st SOV
2nd SOV
3rd SOV
4th SOV
1) * FEEDBACKS OF SOVs CAN BE GROUPED IN FIELD JB AND MULTI PAIR CABLE IS TO BE USED FROM FIELD JB TO MARSHALLING/TERMINATION CUBICLE FOR FEEDBACKS OF GROUP OF SOVs. TYP ARRANGEMENT IS SHOWN FOR A GROUP OF TWO SOVs WITH OPEN AND CLOSE LIMIT SWITCHES.
2) NO. OF LIMIT SWITCHES/NO. OF CONTACT IN LIMIT SWITCHES SHALL BE PROVIDED FOR EACH VALVE AS PER SPEC. REQUIREMENT/ PHILOSOPHY FOR RESPECTIVE SYSTEM.
3) ** MULTIPAIR CABLE IS TO BE USED FOR CONNECTION OF COMMAND OUTPUTS FROM MARSHALLING/TERMINATION CUBICLE TO RELAY PANEL FOR A GROUP OF SOVs.
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REV. NO.
B
DESCRIPTION
FIRST ISSUE
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DESIGN
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APPD
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राष्ट्रीय थर्मल पावर कार्पोरेशन लिमिटेड
National Thermal Power Corporation Ltd.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION
PROJECT
TYPICAL THERMAL POWER PROJECT
TITLE
INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR
(SINGLE COIL SOLENOID)
SIZE
A3
SCALE
NTS
DRG. NO.
0000-999-POI-A-065
REV. NO.
C
SH 08 OF 14


Marshalling/ Termination Cubicle
POST-A
Marshalling/ Termination Cubicle
POST-B
FIELD JB *
** MULTI PAIR, 0.5 Sq. mm
RELAY PANEL
BLUE
RED
GRAY
YELLOW
GREEN
BROWN
WHITE
BLACK
SH
COMMON
NO
OPEN LS
CLOSE LS
1st DSOV
2nd DSOV
R1
R2
R3
R4
SIGNAL GROUND
MULTI PAIR, 0.5 Sq. mm
1) * FEEDBACKS OF DSOVs CAN BE GROUPED IN FIELD JB AND MULTI PAIR CABLE IS TO BE USED FROM FIELD JB TO MARSHALLING/TERMINATION CUBICLE FOR FEEDBACKS OF GROUP OF DSOVs. TYP ARRANGEMENT IS SHOWN FOR A GROUP OF TWO DSOVs WITH OPEN AND CLOSE LIMIT SWITCHES.
2) NO. OF LIMIT SWITCHES/NO. OF CONTACT IN LIMIT SWITCHES SHALL BE PROVIDED FOR EACH VALVE AS PER SPEC. REQUIREMENT/ PHILOSOPHY FOR RESPECTIVE SYSTEM.
3) ** MULTIPAIR CABLE IS TO BE USED FOR CONNECTION OF COMMAND OUTPUTS FROM MARSHALLING/TERMINATION CUBICLE TO RELAY PANEL FOR A GROUP OF DSOVs.
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B
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DESCRIPTION
REV NO
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National Thermal Power Corporation Ltd.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION
एन टी पी सी
NTPC
PROJECT
TYPICAL THERMAL POWER PROJECT
TITLE
INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR
(DOUBLE COIL SOLENOID)
SIZE
A3
SCALE
NTS
DRG NO.
0000-999-POI-A-065
SH 09 OF 14
REV. NO.
C


NARSHALLING/ TERMINATION CUBICLE
4 PAIR 0.5 Sq. mm
MCC/SWGR
ELECT. PROTECTION OPERATED (RELAY/ MET CABINET)
STATUS ON (CLOSE) OFF (OPEN)
FROM BREAKER
COMMAND 'OPEN'
COMMAND 'CLOSE'
24 V SIGNAL FROM DCS FOR SWGR RELAY/ MET CABINET
IN SYNCH SIGNAL FROM RELAY/ MFT CABINET
SHIELD BUS
SIGNAL GROUND
STATUS CLOSED/ OPEN CONTACTS FOR OTHER SYSTEMS (WHERE REQUIRED)
NOTE:-
1. SPARE CORES AT MCC/SWGR END ARE TO BE TERMINATED AT SPARE TERMINALS.
2. RELAY FAULT ALONG WITH OTHER INFORMATION SHALL FLOW THROUGH SOFT LINK.
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NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION
PROJECT
TYPICAL THERMAL POWER PROJECT
TITLE
INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR
(Elect. Bkr. - Sync.-LT)
SIZE A3
SCALE NTS
DRG. NO. 0000-405-POI-A-065
REV. NO. B
SH 10 OF 14
DESCRIPTION
Revised for Numerical Relay based SWGR.
DRAWN DESIGN CHKD.
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14.02.08
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WALL TYPE HANDSET STATION
SECTION A-A
TABLE
4-ϕ15 MOUNTING HOLES
1400
880
2200
A
A
NOTES
1. LOCATIONS SHALL BE FINALISED DURING DETAILED ENGINEERING.
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ENGINEERING DIVISION
PROJECT
TYPICAL THERMAL POWER PROJECT
TITLE
ACOUSTIC HOOD OUT LINE
SIZE A3
SCALE N.T.S.
DRG. NO. 0000-999-POI-A-070
REV. NO. A
REV.NO. DESCRIPTION DRAWN DESIGN CHK'D. M E C C&I ARCH. APP'D DATE
A FIRST ISSUE 29.04.06
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INSTRUMENTATION CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY

5.00.00 **INSTRUMENTATION CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY**

The cable interconnection philosophy to be adopted shall be such that extensive grouping of signals by large scale use of field mounted Group Junction Boxes (JBs) at strategic locations (where large concentration of signals are available, e.g. valves limit & torque switches, switchgear) is done and consequently cable with higher number of pairs are extensively used. The details of termination to be followed are mentioned in the given Table A.

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

Application		Type Of Termination		Type Of Cable
FROM (A)	TO (B)	END A	END B	
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
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 connector at one end)
DDCMIS/PLC cabinets	PC, Printers etc.	Plug in connector	Plug in connector	Mfr.'s Standard

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 For Cable type and cable termination scheme for the instruments/ equipment that are connected to Steam Turbine and Generator (STG) control system defined at Part A, sub section IIC, clause no. 2.03.01 (a) (ii) above and hydrogen generation plant auxiliaries system, Contractor's standard and proven practice is also acceptable. However, for termination of instrumentation cable at marshalling cabinets/DCS panel end, cage-clamp termination shall be offered. For power and control cable termination, Contractor's standard and proven practice would be acceptable

CLAUSE NO.	TECHNICAL REQUIREMENTS
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.)

CLAUSE NO.	TECHNICAL REQUIREMENTS
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

CLAUSE NO.	TECHNICAL REQUIREMENTS
	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.

CLAUSE NO.	TECHNICAL REQUIREMENTS

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 lead coated galvanized 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

CLAUSE NO.	TECHNICAL REQUIREMENTS
	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.

QUALITY ASSURANCE-INSTRUMENTS

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)

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-770)	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 (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

:

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. Flue Gas analyser	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) Detailed procedure of Environmental Stress screening test shall be as per Quality Assurance. Programme in General Technical Conditions

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.

ELECTRICAL ACTUATOR WITH INTEGRAL STARTER

Test/Attributes Characteristics / ITEM/ COPONENT/ SUB SYSTEM ASSEMBLY/ TESTING	RPM ®	No Load Current ®	IR & HV Test®	Mounting Dimension®	All routine Test as per Standard & Specification®	Correct Phase Sequence®	Operation & Setting of limit Switch/Torque Switch®	Stall Torque/Current (A)	Hand Wheel operation/ Auto de clutch function (A)	Function of Aux. like Potentiometer, space heater, position indicator ®	EPT output ®	Grease leakage ®	Local/ Remote (Open-Stop-Close) Operation® Safety check (Single phasing, Phase correction, Tripping etc.) (A)
ELECTRICAL ACTUATOR WITH INTEGRAL STARTER(IS_9334)													
Motor	Y	Y	Y	Y	Y								
Final Testing	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Note: 1) Detailed procedure of Environmental Stress Screening test shall be as per Quality Assurance Programme in General Technical Conditions. Requirement of test and procedure finalized during QP finalization

2) 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.

® - Routine Test (A) - Acceptance Test Y - Test applicable

SUB-SECTION–E-58

VFD MODULES

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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.

QUALITY ASSURANCE

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	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 IS/IEC
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.

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

CHECK LIST FOR SOLENOID VALVES

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE						
	MAKE						
	MODEL No.						
2	MATERIAL (BODY. PLUNGER/TRIM)			P	W	V	
3	PORT SIZE			P	W	V	
4	CABLE CONNECTION SIZE			P	W	V	
5	ENCLOSURE CLASS			P	W	V	TYPE TEST CERTIFICATE TO BE FURNISHED BY VENDOR
6	No. OF COILS & INSULATION CLASS			P	W	V	TEST CERTIFICATE TO BE FURNISHED FOR INSULATION CLASS BY VENDOR
7	POWER SUPPLY CHECK			P	W	V	
8	IR / HV TEST			P	W	V	
9	FUCTIONAL TEST			P	W	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. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

PEM :: C&I

STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
1.0	**INCOMING MATERIAL**											
1.1	Body & Bonnet casting / forgings, plug, valve stem, seat ring/cage.	1. Physical, Chemical properties	MA	Physical, Chemical tests	One/ Heat(HT Batch)	Approved drg. / data sheet /	Approved drg. / data sheet /	Test Certificate	3	---	2,1	TC for body/bonnet from foundry only
		2. Heat Treatment	MA	Review of H.T. Chart	Each H.T.	Approved drg. / data sheet /	Approved drg. / data sheet /	Test Certificate	3/2	2	1	1.IBR Certification (if applicable) to be verified by BHEL. 2.Applicable for body /bonnet only
		3. Internal quality of castings	MA	RT for Body & UT for Bonnet	100%	ASME B 16.34	ASME B 16.34	Test Report / FILM	3/2	2	1	Applicable for body and bonnet for rating ANSI 900 and above.
		4. Surface Quality	MA	1. Visual	100%	MSS-SP-55	MSS-SP-55	Test Certificate	3/2	---	2	
				2. MT/PT	100%	ASME B 16.34	ASME B 16.34	Test Certificate	3	2	1	After Machining on machined surface only
		5. Pressure test for shell	MA	Hyd. Test	100%	ISA-S-75.19/ ASME B 16.34	ISA-S-75.19/ ASME B 16.34	Test Certificate	2	2	1	For Body & Bonnet after machining.
1.2	Diaphragm	1. Surface Quality	MA	Visual	100%	Mfr. standard	Mfr. standard	Test Certificate	3/2	---	2	

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
RT- Radiographic Test; UT – Ultrasonic Test; PT – Dye penetrant Test; MT- Magnetic Test
$ P - Agency Performing the Test.; W - Agency Witnessing the Test.; V - Agency Verifying the Test.
1 - BHEL; 2 - Vendor; 3 - Sub-vendor

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
		2. Hardness	MA	Measurement	100%	Mfr. standard	Mfr. standard	Test Certificate	3/2	---	2	
		3. Endurance / Life cycle	MA	Cyclic test 10,000 cycles	One / Type	10,000 cycles/ Mfr. standard.	No damage	Test Certificate	3/2	---	2,1	
1.3	Spring	1. Composition	MA	Chemical-Analysis	One sample/ Heat	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2	
		2. Mech. Properties	MA	Mech. Test	One sample/ Heat	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2	
		3. Performance	MA	1. Stiffness ratio	100%	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2	
				2. Scragging	100%	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2	
				3. Cyclic test (Endurance)	One / type	10,000 cycles	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
				4. Dimension (Measurement)	One sample/ Lot	Mfr. standard	Mfr. standard	Record	3	---	2	
1.4	Electrical items [Limit switches, Solenoids, Position Transmitter(if provided externally)]	1. Routine Test	MA	HV, IR, Continuity function	100%	Relevant Standards	Relevant Standards	Test Certificate	3	---	2	
		2. Degree of protection	MA	IP/NEMA Tests	One sample / type	Approved Data sheet	Approved Data sheet	Test Certificate	3	---	2,1	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
1.5	Pressure Gauges	1. Performance	MA	Review of calibration certificates	100%	Mfr. Standard	Mfr. Standard	Test Certificate	3	---	2	
		2. Marking	MA	Visual	100%	Mfr. standard	Mfr. standard	Records	3	---	2	
2.0	**IN PROCESS INSPECTION**											
2.1	After machining, i, Body ii Bonnet iii Plug iv Valve Stem v seat ring/cage	1. Surface flaws	MA	Visual & MT/PT	100% (on accessible surfaces)	ASME B 16.34	ASME B 16.34	Test Records	2	---	1	Butt weld ends shall be included.
		2. Dimensional checks	MA	Measurement	100%	Mfr. Standard	Mfr. Standard	Records	2	---	1	
		3. Hard facing (wherever applicable)	MA	Hardness Measurement	One sample/Lot	Mfr. Standard	Mfr. Standard	Records	2	---	1	
3.0	**TESTS ON COMPLETED VALVE**											
3.1	Actuator Chamber	Leakage & Strength	MA	Pneumatic test	100%	Mfr. Standard	No Leakage	Test Certificate	2	1	1	Refer Note-4
3.2	Body	Leakage and Pressure test (Body Mount Leakage)	MA	Hydro test	100%	ISA - S-75.19/ ASME B16.34	No Leakage	Test Certificate	2	1	1	Refer Note-4
3.3	Seat leakage test for completed valve	Seat Leakage	MA	Pneumatic Test	100%	FCI-70.2	FCI-70.2	Test Certificate	2	1	1	Refer Note-4
4.0	**OPERATION TEST ON COMPLETED VALVE (Final inspection)**	1. Valve Travel	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		2. Opening/Closing time	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		3. Linearity/cam characteristic	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
		4. Repeatability	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		5. Hysteresis	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		6. Sensitivity	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		7. Accuracy (Overall)	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		8. Control Valve characteristics / CV Test	MA	♦Measurement (Press. vs. discharge and discharge vs. opening 0-100% in steps of 10%)	One per type	Mfr. Procedure	Approved drg. / data sheet	Test Certificate	2	--	1	♦Size = Body & port size Or Body size & CV for non std port. Refer Note 1.
		9. Operation of limit switch & solenoids and other accessories	MA	Function	100%	Mfr. Procedure	Approved drg./ data sheet	Test Report	2	1	1	On assembled valve Refer Note-4
		10. Overall dimensions	MI	Visual and dimensional	100%	Approved drg. / data sheet	Approved drg./ data sheet	Records	2	1	1	Refer Note-4
		11. Pre defined valve position in case of air failure	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	1	1	
		12. Cleanliness, painting, stamping (for direction of flow), Tag No.	MA	Visual and dimensional, paint thickness	100%	Mfr. Procedure	Approved drg./ data sheet	Test Certificate	2	1	1	
		13. Surface Quality	MA	Visual	100%	MSS-SP-55	MSS-SP-55	Test Certificate	3/2	---	2,1	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
5.0	**AUXILIARY ITEMS (Performance test of auxiliary items shall be performed on the completely assembled valve)**											
5.1	Positioner	Overall leakage after assembly including Nozzles leakage	MA	Leak Test (in the steady state input signal)	100 %	Mfr. Standard	No leakage	Test Certificate	3/2	---	---	Certificate of Conformance (C.O.C)
5.2	Air filter regulator	1. Normal air consumption	MA	Measurement	Each type	Mfr. Standard	No leakage	Test Certificate	3/2	---	---	(C.O.C)
		2. Overall leakage	MA	Visual (soap solution)	100 %	Mfr. Standard	No leakage	Test Certificate	3/2	---	---	(C.O.C)
5.3	Air lock relay	Performance Test	MA	Leakage test	100%	Mfr. Standard	No leakage	Test Certificate	3/2	---	---	(C.O.C)
5.4	Electronic position transmitter(not applicable if provided integral to smart positioner)	1. Accuracy	MA	Operation	100%	Approved data sheet /	Approved data sheet /	Test Certificate	2	1	---	(C.O.C)
5.5	Current to Pneumatic converter(not applicable for smart positioner)	1. Physical Verification Make/Model	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	---	---	(C.O.C)
		2. Degree of Protection	MA	IP/NEMA test	Each type	Relevant Standard	Relevant Standard	Test Certificate	3	---	---	(C.O.C)
		3. Linearity	CR	Measurement	100%	Approved drg. / data sheet /	Approved drg. / data sheet /	Inspection Report	2	---	---	(C.O.C)
		4. Hysterisis	CR	Measurement	100%	Approved drg. / data sheet /	Approved drg. / data sheet /	Inspection Report	2	---	---	(C.O.C)
5.6	Smart Positioner	1. Physical Verification Make/Model	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	---	---	(C.O.C)

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
	(As Applicable)	2. Degree of Protection	MA	IP/NEMA test	Each type	Relevant Standard	Relevant Standard	Test Certificate	3	---	---	(C.O.C)
		3. Linearity	CR	Measurement	100%	Approved drg. / data sheet /	Approved drg. / data sheet /	Inspection Report	2	---	---	(C.O.C)
		4. Hysterisis	CR	Measurement	100%	Approved drg. / data sheet /	Approved drg. / data sheet /	Inspection Report	2	---	---	(C.O.C)
		5. Calibration with Hand Held Communicator	MA	Measurement	Each type	Mfr. Standard	Mfr. Standard	Test Certificate	2	---	---	(C.O.C)
6.0	**PAINTING**	Soundness of Painting	MA	Visual and Measurement	100%	Mfr. Standard	Mfr. Standard	Inspection Report	2	---	---	Refer Note-2
7.0	**PACKING**	Soundness of Packing against transit damage	MA	Visual	100%	Mfr. Standard	Mfr. Standard	Inspection Report	2	---	---	Refer Note-3

NOTES:

1. In case valid CV test certificate for a similar control valve (same size, same CV, same trim characteristics) is not submitted to BHEL by the vendor, CV test shall be conducted at FCRI/Any govt. approved laboratory/ BHEL approved Laboratory.
2. In the absence of BHEL spec. for painting, vendor to obtain BHEL's approval on their painting specification / procedure.
3. Sea worthy packing shall be provided, if called for in the Data sheets.
4. The quantum of check shall be 100% for manufacturer and 10% for BHEL/BHEL nominated inspection agency.
5. IBR certificates in Form III-C shall be submitted if called for in the specification/datasheet.
6. Copies of all TC's(Test Certificates) for materials duly correlated with Heat Nos., TC's for electrical items and mechanical tests(Leak/Operation), C.O.C's(Certificates of Conformance) shall be submitted to BHEL for verification and acceptance.

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
RT- Radiographic Test; UT – Ultrasonic Test; PT – Dye penetrant Test; MT- Magnetic Test
$ P - Agency Performing the Test.; W - Agency Witnessing the Test.; V - Agency Verifying the Test.
1 - BHEL; 2 - Vendor; 3 - Sub-vendor

TYPE TEST REQUIREMENTS

CLAUSE NO.	TECHNICAL 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 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 C&I SYSTEMS' at the end of this chapter and under the item Special Requirement for Solid State Equipments/Systems. For the balance equipment instrument, type tests may be conducted as per manufactures standard or if required by relevant standard. (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	As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by the main Bidder or his authorized representative and the balance have to be approved by the Employer.
1.01.03	The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion.
1.01.04	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.
1.01.05	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.

CLAUSE NO.	TECHNICAL REQUIREMENTS
2.00.00	**SPECIAL REQUIREMENT FOR SOLID STATE EQUIPMENTS/ SYSTEMS**
2.01.00	The minimum type test reports, over and above the requirements of above clause, which are to be submitted for each of the major C&I systems 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 37.90.1/ IEEE-472. Hence, all front end cards 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 37.90.1/ IEEE-472. 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 above, suitable class of EN 61000-4-12 which is equivalent to ANSI 37.90.1/ IEEE-472 may also be adopted for SWC test. ii) Dry Heat test as per IEC-68-2-2 or equivalent. iii) Damp Heat test as per IEC-68-2-3 or equivalent. iv) Vibration test as per IEC-68-2-6 or equivalent. v) Electrostatic discharge tests as per EN 61000-4-2 or equivalent. vi) Radio frequency immunity test as per EN 61000-4-6 or equivalent. vii) Electromagnetic Field immunity as per EN 61000-4-3 or equivalent. Test listed at item no. v, vi, vii, above are applicable for electronic cards only as defined under item (i) above.

CLAUSE NO.	TECHNICAL REQUIREMENTS

3.00.00 TYPE TEST REQUIREMENT FOR 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	Elect. Metering instruments	As per standard (col 4)	IS-1248	No	Yes
2	Transducers	As per standard (col 4)	IEC-60688,IS12784	No	Yes
3	Thermocouple	Degree of protection test	IS-13947	No	No
4	RTD	As per standard (col 4)	IEC-60751	No	No
5	Electronic transmitter	As per standard (col 4)	BS-6447 / IEC-60770	No	Yes
6	E/P converter	As per standard (col 4)	Mfr. standard	No	No
7	Dust emission monitor	Degree of protection test	IS-13947	No	Yes
8	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

CLAUSE NO.	TECHNICAL REQUIREMENTS				
		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

9 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 37.90.1/ IEEE-472,EN 61000-4-12	No	Yes
Dry Heat Test	IEC-68-2-2 or equivalent	No	Yes
Damp Heat test	IEC-68-2-3 or equivalent	No	Yes
Vibration test	IEC68-2-6 or equivalent	No	Yes
Electrostatic discharge test	EN 61000-4-2 orr equivalent	No	Yes
Radio frequency immunity test	EN-61000-4-3 orr equivalent	No	Yes
Electromagnetic field immunity	EN 61000-4-3 orr equivalent	No	Yes
Degree of Protection	IS-13947 or equivalent	No	Yes

CLAUSE NO.	TECHNICAL REQUIREMENTS				
10	Battery ##	As per standard (col 4)	IS-10918 (Ni-Cd Batteries)	No	Yes
			IS-1652 (Lead Acid Plante Batteries)	No	Yes
11	NOT APPLICABLE				
12	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 37.90.1/ IEEE-472,EN 61000-4-12	No	Yes
		Dry Heat Test	IEC-68-2-2 orı equivalent	No	Yes
		Damp Heat test	IEC-68-2-3 orı equivalent	No	Yes
		Vibration test	IEC68-2-6 orı equivalent	No	Yes
		Electrostatic discharge test	EN 61000-4-2 orr equivalent	No	Yes
		Radio frequency immunity test	EN-61000-4-3 orr equivalent	No	Yes
		Electromagnetic field immunity	EN 61000-4-3 orr 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

CLAUSE NO.	TECHNICAL REQUIREMENTS				
	13	Voltage Stabilisers	Over Load Test	Approved procedure	No	Yes
			Temp rise test without redundant fans	Approved procedure	No	Yes
	14	Public Address System				
		- Amplifiers	As per standard (col 4)	IS 9302, Part-II	No	Yes
		Microphones	As per standard (col 4)	IS 9302, Part-III IS 15482:2004/ IEC 61842(2002)	No	Yes
		Loudspeaker	As per standard (col 4)	IS 9302, Part-IV	No	Yes
	15	LIE / LIR	Degree of protection test	IS-13947	No	Yes
	16	Flue gas analyzers	Degree of protection test	IS-13947	No	Yes
	17	Master Clock	Functional test	As per approved procedure	No	Yes
	18	CJC Box	Degree Of protection test	IS-13947	No	Yes
	19	Junction Box	Degree Of protection Test	IS-13947	No	Yes
	20	OPC Data Access Server, Data Exchange Server &	OPC Compliance Testing		No	Yes (Self certification is also

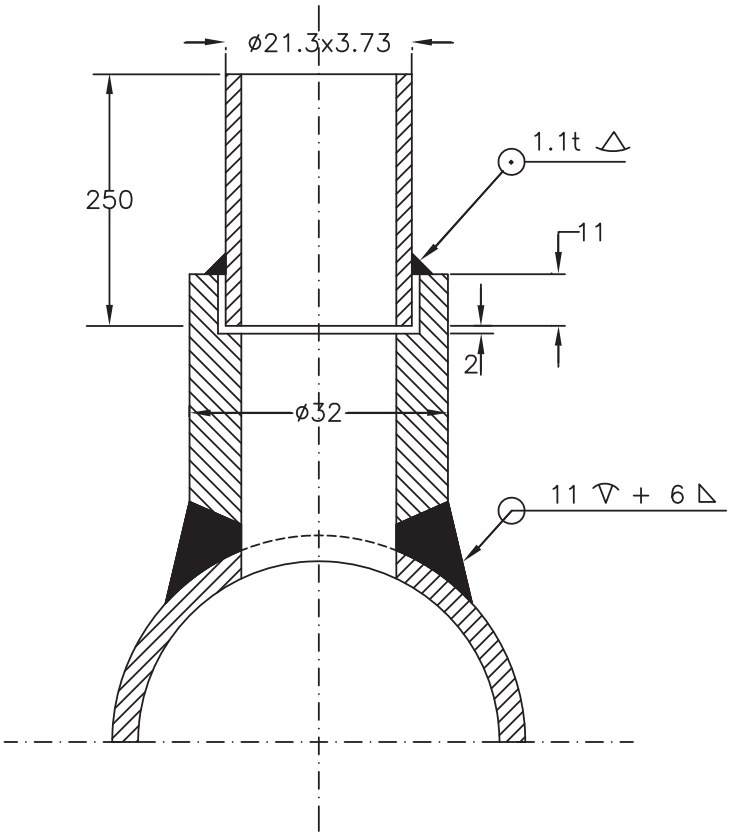
	Historical Data Access Server				acceptable)
21	Conductivity Type Level Switch	Degree of protection test	IS-2147	No	No
22	Local Gauges	Degree of protection test	IS-2147	No	No
23	Process actuated Switches	Degree of protection test	IS-2147	No	No
24	Control Valves	CV test	ISA 75.02& 75.11	No	Yes
25	PLCs	As per standard (Col 4)	IEC 1131	No	No
26	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 / owners 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.

INSTRUMENT STUB DETAILS

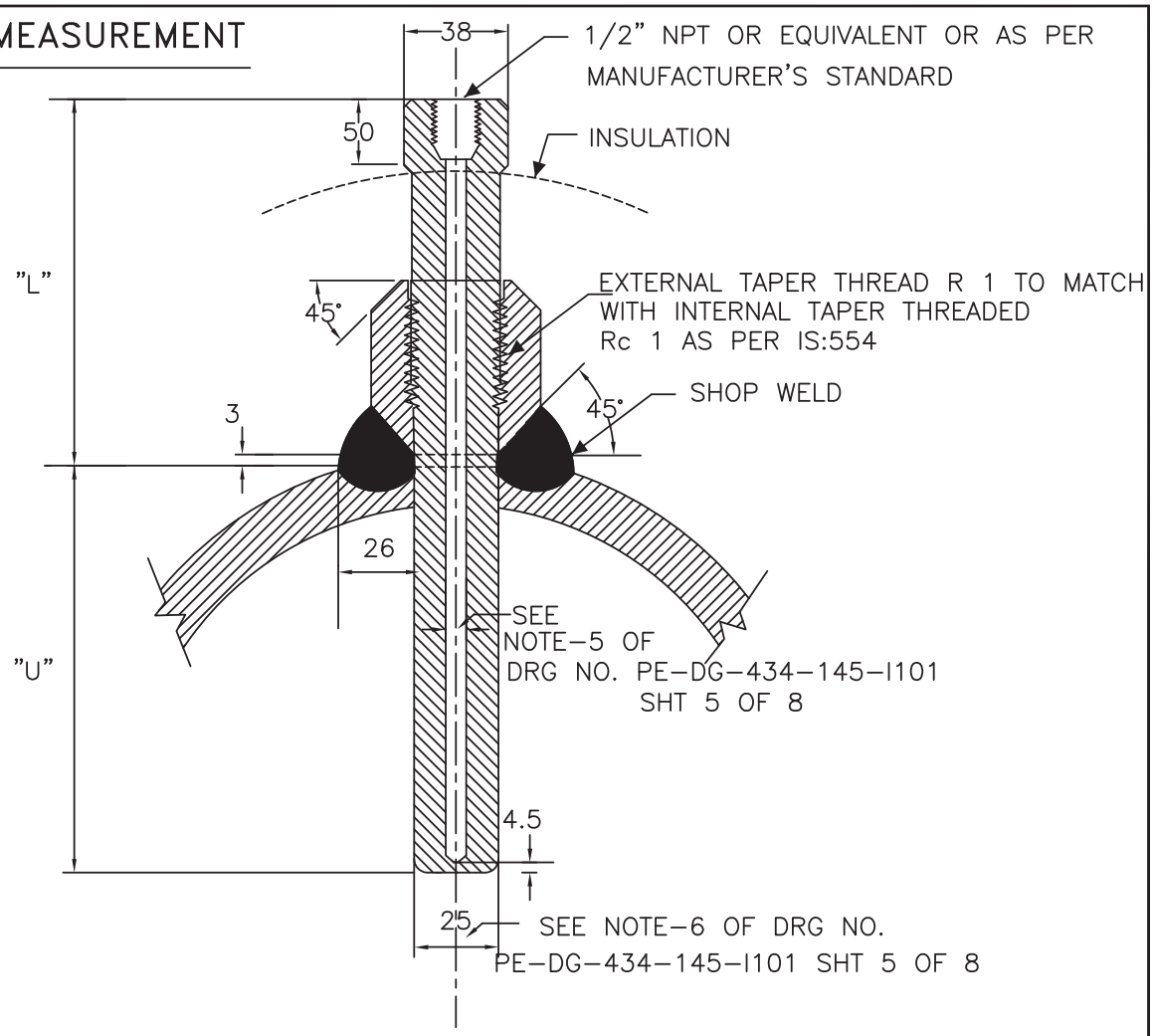


NOTE :

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
4. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES
5. STUB LENGTH SHALL BE 64mm UPTO 250Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.

भेल BHEL	TITLE : INSTRUMENT STUB DETAILS FOR PRESSURE MEASUREMENT (SYSTEM PRESS UPTO 40Kg/Cm2, TEMP< 400 Deg C)	DRG. NO. PE-DG-434-145-I101 REV. 00 SH. 04 OF 08 SHS.

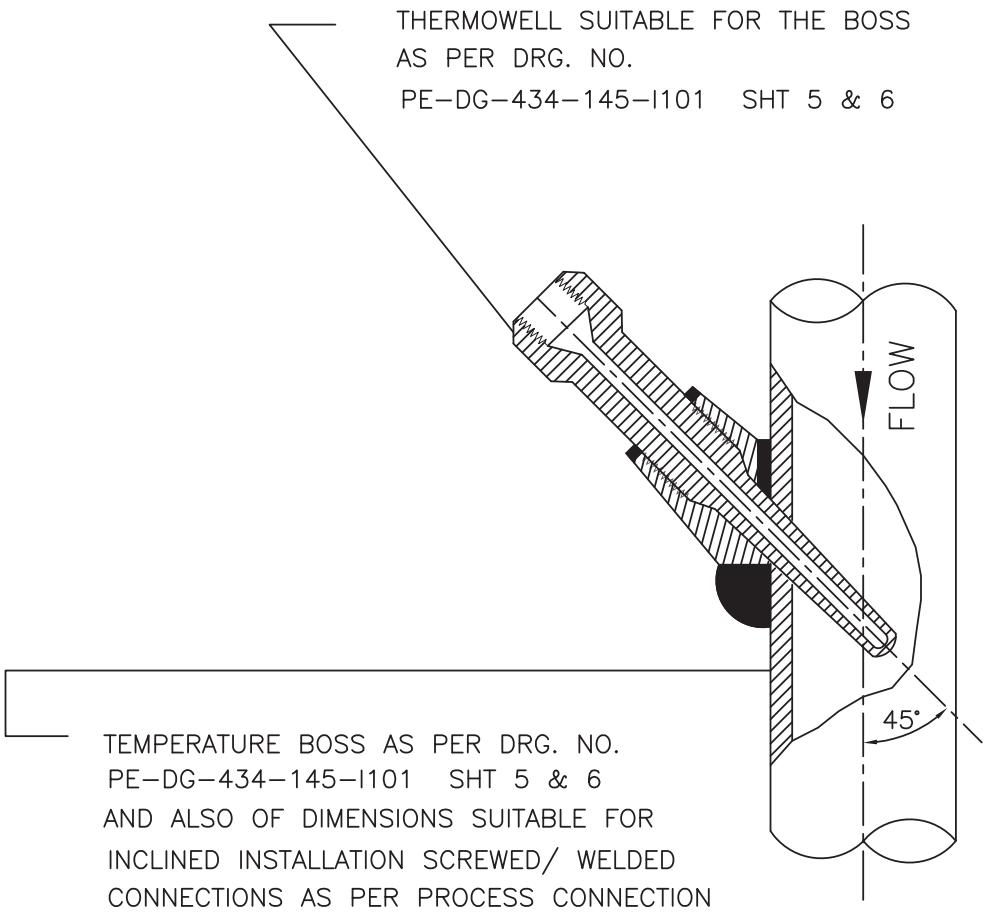
TEMP. MEASUREMENT



NOTES :–

1. THIS TYPE OF TEMPERATURE BOSS IS APPLICABLE FOR THE PROCESS PRESS/ TEMP. BELOW 40 KG/CM2(g)/400°C.
2. SEE NOTES–2 TO 9 IN SHT. 5 OF 8 OF THIS DRG.
3. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED.

भेल BHEL	TITLE : INST. STUB DETAILS (TEMP) (APPLICABLE FOR PIPE SIZE ABOVE 4") [PROCESS PRESS < 40 Kg/Cm2 (g),TEMP < 400 ℃]	DRG. NO. PE–DG–434–145–I101 REV. 00 SH. 06 OF 08 SHS.



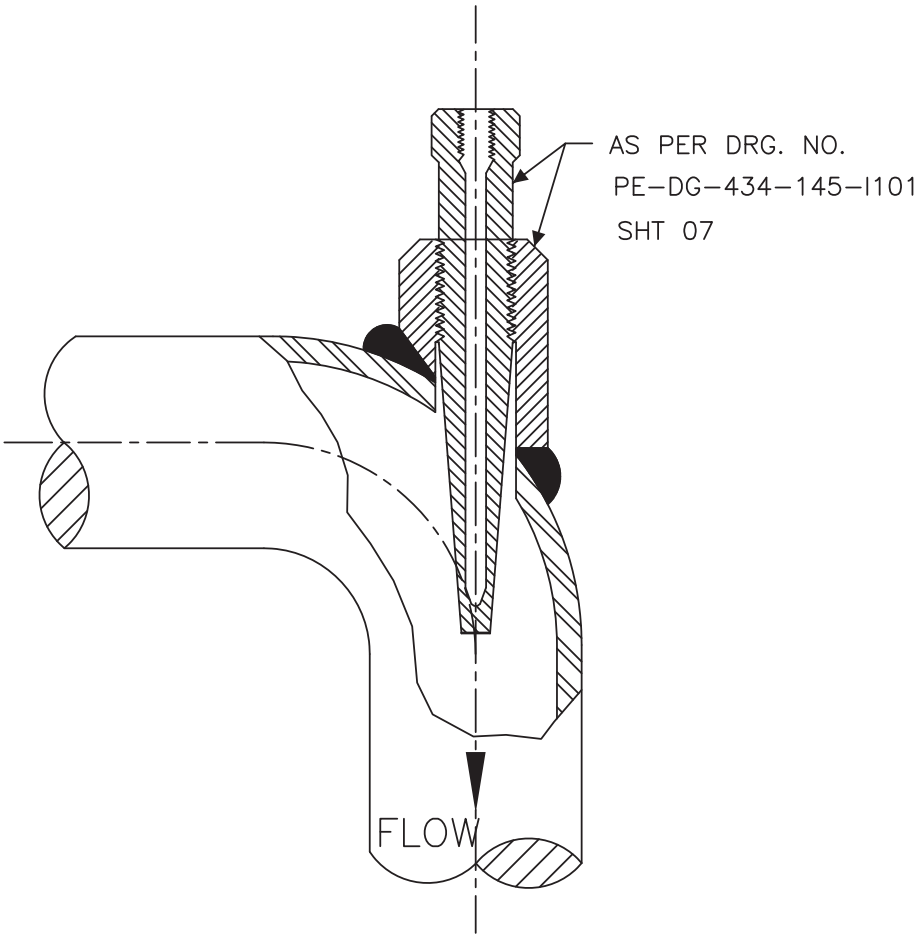
NOTES :–

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 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 INSTALLED THERMOWELL).

TITLE :

THERMOWELL INSTALLATION

DRG. NO.
PE–DG–434–145–I101
REV. 00
SH. 07 OF 08 SHS.

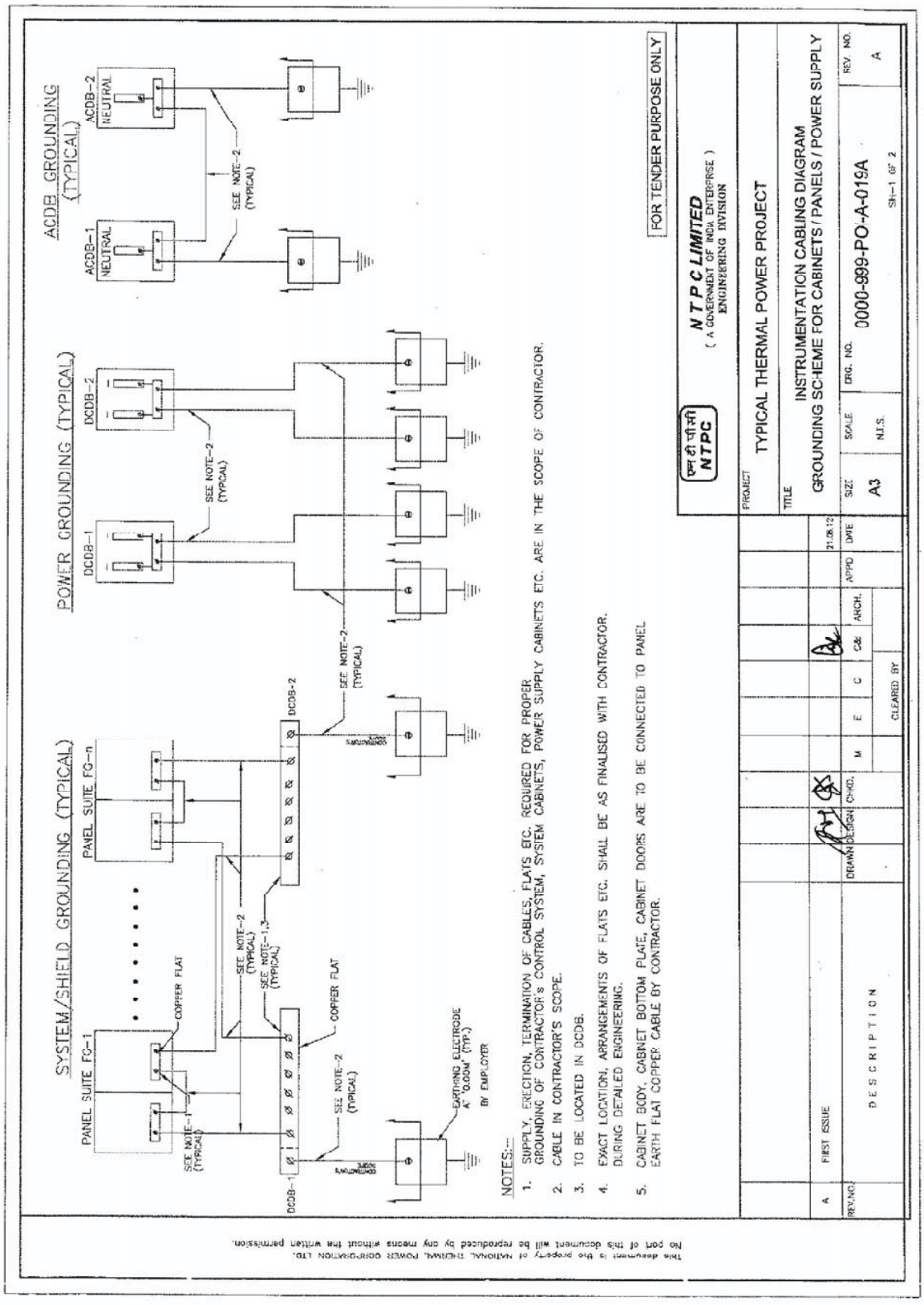


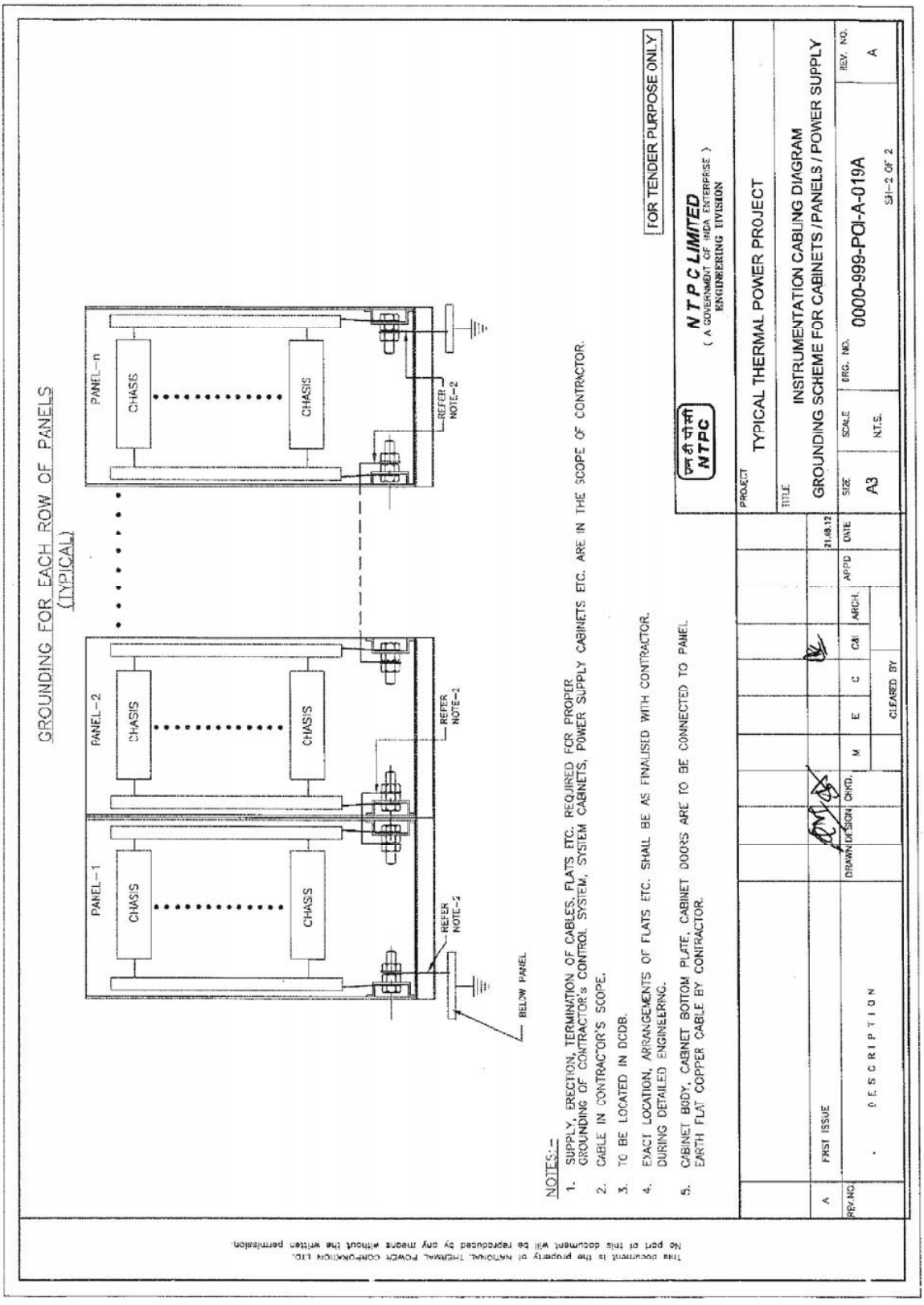
NOTES :-

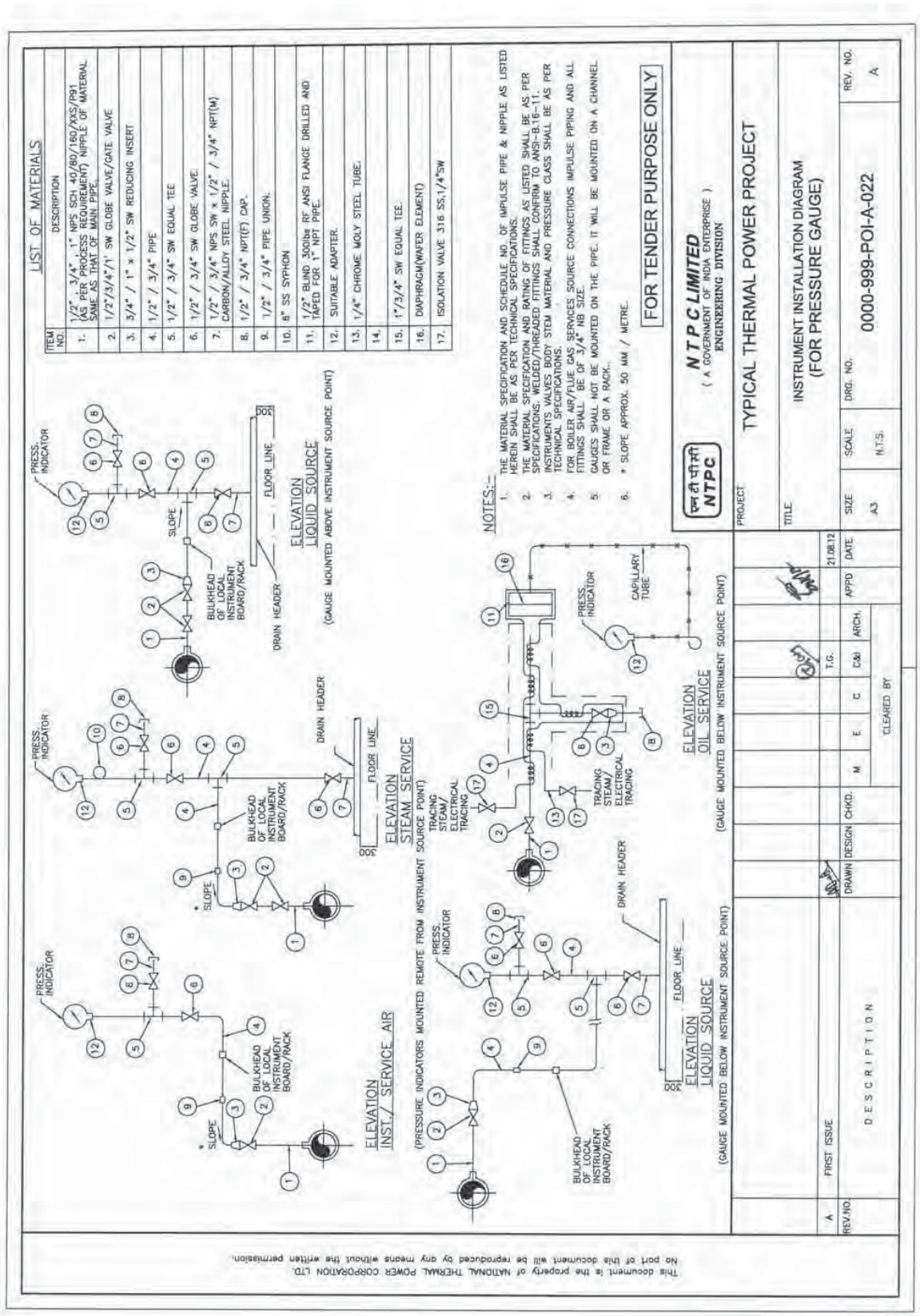
1. FLOW INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MINIMUM 3" LINE SIZE. THIS DETAIL IS APPLICABLE FOR THERMOWELL INSTALLATION IN BEND PIPES.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF ELBOW FORM (AS SHOWN) OF 3" SIZE SHALL BE USED.
3. ELBOW EXPANDER SECTION IN HORIZONTAL PLANE TO BE USED FOR LIQUID SERVICE. FOR STEAM SERVICES EXPANDER SECTION TO BE USED IN VERTICAL PLANE.

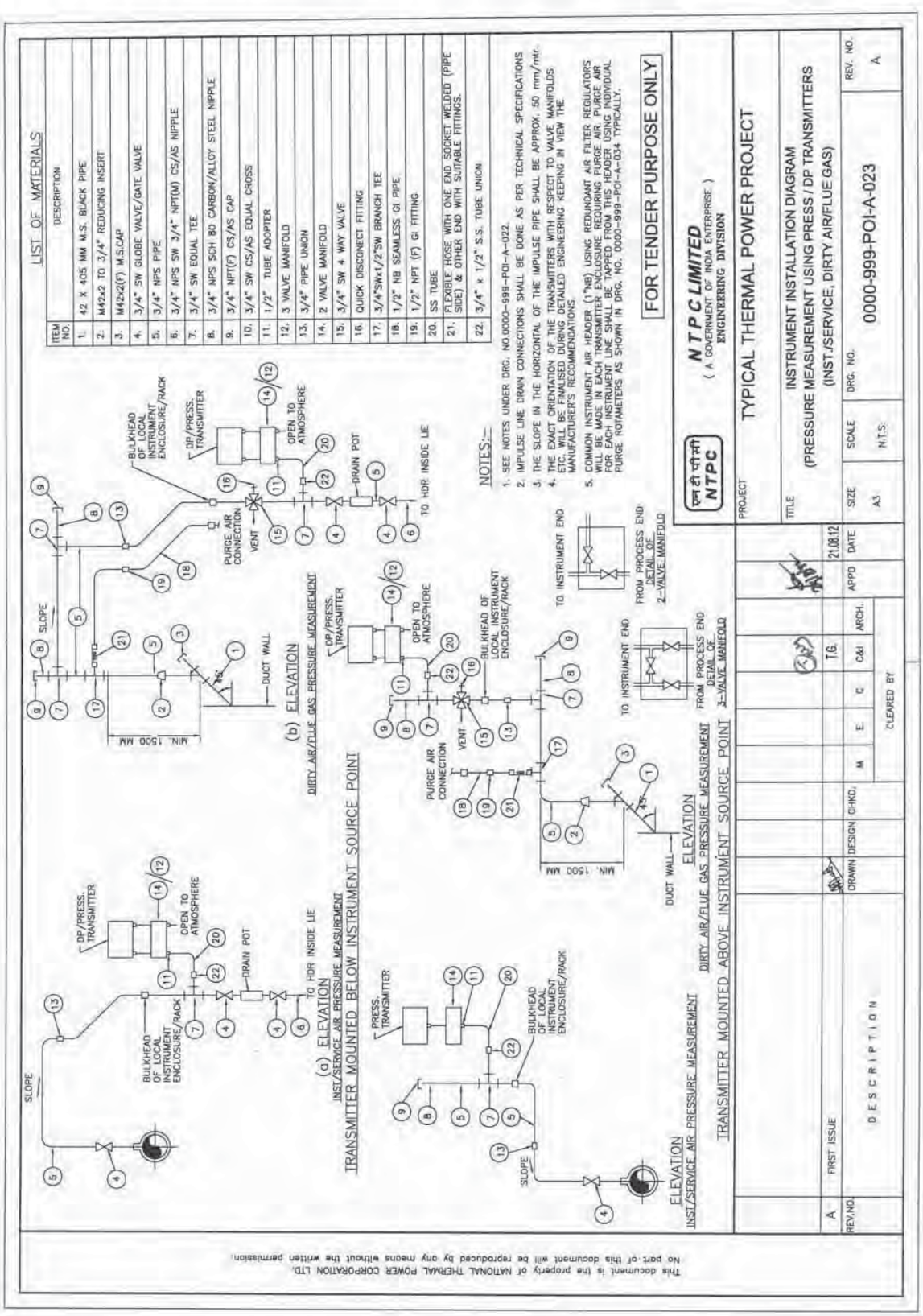
BHEL	TITLE : THERMOWELL INSTALLATION (IN BEND PIPES)	DRG. NO. PE-DG-434-145-I101 REV. 00 SH. 08 OF 08 SHS.

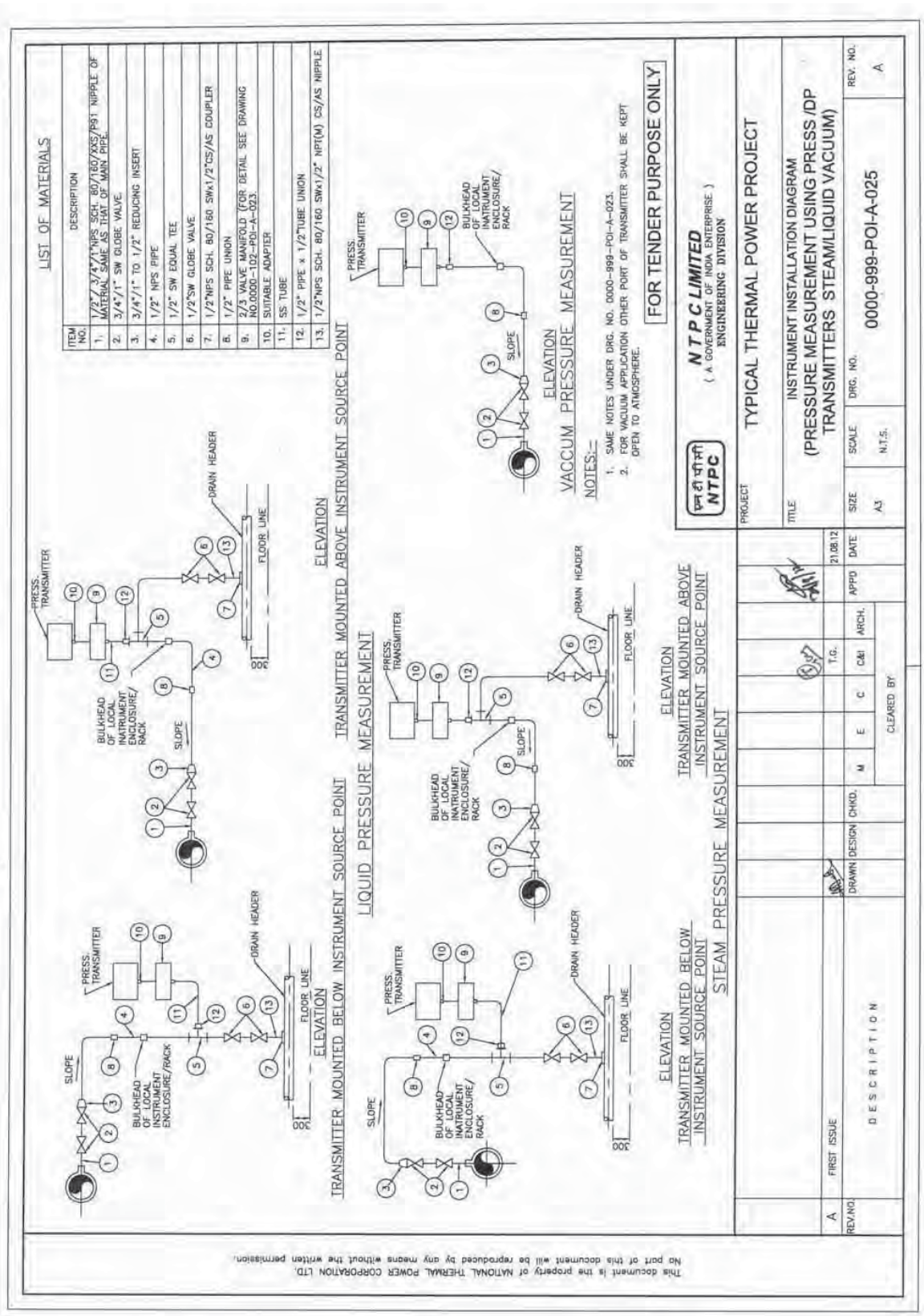
INSTRUMENT INSTALLATION DRAWING

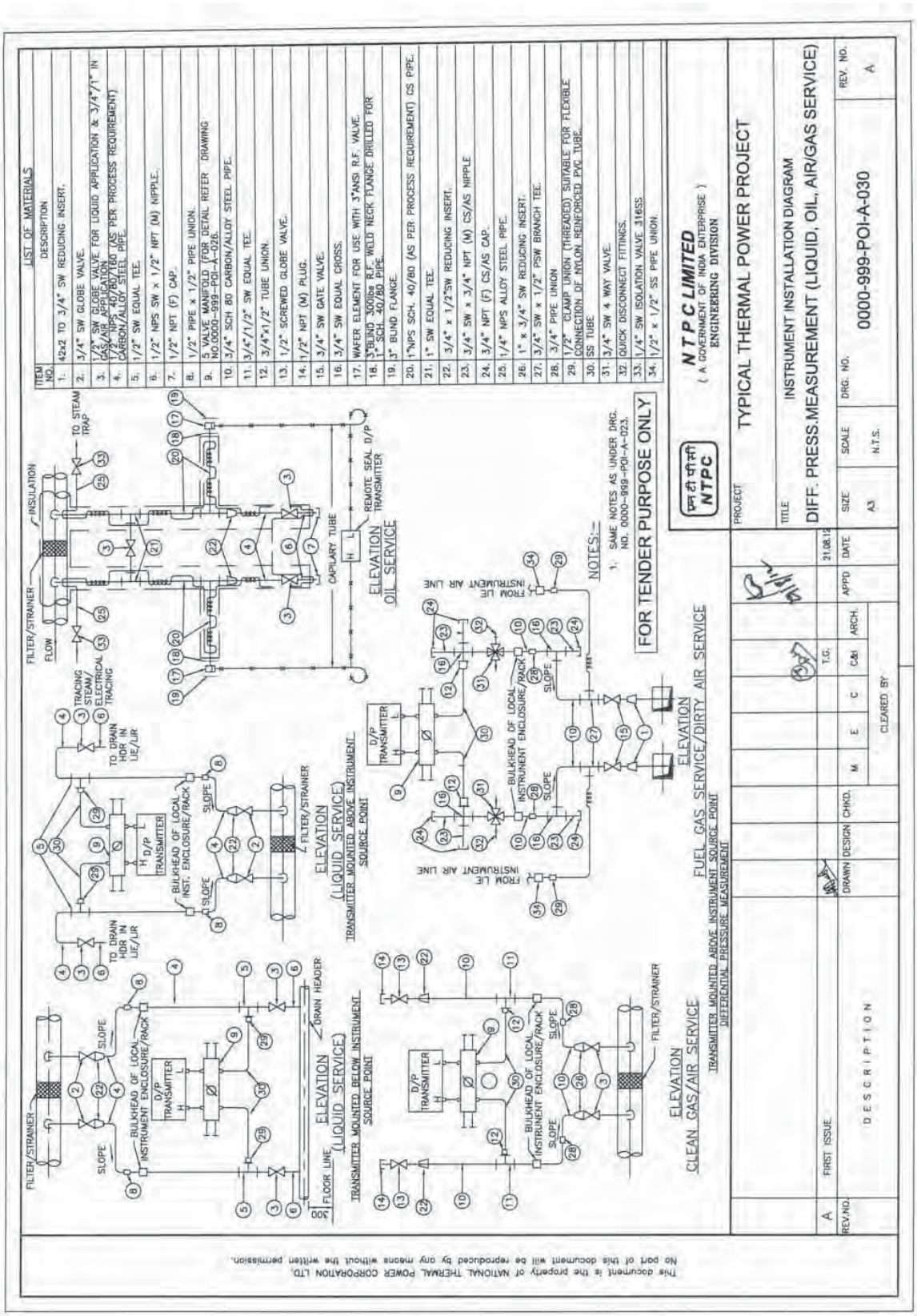

SYSTEM/SHIELD GROUNDING (TYPICAL)
PANEL SUITE FG-1
PANEL SUITE FG-n
COPPER FLAT
SEE NOTE-1 (TYPICAL)
SEE NOTE-2 (TYPICAL)
SEE NOTE-1,3 (TYPICAL)
DCDB-1
DCDB-2
EARTHING ELECTRODE AT 'GODW' (TYP.) BY EMPLOYER
POWER GROUNDING (TYPICAL)
SEE NOTE-2 (TYPICAL)
ACDB GROUNDING (TYPICAL)
ACDB-1 NEUTRAL
ACDB-2 NEUTRAL
NOTES:-
1. SUPPLY, ERECTION, TERMINATION OF CABLES, FLATS ETC. REQUIRED FOR PROPER GROUNDING OF CONTRACTOR's CONTROL SYSTEM, SYSTEM CABINETS, POWER SUPPLY CABINETS ETC. ARE IN THE SCOPE OF CONTRACTOR.
2. CABLE IN CONTRACTOR'S SCOPE.
3. TO BE LOCATED IN DCDB.
4. EXACT LOCATION, ARRANGEMENTS OF FLATS ETC. SHALL BE AS FINALISED WITH CONTRACTOR. DURING DETAILED ENGINEERING.
5. CABINET BODY, CABINET BOTTOM PLATE, CABINET DOORS ARE TO BE CONNECTED TO PANEL EARTH FLAT COPPER CABLE BY CONTRACTOR.
FOR TENDER PURPOSE ONLY
NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION
PROJECT
TYPICAL THERMAL POWER PROJECT
TITLE
INSTRUMENTATION CABLING DIAGRAM
GROUNDING SCHEME FOR CABINETS / PANELS / POWER SUPPLY
SIZE A3
SCALE N.T.S.
DRG. NO. 0000-999-PO-A-019A
SH-1 OF 2
REV. NO. A
REV.NO. A
DESCRIPTION FIRST ISSUE
DRAWN DESIGN CHKD. CLEARED BY
APPD DATE 21.06.12
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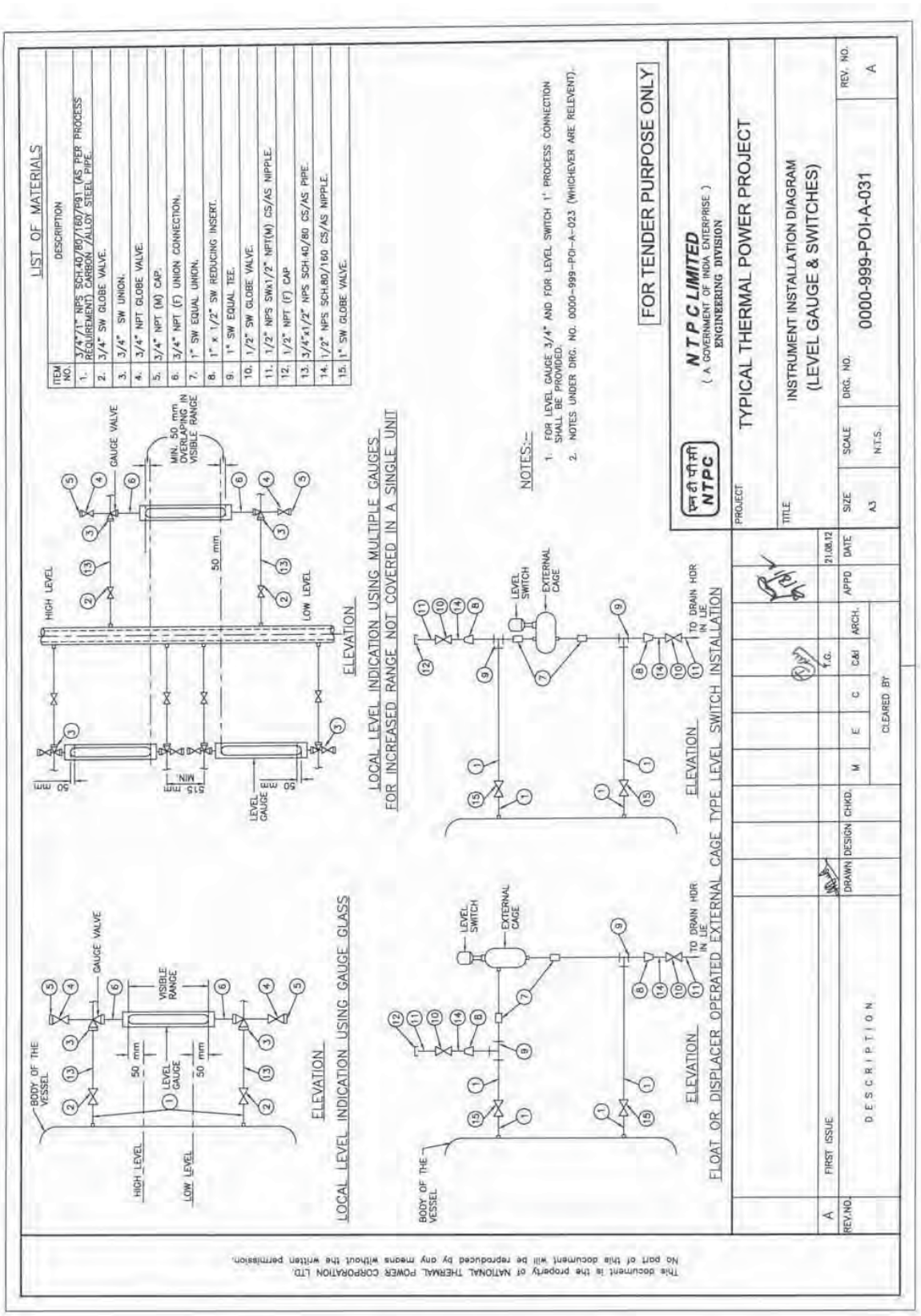

GROUNDING FOR EACH ROW OF PANELS
(TYPICAL)
PANEL-1
PANEL-2
PANEL-n
CHASIS
REFER NOTE-2
BELOW PANEL
NOTES:-
1. SUPPLY, ERECTION, TERMINATION OF CABLES, FLATS ETC. REQUIRED FOR PROPER GROUNDING OF CONTRACTOR's CONTROL SYSTEM, SYSTEM CABINETS, POWER SUPPLY CABINETS ETC. ARE IN THE SCOPE OF CONTRACTOR.
2. CABLE IN CONTRACTOR'S SCOPE.
3. TO BE LOCATED IN DCDB.
4. EXACT LOCATION, ARRANGEMENTS OF FLATS ETC. SHALL BE AS FINALISED WITH CONTRACTOR. DURING DETAILED ENGINEERING.
5. CABINET BODY, CABINET BOTTOM PLATE, CABINET DOORS ARE TO BE CONNECTED TO PANEL EARTH FLAT COPPER CABLE BY CONTRACTOR.
FOR TENDER PURPOSE ONLY
NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION
PROJECT
TYPICAL THERMAL POWER PROJECT
TITLE
INSTRUMENTATION CABLING DIAGRAM
GROUNDING SCHEME FOR CABINETS / PANELS / POWER SUPPLY
SIZE A3
SCALE N.T.S.
DRG. NO. 0000-999-POI-A-019A
SH-2 OF 2
REV. NO. A
REV.NO. DESCRIPTION DRAWN DESIGN CHKD. M E C CM ARCH. APPD DATE
A FIRST ISSUE 21.08.12
CLEARED BY
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LIST OF MATERIALS
ITEM NO. DESCRIPTION
1. 1/2" 3/4" 1" NPS SCH 40/80/160/XXS/291 (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.
ELEVATION INST./ SERVICE AIR
(PRESSURE INDICATORS MOUNTED REMOTE FROM INSTRUMENT SOURCE POINT)
(GAUGE MOUNTED BELOW INSTRUMENT SOURCE POINT)
ELEVATION STEAM SERVICE
TRACING STEAM/ ELECTRICAL TRACING
ELEVATION LIQUID SOURCE
(GAUGE MOUNTED BELOW INSTRUMENT SOURCE POINT)
ELEVATION LIQUID SOURCE
(GAUGE MOUNTED ABOVE INSTRUMENT SOURCE POINT)
ELEVATION OIL SERVICE
(GAUGE MOUNTED BELOW INSTRUMENT SOURCE POINT)
PRESS. INDICATOR
BULKHEAD OF LOCAL INSTRUMENT BOARD/RACK
DRAIN HEADER
FLOOR LINE
SLOPE
CAPILLARY TUBE
TRACING STEAM/ ELECTRICAL TRACING
FOR TENDER PURPOSE ONLY
NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION
PROJECT: TYPICAL THERMAL POWER PROJECT
TITLE: INSTRUMENT INSTALLATION DIAGRAM (FOR PRESSURE GAUGE)
SIZE: A3
SCALE: N.T.S.
DRG. NO. 0000-999-POI-A-022
REV. NO. A
REV.NO. DESCRIPTION DRAWN DESIGN CHKD. M E C C&I ARCH. APPD DATE
A FIRST ISSUE T.G. 21.08.12
CLEARED BY
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LIST OF MATERIALS
ITEM NO. | DESCRIPTION
1. 42 X 405 MM M.S. BLACK PIPE
2. M42x2 TO 3/4" REDUCING INSERT
3. M42x2(F) M.S.CAP
4. 3/4" SW GLOBE VALVE/GATE VALVE
5. 3/4" NPS PIPE
6. 3/4" NPS SW 3/4" NPT(M) CS/AS NIPPLE
7. 3/4" SW EQUAL TEE
8. 3/4" NPS SCH 80 CARBON/ALLOY STEEL NIPPLE
9. 3/4" NPT(F) CS/AS CAP
10. 3/4" SW CS/AS EQUAL CROSS
11. 1/2" TUBE ADOPTER
12. 3 VALVE MANIFOLD
13. 3/4" PIPE UNION
14. 2 VALVE MANIFOLD
15. 3/4" SW 4 WAY VALVE
16. QUICK DISCONECT FITTING
17. 3/4"SWx1/2"SW BRANCH TEE
18. 1/2" NB SEAMLESS GI PIPE
19. 1/2" NPT (F) GI FITTING
20. SS TUBE
21. FLEXIBLE HOSE WITH ONE END SOCKET WELDED (PIPE SIDE) & OTHER END WITH SUITABLE FITTINGS.
22. 3/4" x 1/2" S.S. TUBE UNION
NOTES:-
1. SEE NOTES UNDER DRG. NO.0000-999-POI-A-022.
2. IMPULSE LINE DRAIN CONNECTIONS SHALL BE DONE AS PER TECHNICAL SPECIFICATIONS
3. THE SLOPE IN THE HORIZONTAL OF THE IMPULSE PIPE SHALL BE APPROX. 50 mm/mtr.
4. THE EXACT ORIENTATION OF THE TRANSMITTERS WITH RESPECT TO VALVE MANIFOLDS ETC. WILL BE FINALISED DURING DETAILED ENGINEERING KEEPING IN VIEW THE MANUFACTURER'S RECOMMENDATIONS.
5. COMMON INSTRUMENT AIR HEADER (1"NB) USING REDUNDANT AIR FILTER REGULATORS WILL BE MADE IN EACH TRANSMITTER ENCLOSURE REQUIRING PURGE AIR. PURGE AIR FOR EACH INSTRUMENT LINE SHALL BE TAPPED FROM THIS HEADER USING INDIVIDUAL PURGE ROTAMETERS AS SHOWN IN DRG. NO. 0000-999-POI-A-034 TYPICALLY.
FOR TENDER PURPOSE ONLY
NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION
PROJECT
TYPICAL THERMAL POWER PROJECT
TITLE
INSTRUMENT INSTALLATION DIAGRAM
(PRESSURE MEASUREMENT USING PRESS / DP TRANSMITTERS
(INST./SERVICE, DIRTY AIR/FLUE GAS)
SIZE A3
SCALE N.T.S.
DRG. NO. 0000-999-POI-A-023
REV. NO. A
REV.NO. A
DESCRIPTION FIRST ISSUE
DRAWN DESIGN CHKD. M E C C&I ARCH.
APPD
DATE 21.08.12
CLEARED BY
(a) ELEVATION
INST/SERVICE AIR PRESSURE MEASUREMENT
TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT
(b) ELEVATION
DIRTY AIR/FLUE GAS PRESSURE MEASUREMENT
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT
ELEVATION
INST/SERVICE AIR PRESSURE MEASUREMENT
ELEVATION
DIRTY AIR/FLUE GAS PRESSURE MEASUREMENT
SLOPE
BULKHEAD OF LOCAL INSTRUMENT ENCLOSURE/RACK
DP/PRESS. TRANSMITTER
PRESS. TRANSMITTER
OPEN TO ATMOSPHERE
DRAIN POT
TO HDR INSIDE LIE
DUCT WALL
MIN. 1500 MM
PURGE AIR CONNECTION
VENT
TO INSTRUMENT END
FROM PROCESS END
DETAIL OF 2-VALVE MANIFOLD
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LIST OF MATERIALS
ITEM NO. | DESCRIPTION
1. 1/2"/ 3/4"/1"NPS SCH. 80/160/XXS/P91 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
PRESS. TRANSMITTER
BULKHEAD OF LOCAL INATRUMENT ENCLOSURE/ RACK
SLOPE
DRAIN HEADER
FLOOR LINE
ELEVATION
TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT
LIQUID PRESSURE MEASUREMENT
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT
VACUUM PRESSURE MEASUREMENT
STEAM 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.
FOR TENDER PURPOSE ONLY
NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION
PROJECT: TYPICAL THERMAL POWER PROJECT
TITLE: INSTRUMENT INSTALLATION DIAGRAM (PRESSURE MEASUREMENT USING PRESS /DP TRANSMITTERS STEAM/LIQUID VACUUM)
SIZE: A3
SCALE: N.T.S.
DRG. NO.: 0000-999-POI-A-025
REV. NO.: A
REV.NO. | DESCRIPTION | DRAWN | DESIGN | CHKD. | M | E | C | C&I | ARCH. | APPD | DATE
A | FIRST ISSUE | T.G. | 21.08.12
CLEARED BY
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LIST OF MATERIALS
ITEM NO. DESCRIPTION
1. 42x2 TO 3/4" SW REDUCING INSERT.
2. 3/4" SW GLOBE VALVE.
3. 1/2" SW GLOBE VALVE FOR LIQUID APPLICATION & 3/4"/1" IN GAS/AIR APPLICATION.
4. 1/2" NPS 40/80/160 (AS PER PROCESS REQUIREMENT) CARBON/ALLOY STEEL PIPE.
5. 1/2" SW EQUAL TEE.
6. 1/2" NPS SW x 1/2" NPT (M) NIPPLE.
7. 1/2" NPT (F) CAP.
8. 1/2" PIPE x 1/2" PIPE UNION.
9. 5 VALVE MANIFOLD (FOR DETAIL REFER DRAWING NO.0000-999-POI-A-026.
10. 3/4" SCH 80 CARBON/ALLOY STEEL PIPE.
11. 3/4"x1/2" SW EQUAL TEE.
12. 3/4"x1/2" TUBE UNION.
13. 1/2" SCREWED GLOBE VALVE.
14. 1/2" NPT (M) PLUG.
15. 3/4" SW GATE VALVE.
16. 3/4" SW EQUAL CROSS.
17. WAFER ELEMENT FOR USE WITH 3"ANSI R.F. VALVE.
18. 3"BLIND 300lbs R.F. WELD NECK FLANGE DRILLED FOR 1" SCH. 40/80 PIPE.
19. 3" BLIND FLANGE.
20. 1"NPS SCH. 40/80 (AS PER PROCESS REQUIREMENT) CS PIPE.
21. 1" SW EQUAL TEE.
22. 3/4" x 1/2"SW REDUCING INSERT.
23. 3/4" SW x 3/4" NPT (M) CS/AS NIPPLE
24. 3/4" NPT (F) CS/AS CAP.
25. 1/4" NPS ALLOY STEEL PIPE.
26. 1" x 3/4" SW REDUCING INSERT.
27. 3/4" SW x 1/2" PSW BRANCH TEE.
28. 3/4" PIPE UNION
29. 1/2" CLAMP UNION (THREADED) SUITABLE FOR FLEXIBLE CONNECTION OF NYLON REINFORCED PVC TUBE.
30. SS TUBE
31. 3/4" SW 4 WAY VALVE.
32. QUICK DISCONNECT FITTINGS.
33. 1/4" SW ISOLATION VALVE 316SS.
34. 1/2" x 1/2" SS PIPE UNION.
NOTES:-
1. SAME NOTES AS UNDER DRG. NO. 0000-999-POI-A-023.
FOR TENDER PURPOSE ONLY
NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION
PROJECT TYPICAL THERMAL POWER PROJECT
TITLE INSTRUMENT INSTALLATION DIAGRAM
DIFF. PRESS.MEASUREMENT (LIQUID, OIL, AIR/GAS SERVICE)
SIZE A3
SCALE N.T.S.
DRG. NO. 0000-999-POI-A-030
REV. NO. A
DATE 21.06.12
APPD
ARCH.
C&I
E
M
T.G.
CLEARED BY
DRAWN DESIGN CHKD.
REV.NO. DESCRIPTION
A FIRST ISSUE
FILTER/STRAINER
INSULATION
FLOW
TO STEAM TRAP
TRACING STEAM/ ELECTRICAL TRACING
TO DRAIN HDR IN I/E/UR
BULKHEAD OF LOCAL INSTRUMENT ENCLOSURE/RACK
D/P TRANSMITTER
SLOPE
ELEVATION (LIQUID SERVICE)
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT
CAPILLARY TUBE
REMOTE SEAL D/P TRANSMITTER
ELEVATION OIL SERVICE
FROM I/E INSTRUMENT AIR LINE
ELEVATION FUEL GAS SERVICE/DIRTY AIR SERVICE
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT
DIFFERENTIAL PRESSURE MEASUREMENT
DRAIN HEADER
FLOOR LINE
ELEVATION (LIQUID SERVICE)
TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT
ELEVATION CLEAN GAS/AIR SERVICE
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT
DIFFERENTIAL PRESSURE MEASUREMENT
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LIST OF MATERIALS
ITEM NO.
DESCRIPTION
1. 3/4"/1" NPS SCH.40/80/160/FP31 /AS PER PROCESS REQUIREMENT) CARBON /ALLOY STEEL PIPE.
2. 3/4" SW GLOBE VALVE.
3. 3/4" SW UNION.
4. 3/4" NPT GLOBE VALVE.
5. 3/4" NPT (M) CAP.
6. 3/4" NPT (F) UNION CONNECTION.
7. 1" SW EQUAL UNION.
8. 1" x 1/2" SW REDUCING INSERT.
9. 1" SW EQUAL TEE.
10. 1/2" SW GLOBE VALVE.
11. 1/2" NPS SWx1/2" NPT(M) CS/AS NIPPLE.
12. 1/2" NPT (F) CAP
13. 3/4"x1/2" NPS SCH.40/80 CS/AS PIPE.
14. 1/2" NPS SCH.80/160 CS/AS NIPPLE.
15. 1" SW GLOBE VALVE.
NOTES:-
1. FOR LEVEL GAUGE 3/4" AND FOR LEVEL SWITCH 1" PROCESS CONNECTION SHALL BE PROVIDED.
2. NOTES UNDER DRG. NO. 0000-999-POI-A-023 (WHICHEVER ARE RELEVENT).
BODY OF THE VESSEL
GAUGE VALVE
VISIBLE RANGE
LEVEL GAUGE
HIGH LEVEL
LOW LEVEL
50 mm
ELEVATION
LOCAL LEVEL INDICATION USING GAUGE GLASS
MIN. 50 mm OVERLAPING IN VISIBLE RANGE
MIN. 515 mm
LEVEL GAUGE
ELEVATION
LOCAL LEVEL INDICATION USING MULTIPLE GAUGES FOR INCREASED RANGE NOT COVERED IN A SINGLE UNIT
LEVEL SWITCH
EXTERNAL CAGE
TO DRAIN HDR IN LIE
ELEVATION
FLOAT OR DISPLACER OPERATED EXTERNAL CAGE TYPE LEVEL SWITCH INSTALLATION
FOR TENDER PURPOSE ONLY
NTPC
N T P C LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION
PROJECT
TYPICAL THERMAL POWER PROJECT
TITLE
INSTRUMENT INSTALLATION DIAGRAM
(LEVEL GAUGE & SWITCHES)
SIZE
A3
SCALE
N.T.S.
DRG. NO.
0000-999-POI-A-031
REV. NO.
A
REV.NO.
DESCRIPTION
DRAWN
DESIGN
CHKD.
M
E
C
C&I
ARCH.
APPD
DATE
21.08.12
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CLAUSE NO.	TECHNICAL REQUIREMENTS

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. in Boiler Turbine Generator measurements (except for all fuel oil applications) shall be suitably grouped together and mounted inside (i) local instruments enclosures in case of open areas of the plant like boiler area, etc. and (ii) In local instrument racks in case of covered areas like Turbine/Generator area. 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.

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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 instrument racks shall be free standing type constructed of suitable 3 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 in Boiler Turbine Generator measurements shall be suitably grouped together and mounted inside (i) Enclosures in case of open areas of the plant like boiler area, etc. and (ii) Racks in case of covered areas like Turbine/Generator area. 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.

SUB VENDOR LIST

NTPC	PROJECT : Patratu STPS Phase-I (3 X800MW)	LIST OF ITEMS REQUIRING QP	
	PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR : BHEL Ltd	VENDOR AS APPROVED BY	DATE : 26.04.2017
	CONTRACT NO : CS-9585-001-2		

No.	Major Equipment	QP Inspection Category	QP No. 9585-001-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Sub QR	Remark
		*				KOSO	Japan / Nasik	DR				requirements.
		*				Nakikata	Japan	DR				
		*				Parcol Spa	USA	DR				
		*				Yamatake	Japan	DR				
		*				BOPP & ROUTHER	Germany	DR				
		*				KSB MIL	Alwaye	DR				
20	Control valve for feedwater flow Control	II				CCI	USA/Austria /Korea	A				
		II				Dressor Masoneilan	France	A				
		II				HORA	Germany	A				
		II				EMERSON (Fisher)	USA/France /Japan	A				
		II				Sempell	Germany	A				
		II				KOSO	Japan	A				
		*				LESLIE	USA	DR				M/s BHEL will forward only three proposals after details review of NTPC Technical specification requirements.
		I				CCI	Srictly	A				
		*				Parcol Spa	USA	DR				
		*				WEIR VALVES and Controls	UK	DR				
		*				KOSO	Nasik	DR				
		*				KSB MIL	Alwaye	DR				
		I				Emerson Process Management	Chennai	A				
		*				BOMAFA Special valve solutions Pvt. Ltd.	Ahmedabad	DR				
		*				Suzhou delan enfery science and tehnology co. Ltd.	China	DR				
21	Control Valve (other than Sr. No. - 17 to 20)	II				CCI	USA/Switzerland/Korea	A				
		II				Tyco Sampell	Germany	A				
		II				EMERSON (Fisher)	USA/France/Japan / Chennai	A				
		II				Dressor Masoneilan	France	A				
		II				KOSO	Japan	A				
		II				HORA	Germany	A				
		II				CCI	Srictly	A				
		II				Spx Copes Vulcan	USA	A				
		II				Dressor	Coimbatore	A				
		II				IL	Palakkad	A				
		II				KSB MIL	Alwaye	A				
		II				KOSO	Palakkad	A				
		II				EMERSON	Chennai	A				
		II				Flow Serve	Bangalore	A				
		II				Copes Vulcan	UK	A				
		II				Leslie	USA	A				
		II				Parcol Spa	Italy	A				
		II				KOSO	Nasik	A				

4 of 26

Bharat Heavy Electricals Limited PS-MKTG Delhi

C.E. Deptt.

This page is the part of Tech. Spec. No. PE-TS-434-571-A002

NTPC	PROJECT : Patratu STPS Phase-I [3 X800MW]	LIST OF ITEMS REQUIRING QP	
	PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR :BHEL Ltd	VENDOR AS APPROVED BY	DATE : 26.04.2017
	CONTRACT NO : CS-9585-001-2		

No.	Major Equipment	QP Inspection Category	QP No. 9585-001-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Sub QR	Remark
		II				Forbes Arca	Pune	A				Approvd up to 4" and 300 Class. "DR" for Higher rating and Size.
		*				Daume Regelarmaturen GmbH	Germany	DR				M/s BHEL will forward only three proposals after details review of NTPC Technical specification requirements.
		*				Metso Singapore PTE ltd.	South Korea	DR				
		*				Severn Glocon	Chennai	DR				
		*				Spx Corporation	USA	DR				
		*				Ringo Valvulas SL	Spain	DR				
		*				Valvitalia SPA	Italy	DR				
		*				R K Controls	Thane	DR				
		*				Circor (Leslie)	Coimbatore	DR				
		*				Spx Flow Technologies	USA	DR				
		*				Circor (Leslie)	Coimbatore	DR				
		*				Schenjang valve co. ltd.	China	DR				
		*				Spx Flow Technologies	Ahamadabad	DR				
		*				WEIR Valves and Controls	UK	DR				
		*				WALDEMAR PRUSS ARMATURENFABRIK GMBH	Germany	DR				
		*				BOMAFA Special valve solutions Pvt. Ltd.	Ahmedabad	DR				
		*				Suzhou delan entery science and tehnology co. Ltd.	China	DR				
22	Temperature Transmitter	III				EMERSON	U.S.A/Pawana / Singapore	A			Sub QR	
	(Single and Dual Input)	III				Yokogawa	Japan	A				Final testing at M/S YIL,Bangalore is also acceptable
		III				Moore	USA	A				
		III				M System	JAPAN	A				
		III				ABB	GERMANY/ Bangalore	A				
		III				ENDRESS & HOUSER	Aurangabad	A				
		*				Khrone		DR				M/s BHEL will forward only two proposals after details review of NTPC Technical specification requirements.
		*				Tokyo Keiso	Japan	DR				
		*				Honeywell	Pune	DR				
		*				INOR	Sweden	DR				
		*				P & F	Bangalore	DR				
		*				Siemens		DR				
		*				Yamatake	JAPAN	DR				
		*				Yamari	JAPAN	DR				
		*				Foxboro		DR				
23	Conduits/Pipe(GI)					Refer Electrical List						
24	Electronic transmitters (pressure, DP,Flow)	III				EMERSON (Rosemount)	USA/ Pawana	A			Sub QR	
		III				FUJI ELECTRIC	France	A				
		III				YOKOGAWA	JAPAN	A				Testing and Calibration at M/s YIL, Bangalore is also acceptable.

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This page is the part of Tech. Spec. No. PE-TS-434-571-A002

NTPC	PROJECT : Patratu STPS Phase-I (3 x800MW)	LIST OF ITEMS REQUIRING QP	REVISION NO : 00
	PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	DATE : 16.04.2017
	CONTRACTOR : BHEL Ltd	VENDOR AS APPROVED BY	
	CONTRACT NO : CS-9585-091-2		

Itm.	Major Equipment	QP Inspection Category	QP No. 9585-091-QVC-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Sub QR	Remark
		III				YOKOGAWA	Bangalore	A				EJA- E series 110,430,530
		III				ABB	Bangalore	A				Model - 2600 T
		III				ABB	GERMANY / Italy	A				Model - 2600 T
		III				Siemens	France / Kalwa	A				
		III				Honeywell	Pune	A				
		III				Lauson Automation	Daman	A				SMAR Make
		III				Baldota	Mumbai	A				SMAR Make
		*				ENDRESS & HOUSER	Aurangabad/ Germany	DR				
		*				CHINO	Ghaziabad	DR				
25	Thermocouples, RTD & Thermowell	III				HERAUS SENSOR	GERMANY	A			Sub QR	
		III				WISE Control	Korea	A				
		II				Tempsens	Udaipur	A				
		II				Pyrotechnic	Goa	A				
		II				Delta Instrumentation & Electronics Ltd	Mumbai	A				
		III				Minco	USA	A				
		III				CHAZAKI corporation	JAPAN	A				
		III				Yamari	JAPAN	A				
		III				Yamari	Singapore	A				For RTD Reference list and Performance feedback is to be submitted.
		III				ABB/SENSYCON	Germany	A				
		III				EMERSON (Rosemount)	Germany	A				
		II				EMERSON (Rosemount)	Pawane	A				Imported from Emerson, Germany (make)
		II				Thermal Instruments(GIC)	Savarkwadi	A				
		II				Techno Instruments	Ahamadabad	A				
		II				GOA Instrument Industries	GOA	A				
		*				GOA Instrument Industries	GOA	DR				For Thermowell only
		*				WIKA	Pune	DR				M/s BHEL will forward only two proposals after details review of NTPC Technical specification requirements.
		*				Textrafined Industries	Ather	DR				
		*				E & H	Aurangabad	DR				
		*				Nestech	Vapi	DR				
		*				Industrial Instruments	Kolkata	DR				
		*				Exotherm	Thane	DR				
		*				Baumer Technologies	Vapi	DR				
		*				Eland Engineering	Noida	DR				
		*				Siemens India	Gurgaon	DR				
		III				Jindal Electrodes	Roorkee	A				For Generator turbine & Motor
26	Ultrasonic type level Transmitter	III				E & H	Aurangabad/ Germany	A			Sub QR	
		III				EMERSON	Pawane	A				
		III				SIEMENS MILTRONICS	CANADA	A				
		III				Nivelco	Hungary	A				
		*				Vega	Germany	DR				

Bharat Heavy Electricals Limited * PS-MKTG Delhi *

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NTPC	PROJECT : Patratu STPS Phase-I (3 X800MW)	LIST OF ITEMS REQUIRING QP	
	PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR :BHEL Ltd	VENDOR AS APPROVED BY	DATE : 26.04.2017
	CONTRACT NO : CS-9585-001-2		

No.	Major Equipment	QP Inspection Category	QP No. 9585-001-QVIQ	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Sub QR	Remark
		*				Khrone	France / USA / Pune	DR				M/s BHEL will forward only two proposals after details review of NTPC Technical specification requirements.
		*				Yokogawa	Bangalore	DR				
		*				P&F	Germany	DR				
		*				Magnetrol	Belgium	DR				
		*				ABB	Germany / India	DR				
		*				Forbes Marshall	Pune	DR			Sub QR	
27	Orifice plate assembly	III				Instrumentation Limited	Palghat	A				
		III				Microprecision	Palwal	A				
		III				Starmech	Pune	A				
		III				Flow Star	Faridabad	A				
		III				SEIKO	Austria	A				
		III				MINCO India Pvt. Ltd.	GOA	A				Up to 32"
		III				MINCO India Flow Elements Pvt. Ltd.	GOA	A				Up to 28"
		III				WISE Control	Korea	A				
		III				T M Technomatic	Italy	A				
		*				IEPL	Hyderabad	DR				
		*				Engg. Specialities	Kolkata	DR				
		*				BALIGA	CHENNAI	DR				
		*				Pyroelectric	Mumbai	DR				
		*				Hydropneumatics	Mapusa	DR				
		*				Tensa Equipment Pvt. LTd.	Thane	DR				
		*				Dynamic Fluid Valves Pvt. Ltd.	Belgium	DR				
28	Pressure, DP Gauge	III				BUDENBERG	UK	A				
		III				ASHCROFT	USA/Germany/ India	A				
		III				Wika	GERMANY	A				
		III				WISE Control	Korea	A				
		III				Nagano KEIKI	Japan	A				
		III				H.Guru South India	Bangalore	A				Not for MS & FW application
		III				A.N. Instruments	Kolakatta	A				Not for MS & FW application
		III				Gauge Bourdon	Panvel	A				
		III				Goa Thermostatic	GOA	A				Not for MS & FW application
		III				Wika	Pune	A				DR for MS & FW application
		III				Baumer	Vapi	A				DR for MS & FW application
		III				Precision mass products Pvt. Ltd.	Gandhinagar	A				Not for MS & FW application
		III				H Guru	Rishra/Muzaffarpur	A				Not for MS & FW application
		*				US Gauge	USA	DR				
		*				Winters	USA	DR				
		III				Forbes Marshall	Hyderabad	A				
		*				Manometer	Mumbai	DR*				
		III				Walchandnagar Industries Ltd.	Dharwad	A				
		III				Nesstech	Vapi	A				DP Gauge for M/s Nesstech, Japan
		*				Gauges Bourdon	UK	DR				
		*				Fisher Mess	Germany	DR				

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Bharat Electricals Limited PS-MKTG Delhi
C&M Deptt. Patratu Thermal Power Station Jharkhand

NTPC	PROJECT : Patratu STPS Phase-I [3 X660MW]	LIST OF ITEMS REQUIRING QP	
	PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR :BHEL Ltd	VENDOR AS APPROVED BY	DATE : 26.04.2017
	CONTRACT NO : CS-9585-001-2		

No.	Major Equipment	QP Inspection Category	QP No. 9585-001-QVIQ	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Sub QR	Remark
		*				Protech Control	Kolkata	DR				
		*				New Scientific	Kolkata	DR				
		*				PTCI	Kolkata	DR				
29	Level gauge (Transparent & Reflex, Tubular type)	III				Main Contractor approved Sources		A				
30	Press, DP, Vaccum Switch	III				SOR	USA	A			Sub QR	
		III				DRESSOR (ASHCROFT)	USA/Germany	A				
		III				ITT BARTON	USA	A				
		III				HERION	GERMANY	A				
		III				BARKSDALE	GERMANY	A				
		*		*		Nagano KEIKI	Japan	DR				
		II				Switzer Process Instrument	Chennai	A				Up to 40kg/cm2 & not for Compound Switch and except 900 series
		II				Trafag	Gurgaon	A				Up to 40kg/cm2 & not for Compound Switch
		II				Switzer Process Instrument	Ghaziabad	A				Up to 40kg/cm2 & not for Compound Switch
		III				Delta control	UK	A				
		I				Gauges Bourdon (GIC)	Panvel	A				Up to 40kg/cm2 & not for Compound Switch
		I				ASHCROFT	Gandhinagar	A				
		*				Wika	Pune	DR				
		III				Gergeion	France	A				
		III				United Electric	USA	A				M/s BHEL will forward only two proposals after details review of NTPC Technical specification requirements.
		*				SMC	Japan	DR				
		*				Neodyne	USA	DR				
		*				IMI NORGEN	Noida	DR				
		*				WISE Control	Korea	DR				
		*				Baumer	Vapi	DR				
		*				Vasu Tech	New Delhi	DR				
		III				Bell & Krich	Germany	DR				
31	Temperature Switch	III				SOR	USA	A			Sub QR	
		III				DRESSOR (ASCHROFT)	USA/Germany	A				
		III				ITT BARTON	USA	A				
		III				DELTA CONTROLS	UK	A				
		I				Switzer Process Instrument	Chennai	A				up to 200 Deg. C
		I				Switzer Process Instrument	Ghaziabad	A				up to 200 Deg. C
		II				Trafag	Gurgaon	A				up to 200 Deg. C
		I				ASHCROFT	Gandhinagar	A				
		*				Wika	Pune	DR				
		III				Gergeion	France	A				
		III				United Electric	USA	A				
		*				SMC	Japan	DR				
32	Flow switch	III				UNIVERSAL FLOW METER	USA	A			Sub QR	
		III				Switzer	Chennai	A				

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C&M Deptt.

Patratu Vidyut Utpadan Nigam Limited (Jharkhand)

Thanks,

NTPC	PROJECT : Patratu STPS Phase-I [3 X800MW)	LIST OF ITEMS REQUIRING QP	
	PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR :BHEL Ltd	VENDOR AS APPROVED BY	DATE : 28.04.2017
	CONTRACT NO : CS-9585-001-2		

No.	Major Equipment	QP Inspection Category	QP No. 9585-001-QVIQ	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Sub QR	Remark
		III				Levcon	Kolkatta	A				
		III				DK Instrument	Kolkatta	A				
		III				Khrone Marshal	Pune	A				
		III				Chemtrol	India	DR				
		III				V Automat	NewDelhi	DR				
		III				Gauges Bourdon	Panvel	A				
		III				Magnetrol	Belgium	A				
		III				Ashcroft	Germany	A				
		III				Auxitrol	UK	A				
		III				Medicoid	USA	A				
		III				Delta Control	UK	A				
		III				Merlum	USA	A				
		*				Sumag Corperation		DR				
33	Condensing Pots	III				Main Contractor approved Sources		A				
34	Electric to Pneumatic converter	III				IMI NORGEN	India	A			Sub QR	Make : WATSON SMITH
		III				Fair child	USA	A				
		*				ABB	India	A				Subject to meeting the NTPC specificaion requirement
		*				SMC Pneumatics	Noida	DR				
		*				P & F	Bangalore	DR				
		*				Fairchild India Pvt. Ltd.	Noida	DR				
		*				FESTO	Bangalore	DR				
35	Conduits lead coated (Flexible)	III				Plica	Ghaziabad	A				Main contractor can propose additional vendor for this item
		III				Bansal laboratories	BHOPAL	A				
36	Intelligent Battery charger 24V DC & DCDB /BHMS	II				Chabbi Electricals	Jalgaon	A			Sub QR	Modules from EMERSON
		II				Eltech	Gurgaon	A				Modules from ELTEK
		II				MasTech	Jalgaon	A				Modules from ELTEK
		II				Emerson	India	A				
		II				MasTech (Selek Modules)	Jalgaon	A				BHMS from M/s USV, Germany
		*				HBL Power Systems	India	DR				
		*				Dubas	India	DR				
		*				Chabbi Electricals (Chabbi Modules)	Jalgaon	DR				
		*				Hitachi Hi Rel	Gandhinagar	DR				
		*				Statcon Power Controls Pvt. Ltd.	Noida	DR				
		*				Chloride Power Systems (caldyne)	India	DR				
		*				Amararaja	Tirupati	DR				
		*				Keltron Power Electronics	Trivendram	DR				

M/s BHEL will forward only their proposals after details review of NTPC Technical specification requirements.

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Patratu Vidyut Utpadan Nigam Limited C & M Deptt. Dist. Ramgarh (Jharkhand)

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NTPC	PROJECT : Patratu STPS Phase-I (3 X800MW)	LIST OF ITEMS REQUIRING QP	
	PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR : BHEL Ltd	VENDOR AS APPROVED BY	DATE : 25.04.2017
	CONTRACT NO : CS-9585-001-2		

No.	Major Equipment	QP Inspection Category	QP No. 9585-001-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Sub QR	Remark
		-				Universal instrument manufacturing co P Ltd	India	DR				
		-				Hind Rectifier Ltd	India	DR				
37	Battery Health Monitoring System	III				Emerson	Mumbai	A				
		III				Elink SGS Pvt Ltd	Gurgaon	A				
		-				B Tech Inc	USA	DR				
		III				Hitachi Hi Rel	Gandhinagar	A				
		-				Hopeckee	Germany	DR				
		-				Hitachi Hi Rel	Gandhinagar	DR				
38	Battery(Ni-cd)	I				AMCO SAFT	Bangalore	A				
		II				SAFT	France/Sweeden	A				
		I				HBL POWER	Hyderabad	A				
		II				Hopekee	Germany	A				
39	Socket weld fittings	III				BHEL Approved Sources						
40	Impulse pipe & tubes	II				Maharashtra Seamless	Raigarh	A				Carbon steel only
		II				Sumitomo/Kawasaki/Nippon	Japan	A				
		II				TPS TECHNITUBE	Germany	A				
		II				Veluric & mannesmann	Germany	A				
		II				BHEL	Trichy	A				
		II				Trouvay and Cauvin	France	A				Makes shall be as per approved list (Sr. No. 41)
		II				ISMT	Ahamadnagar	A				Carbon steel only
		II				Sandvik		A				For SS only
		-				TUBACES	Spain	DR				
		-				Salzgitter Mannesmann International	Germany	DR				
		-				Jindal saw	India	DR				
		II				Ratanamani Metal and Tubes	Ahamadabad	A				SS only
		II				Heavy metals and Tubes	Ahamadabad	A				SS and CS only.
		-				Shubhalaxmi Metal and Tubes	Mumbai	DR				
41	Compression fittings	III				Parker	USA	A				
		III				Precision	Mumbai	A				
		III				Astech	Mumbai	A				
		III				Fluid control Pvt. Ltd.	Pune	A				
		III				HP Valves and fittings	CHENNAI	A				Ferruleas are to be hardned at Exim Holland for pressure above 9000 psi.
		III				Excel hydro	Mumbai	A				Ferruleas are to be hardned at Exim Holland for pressure above 9000 psi.
		III				Swagelock	USA	A				
		III				Panam	Mumbai	A				
		III				Meipress	Kolkata	DR				
		-				AURA INC	New Delhi	DR				
		-				Prime Engineers		DR				
		-				Arya Craft		DR				

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NTPC

PROJECT : Patratu STPS Phase-I (3 X800MW)

PACKAGE : EPC PACKAGE

CONTRACTOR :BHEL Ltd

CONTRACT NO : CS-9585-091-2

LIST OF ITEMS REQUIRING QP

APPROVAL & ACCEPTABLE

VENDOR AS APPROVED BY

REVISION NO : 00

DATE : 26.04.2017

No.	Major Equipment	QP Inspection Category	QP No. 9585-091-QVP Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Sub QR	Remark
		*				PMI Engineers	Ahemadabad	DR				
		*				Flowtech	Kolkata	DR				
		*				Parker Hannifin India Pvt Ltd		DR				
42	Instrument valves	III				BHEL	Trichy	A				
		II				Excel Hydro	Mumbai	A				
		II				Instrumentation Ltd.,	Palghat	A				
		III				Swagelok	USA	A				
		III				Parker	USA	A				
		II				HP Valves and fittings	CHENNAI	A				
		II				Fluid control Pvt. Ltd.	Pune	A				
43	Valve manifolds	II				Baldota	Mumbai	A				
		III				Excel hydro	Mumbai	A				
		III				SCHNEIDER	Germany	A				
		III				Anderson Greenwood	USA	A				
		III				Astech	Mumbai	A				
		III				HP Valves and fittings	CHENNAI	A				
		III				Fluid control Pvt. Ltd.	Pune	A				
		III				Manyumission	Faridabad	A				
		III				Parker	USA	A				
		III				Swagelok	USA	A				
		III				Baldota	Mumbai	A				
		*				Manyata Engg. works	Kolkata	DR				
		*				Flow tech	Kolkata	DR				
44	Local Instrument Enclosure/Rack	I				Pyrotech	Udaipur	A				
		I				Instrumentation Limited	Kota	A				
		I				Sajja electrical	Tiruchirapalli	A				
		I				Prammen	Puddukottai	A				
		I				Chamin	Pondicherry	A				
		*				Forbes Marshall	Pune	DR				
		*				Pastronics	Vadodara	DR				
		*				Proton	Chennai	DR				
45	Instrument Cables	I				Paramount	Khushkera	A				PVC,FRLS type,ROP
		I				Polycab	Daman	A				PVC,FRLS type,ROP
		I				Dalos	Faridabad	A				PVC,FRLS type,ROP
		I				KEI	Bhiwadi	A				PVC,FRLS type
		I				Ekay Tekelets	Faridabad	A				PVC,FRLS type
		I				CORDS	Chopanki	A				PVC,FRLS type,ROP
		I				CORDS	Kaharani	A				PVC,FRLS type,ROP
		I				Hicoo	Kolkata	A				PVC,FRLS type
		II				TEW A C	USA	A				
		II				Habia cables	Sweden	A				
		II				Kerpen cables	Germany	A				
		II				Lapp cables	Germany	A				
		II				Thermo electra Elv	Nemadabs	A				
		I				Universal Cable	Satna	A				PVC,FRLS type
		I				Thermocables	Hyderabad	A				PVC,FRLS type

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PROJECT : Pairau STPS Phase-I (3 X800MW) | LIST OF ITEMS REQUIRING QP | REVISION NO : 00

PACKAGE : EPC PACKAGE | APPROVAL & ACCEPTABLE | DATE : 26.04.2017

CONTRACT NO : CS-9385-001-2 | VENDOR AS APPROVED BY

No.	Major Equipment	QP Inspection Category	QP No. 9385-001-QVC-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Sub QR	Remark
		I				Finolex Cable	Pune	DR *				
		I				Incab	Pune	DR *				
		I				Gupta Power Infrastructure Ltd.	Khurdha	A				
		*				Largo cables	India	DR				
		*				Lucki cable	Pune	DR				
		*				RR Kabel	Silvasa	DR				
		*				Gemscab	Dhivadi	DR				
		*				KEC International	Mysore	DR				
		*				Advance cable Technologies	Bangalore	DR				
		*				Sayaji Electricals Ltd.	Vadodara	DR				
		*				Special Cable	India	DR				
		*				CMI	Faridabad	DR				
		*				Goyalal Cables	Kolkata	DR				
		*				Aspodyne Cables	Mumbai	DR				
		*				Radiant RSCC Specialty	Hyderabad	DR				
		*				APAR Industries	Banglore	DR				
		*				Tamilselvi Cable	Udaipur	DR				
		*				Mansfield cables co. Ltd.	Hyderabad	DR				
		*				Seyal India Pvt. Ltd.	Neemrana	DR				
		*				TC Centelnication Pvt. Ltd.	Ghaziabad	DR				
46	Electrical actuator	III				Asma	Germany	A				
		III				Limitorque	USA	A				
		III				Rotork	UK	A				
		II				Limitorque	Faridabad	A				
		II				Rotork	Chennai/ Bangalore	A				
		III				Nippon gear	Japan	A				
		II				Asma	Bangalore	A				
		III				Harold Beck	USA	A				
		III				Drehmo	Germany	A				
		I				Aritteb	Chennai	A				For Low torque application such as SHUH vent, circulation isolation
		*				Limitorque	USA	DR				
		*				Siemens	Germany	DR				
47	Electrical actuator for IDF/PA Blade pitch and Guide vane control	III				Harold Beck	USA	A				
		III				SIPOS Aktorik GmbH	Germany	A				
		*				AUB	Germany	DR				
48	Flow nozzle / Venturi assembly	II				Microprecision	Faridabad	A			Sub QR	
		II				SEIKO	Austria	A				
		II				TECHNOMATIC	Italy	A				
		II				Instrumentation Limited	Palghat	A				
		I				Starmech	Pune	A				
		II				WISE Control	Korea	A				

Bharat Heavy Electricals Limited PS-MKTG Delhi

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NTPC	PROJECT : Patratu STPS Phase-I (3 X800MW)	LIST OF ITEMS REQUIRING QP	
	PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR :BHEL Ltd	VENDOR AS APPROVED BY	DATE : 26.04.2017
	CONTRACT NO : CS-9585-001-2		

No.	Major Equipment	QP Inspection Category	QP No. 9585-001-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Sub QR	Remark
		I				MINCO India Flow Elements Pvt. Ltd.	GOA	A				
		"				SAMIL	Korea	DR				
		"				MINCO	GOA	DR				
		"				Engg. Specialities	Kolkata	DR				
		"				Pyroelectric	Mumbai	DR				
		"				Hydropneumatics	Mapusa / GOA	DR				
		"				ASIAN INDUSTRIAL VALVES	Chennai	DR				
		"				Dynafluid valves Pvt. Ltd.	Belgium	DR				
49	HIGH Temp. cable (PTFE/FEP)	II				Habia cables	Sweden	A				
		II				Lapp cables	Germany	A				
		II				Kerpen cables	Germany	A				
		II				IEW & C	USA	A				
		II				Thermo-Electra Bv	Netherland	A				
		II				Habia cables	China	A				
		II				Thermocables	Hyderabad	A				
		II				Tempatemp	Udaipur	A				
		*				Delton Cables	Faridabad	DR				
		*				RJ Cables	Roorkee	DR				
50	Fiber optic cable	II				HFCL	Goa	A				
		II				R&M	Switzerland	A				
		II				Akash Fibre	Bhiwadi	A				
		II				Finolex	Pune/Goa	A				
		II				Bata Ericsin	Rewa	A				
		II				Molex	UK	A				
		II				Corning	USA	A				
		II				Schneider	GOA	A				Previously known as D Link / Smartlink, Goa
		*				RPG Cables	India	DR				
		*				Unilex Cables	India	DR				
		*				Tarnecom	India	DR				
51	Pneumatic Actuator (Power Cylinder e. g. FOR SADC)	II				Dong Woo Valve Control Co. LTD	Korea	A				
		II				Shin Hwa Engineering Co. LTD	Korea	A				
		I				Instrumentation Limited	Palghat	A				
		I				Kelton	Cochin(Mapsa)	A				
		I				SMC Pneumatics	Noida	A				Up to 12 Inch only
		I				Rotex	Mumbai	A				Conditional
		*				Emerson Process Management	Chennai	DR				
		*				MIL Controls	Alwaye	DR				
		*				Festo	Bangalore	DR				
		*				IMI Norgren	Noida	DR				
52	Level switch capacitance type	III				ENDRESS & HOUSER	Aurangabad	A			Sub QR	
		III				MAGNETROL	BELGIUM	A				
		III				SBEM	PUNE	A				
		III				PUNE TECHTROL	PUNE	A				

Bharat Heavy Electricals Limited PS-MKTG Delhi

Dy. Mgr (Tech) Deptt.

NTPC	PROJECT : Patratu STPS Phase-I (3 X800MW)	LIST OF ITEMS REQUIRING QP	
	PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR :BHEL Ltd	VENDOR AS APPROVED BY	DATE : 26.04.2017
	CONTRACT NO : CS-9585-001-2		

No.	Major Equipment	QP Inspection Category	QP No. 9585-001-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Sub QR	Remark
		III				LEVCON	KOLKATA	A				
		III				Nivo Controls	Indore	A				
		*				V AUTOMAT	New Delhi	DR				
		*				D K Instrument	Kolkata	DR				
		*				Siemens	Germany	DR				
		*				ABB	Korea	DR				
		*				Rosemount	Korea	DR				
53	Transducer	II				AE	Mumbai	A				
		II				Southern Transducer	Chennai	A				
		II				Elster	Mumbai	A				
		III				Camille Bauer	Germany	A				
		III				Metrawol	Germany	A				
		II				Rishab	Nasik	A				
		*				Pyrotech	Udaipur	DR				
		*				Marsbus	Gandhinagar	DR				
		*				SIEMENS	Germany	DR				
54	Mini UPS up to 3.5 KVA	III				EMERSON	Mumbai	A				
		III				EMERSON	Pune	A				
		III				Hitachi Hi- Rel	Gandhinagar	A				
		III				APC	Bangalore	A				
		III				APLAB	Mumbai	A				
		III				Delta	Gurgaon	A				
		*				Powertronix	Bangalore	DR				
		*				DUBAS ENGG.PVT.LTD., BANGALORE		DR				
		*				Grid power conversion Pvt Ltd.		DR				
		*				Schneider	Bangalore	DR				
55	Level switch- cond type	III				EMERSON (Solartron mobrey)	UK	A			Sub QR	
		II				Hi Tech	Kolkata	A				Levelstate, UK System
		III				Yarway	USA	A				
		III				LEVELSTATE	UK	A				
		II				Raman Instruments	Delhi	A				Emerson (Mobrey) System
		*				BHEL	Trichy	DR				
		*				IGEMA	Germany	DR				
56	Level switch – Float/Displacer Type	III				ENDRESS & HOUSER	AURANGABAD	A			Sub QR	
		III				MAGNETROL	BELGIUM	A				
		III				LEVCON	KOLKATA	A				
		III				SBEM	PUNE	A				
		III				Chemtrols samil	Mubmai	A				
		III				NAKATIYA	JAPAN	A				
		III				Sigma Industries	Mubmai	A				
		III				D K Instrument	KOLKATA	A				
		III				PUNE TECHTROL	PUNE	A				
		III				V AUTOMAT	NEW DELHI	A				
		*				WAREE	WAPI	DR				
		III				LEVELSTATE	UK	A				

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Bharat Heavy Electricals Limited PS-MKTG Delhi

C & M Deptt.

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NTPC	PROJECT : Patratu STPS Phase-I (3 X800MW)	LIST OF ITEMS REQUIRING QP	
	PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR :BHEL Ltd	VENDOR AS APPROVED BY	DATE : 28.04.2017
	CONTRACT NO : CS-9585-001-2		

No.	Major Equipment	QP Inspection Category	QP No. 9585-001-QVQ	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Sub QR	Remark
		III				Gauges Bourdon (GIC)	Panvel	A				
		*				Nisan Scientific Process	Navi Mumbai	DR				
57	Air filter regulator	III				Fairchild	USA	A				
		III				Shavo Norgen	Mumbai	A				
		III				SMC Pneumatics	NOIDA	A				
		III				Emerson (Asco)	Chennai	A				
		III				Festo	Bangalore	A				
		III				Placka	Chennai	A				
						Divya Control Elements	Gujarat	DR				
58	Copper tubing/Brass connectors	III				Main Contractor approved Sources		A				
59	Coupling / Interposing relays	III				PARAMOUNT	BANGALORE	A				
		III				OMRON		A				
		III				OEN		A				
		III				Jyoti	Baroda	A				
		III				ELSTA	SWITZERLAND	A				
		*				Schneider	Germany	DR				
		*				Siemens	Germany	DR				
		*				Phoenix	Germany	DR				
		*				Finder		DR				
60	Solenoid valve	III				Rotex	Vadodara	A			Sub QR	
		III				Avcon	Mumabi	A				
		III				Herion	Germany	A				
		III				IMI NORGEN	GERMANY	A				
		III				Jafferson	Argentina	A				
		III				Asco	Chennai/USA	A				
		III				Festo	Bangalore	A				
		III				SMC	Noida	A				
		III				Parker	Brand Name	A				
		*				Schnaider	Germany	DR				
		*				Neucon Industries Pvt. Ltd.		DR				
61	Lube oil control valve - Self Regulating	III				NUOVO PIGNONE	ITALY	A				
		III				EMERSON	CHENNAI	A				
		III				SAMSON	GERMANY / PUNE	A				
		III				Forbes marshall arca pvt. Ltd.	Pune	A				Approved up to 16", 900 Class.
62	Guided waveRadar type level transmitter	III				Magnetrol	Belgium	A			Sub QR	
		III				Endress & Houser	Germany/ Aurangabad	A				
		III				Emerson Process Management	Sweden/ PAWANE	A				
		III				ABB(K-Tech)	USA	A				
		II				Supreme Technology	Thane	A				Make M/s Siemens, Canada
		*				Yokogawa	Japan	DR				
		*				ABB	India	DR				
		*				P & F	Bangalore	DR				

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Bharat Heavy Electricals Limited ★ PS-MKTG Delhi

C & M Deptt.

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NTPC	PROJECT : Patratu STPS Phase-I (3 X800MW)	LIST OF ITEMS REQUIRING QP	
	PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR : BHEL Ltd	VENDOR AS APPROVED BY	DATE : 26.04.2017
	CONTRACT NO : CS-9585-001-2		

No.	Major Equipment	QP Inspection Category	QP No. 9585-001-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Sub QR	Remark
		*				Khrone	France	DR				
		*				HONEYWELL	Pune	DR				
		*				Vega	Germany / India	DR				
		*				Siemens	India	DR				
		*				SBEM	Pune	DR				
63	Maintenance and Calibration Equipment					Main Contractor will propose the vendors during detail Engineering.						
64	Temperature Gauge	III				BUDENBERG	UK	A				
		III				DRESSOR (ASHCROFT)	USA/Germany	A				
		III				Wika	GERMANY/ Pune	A				
		III				WISE Control	Korea	A				
		III				Nagano KEIKI	Japan	A				
		III				H.Guru South India	Bangalore	A				
		III				A.N. Instruments	Kolakatta	A				
		III				NUOVA FIMA	ITALY	A				
		III				Goa Thermostatic	Goa	A				
		III				Goa Instrument Industries	Goa	A				
		III				Baumer	Vapi	A				
		III				Precision mass products Pvt. Ltd.	Gandhinagar	A				
		III				H Guru	Rishra/Muzaffarpur	A				
		III				Baumer	Vapi	A				
		III				Forbes Marshall	Hyderabad	A				
		III				Gauges Bourdon (GIC)	Panvel	A				
		*				Konics	Korea	DR				
		*				Pyroelectric	GOA	DR				M/s BHEL will forward only two proposals after details review of NTPC Technical specification requirements.
		*				Winters Gauge	USA	DR				
		*				Walchandnagar Industries Ltd.	Dhanvad	DR				
		III				Nasstech	Vapi	A				
		*				US Gauge	USA	DR				
65	Furniture for computer (Chair, Almirah, Lock etc.)	III				Main contractor approved sources		A				
66	Terminal Block (Cage and Clamp type)	III				Weidmuller	Germany	A				
		III				Phoenix	Germany / India	A				
		III				Wago	Germany / India	A				
		III				Elmex	Vadodara	A				CE Mark only
67	FRP Junction Box for C&I system	III				BHEL Approved Sources		A				
68	PLC System (if applicable)	I				GE Intelligent platforms	Bangalore	A				
		I				ABB	Bangalore	A				
		I				Schneider	Nasik	A				
		I				Rockwell	Sahibabad	A				
		I				Siemens	Nasik	A				
		I				HONEYWELL	Pune	A				
69	SMART POSITIONER (Make)	#				ABB						# - To be covered in Control Valve QP.

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Bharat Heavy Electricals Limited ★ PS-MKTG Delhi

C & M Deptt. Patratu Vidyut Utpadan Nigam Limited Distt. Ramgarh (Jharkhand)

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NTPC	PROJECT : Patratu STPS Phase-I (3 X800MW)	LIST OF ITEMS REQUIRING QP	
	PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR : BHEL Ltd	VENDOR AS APPROVED BY	DATE : 26.04.2017
	CONTRACT NO : CS-9585-001-2		

No.	Major Equipment	QP Inspection Category	QP No. 9585-001-QVIQ	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Sub QR	Remark
		#				Masoneilan						
		#				Siemens						
		#				Smar						
		#				Yokogawa						
		#				EMERSON (Fisher Rosemount)						
		#				METSO						
		#				Yamatake						
		#				Moore						
70	ROTAMETER	III				IEPL	HYDRABAD	A			Sub QR	
		III				TRAC	HYDRABAD	A				
		III				PLACRA	CHENNAI	A				
		III				EUREKA	PUNE	A				
		III				SCIENTIFIC DEVICES	MUMBAI	A				UP TO 300 NB
		III				FLOW STAR	FARIDABAD	A				
		III				TOKOYO KEISO	JAPAN	A				
		*				Flowtech Instrument Services	Vadodara	DR				
		*				Samil Chemtrol	MUMBAI	DR				
		*				Gauges Bourdon	Panvel	DR				
		*				Tansa Equipment Pvt. Ltd.	Thane	DR				
71	SINGLE AND MULTI POINT TEMPERATURE RECORDER (Microprocessor based)	III				YOKOGAWA INDIA	BANGALORE	A				Make Yokogawa, Japan
		III				CHINO CORPORATION	JAPAN	A				
		III				EUROTHERM	UK	A				
		III				EUROTHERM	INDIA	DR				
		III				YOKOGAWA	JAPAN	A				
		III				ABB	UK / GERMANY	A				
		III				FUJI	JAPAN	A				
		III				HONEYWELL	USA / NETHERLAND	A				
72	Reverse Rotation Indicator (RRI)	III				GE BENTLY NEVEDA	USA	A			Sub QR	ALL TSI VENDORS ARE ALSO ACCEPTABLE
		III				SHINKAWA	JAPAN	A				
		I				P & F	Bangalore	A				
73	Instrument Tube Fittings (Air)	III				Main contractor approved sources		A				
74	pH/ Conductivity Analyser	III				HACH	Switzerland / USA	A			Sub QR	
		III				YOKOGAWA	Banglaore / Japan	A				Make Yokogawa- Japan
		III				ABB	UK / USA	A				
		III				EMERSON	Pawane	A				
		*				Thermo orion		DR				
		*				Forbes Marsbell	Puna	DR				
75	PADO					Main Contractor will propose the vendors during detail Engineering.						
76	DEW Point Sensor / meter/ Moisture Measuring System	III				GE Sensing	USA / Ireland	A				Panametric brand
		III				Michell Instrument	UK	A				
		III				Shaw	UK	A				

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NTPC	PROJECT : Patratu STPS Phase-I (3 X800MW)	LIST OF ITEMS REQUIRING QP	
	PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACT NO : BHEL Ltd	VENDOR AS APPROVED BY	DATE : 26.04.2017
	CONTRACT NO : CS-9585-001-2		

No.	Major Equipment	QP Inspection Category	QP No. 9585-001-QVIQ	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Sub QR	Remark
		III				COSA XENTAUR	USA	A				through Spectrum automation faridabad
		*				VAISHALA	Sweden / Japan	DR				
		*				DWER	USA	DR				
		*				Endee	Mumbai	DR				
		*				Nivo Controls	Indore	DR				
		*				Bartec GMBH	Germany	DR				
77	Blank Panels / Cabinets	III				Rittal	Bangalore	A				
		III				Hoffman	BANGALORE	A				
		III				Pyrotech	Udaipur	A				
		III				BHEL	Bangalore	A				
		III				Schneider	Bangalore	DR				
78	CCTV Components (IP)	*				Sony	Japan	DR				
		*				Siemens	Pondichery	DR				
	Integrators will be decided during detail Engineering.	-				Dv Tel	USA	DR				
		*				Honey Well	Gurgaon	DR				
		II				Bosch	Bangalore	A				With Bosch Software
		II				Axis	Sweden	A				With Bosch Software
		*				Pelco	USA	DR				
		II				Axis	Sweden	A				With Milestone Software
79	Control Desk, Server / PC Rack for Unit Control room and Auxiliary control room.	I				Pyrotech works Space	Udaipur	A				
		I				Cosmos	Noida	A				
		I				Adarsh Control	Bangalore	A				
		*				Chemin Controls	Pondichery	DR				
		*				Harmoney Systems	New Delhi	DR				
80	Digital Indicators	III				Masibus	Gandhi Nagar	A				For Non mosaic mounting
		III				ABB	Germany	A				
		III				Foxboro	UK	A				
		III				Yokogawa	Japan	A				
		III				Gossen / Metrowatt / Camille Bauer	Germany	A				
		III				Siemens	Germany	A				
		III				Chino	Japan	A				
		III				Weigell Messgerate	Germany	A				
		III				Pyrotech	Udaipur	A				For Non mosaic mounting
		*				Chino Corporation	Mumbai	DR				
		*				Yokogawa	Bangalore	DR				For Non mosaic mounting and submit only two proposals
		*				Lektrotek	Pune	DR				
		*				Telecherm	Chennai	DR				
81	Dust Emision Monitor	III				Land Instrument International	UK	A				Land Combustion Division
		III				Durag	Germany	A				
		III				Sick Maihak	Germany	A				
		III				Emerson Process Management	Ireland	A				
		III				Codel	UK	A				

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C & M Dept. Dist. Ramgarh (Jharkhand)

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NTPC	PROJECT : Patratu STPS Phase-I (3 X800MW)	LIST OF ITEMS REQUIRING QP	
	PACKAGE : EPC PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACT OR :BHEL Ltd	VENDOR AS APPROVED BY	DATE : 28.04.2017
	CONTRACT NO : CS-8585-001-2		

No.	Major Equipment	QP Inspection Category	QP No. 9585-001-QVI-Q	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Sub QR	Remark
		II				Forbes Marshall	Pune	A				Main kit from M/s Codel, UK
82	Electrical Indicating Instruments (Mosaic Compatible)	III				Siemens	Germany	A				
		III				Gossen / Metrawatt / Camille Bauer	Germany	A				
		III				Ganz	Germany	A				
		III				Wolgell Messgerate	Germany	A				
83	Flue Gas Analyser (CO)	III				Codel	UK	A			Sub QR	
		III				Emerson Process Management	Pawane	A				Analyser from M/s Emerson, Germany / USA
		III				Land Instrument International	UK	A				Land Combustion Div
		III				Sick Maihak	Germany	A				
		III				Siemens	Germany	A				
84	Flue Gas Analyser (CO2)	*				Codel	UK	DR			Sub QR	
		*				Sick Maihak	Germany	DR				
		*				Kitiwake Procal Ltd.		DR				
85	Flue Gas Analyser (SO2 and Nox)	III				Sick Maihak	Germany	A			Sub QR	
		III				Emerson Process Management	Pawane	A				Analyser from M/s Emerson, Germany / USA
		III				Siemens	Germany	A				
		III				Fuji Electric	Japan	A				
		*				Yokogawa	Japan	DR				
		*				Codel	UK	DR				
		*				ABB	Gloucestershire	DR				
86	Flue Gas Analyser (O2 Analyser (HT))	II				SECO	Chennai	A			Sub QR	Main Contractor Can propose additional vendor for this item
		III				Marathon Monitor	USA	A				
87	Flue Gas Analyser (O2 Analyser (LT))	III				Emerson (Rosemount)	Pawane	A			Sub QR	Make EMERSON, USA
		III				Forbes Marshall	Pune	A				Make Enotec, Germany : Model Oxitec 5000 series
		III				ICE	Mumbai	A				Make Ametek, USA
		III				Yokogawa	Bangalore	A				Make Yokogawa, Japan
		III				ABB	Bangalore	A				Make ABB, UK
		*				AMETEK (P and AI division)	Singapore	DR				
		*				Enotec	Germany	DR				
		*				Fuji Electric	Japan	DR				
		*				Teledyne	USA	DR				
88	Flue Gas Analyser Panel	I				Chemtrol	Goa	A			Sub QR	
		I				Emerson Process Management	Navi Mumbai	A				
		I				Pyrotech	Udaipur	A				
		I				Analytical Instrument Company	Kota	A				Analyser from M/s Fuji, Japan
		I				Yokogawa	Bangalore	DR				
		I				Adage	Mumbai	A				
		*				Marvel Engg Company	Chennai	DR				

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Bharat Heavy Electricals Limited * PS-MKTG Delhi

C & M Dept.

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SUB VENDOR LIST (PERMANENT CATEGORY) AS ON 12/19/2019 2:58:38 PM

Sl No	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address
1	Cold Junction Compensation Box (CJCB)	CREATIVE INSTRUMENTS & CONTROLS	NO-17/1 , 1ST FLOOR , 11TH CROSS 1ST K BLOCK , RAJAJINAGAR, BANGALORE-560010 Phone- Pincode : Email : crinstruments@gmail.com	
2	CONTROL VALVE	Valvitalia S.P.A. ,	Mr. Salvatore Ruggeri Via Tortona 69, Rivanazzano (Pavia) Phone- +39-03839459875 Pincode : 27055 Email : dario.torluccio@valviatalia.com	Works-1->Mr. Salvatore Ruggeri Via Tortona 69,Rivanazzano (Pavia) - - Italy Phone- +39-03839459875 FAX : Pincode : 27055 Email : dario.torluccio@valviatalia.com; diego.poletti@valvitalia.com; sales@bhgassociates.com
		R.K.CONTROL INSTRUMENTS PVT. LTD.	PLOT NO.A-250, OPP.POLICE STATION, WAGLE INDUSTRIAL ESTATE, THANE Phone- 25820943/2331 Pincode : 400604 Email : rkcipl@vsnl.com ; rkcinpvt@bol.net.in	Works-1->SAVITH KUMAR PLOT NO. A-250, OPP.POLICE STATION,WAGLE INDUSTRIAL ESTATE, THANE -THANE-MAHARASHTRA INDIA Phone- 022-'66060942 FAX : 022-25820801 Pincode : 400 604 Email : rkadmin@rkcipl.co.in
		Mascot Valves Pvt. Ltd.	166-167 GIDC Naroda Ahmedabad Phone- 0792282 1619 Pincode : 382330 Email : dom.sales@mascotvalves.com	Works-1->Varun Patel Dir 166-167 ,GIDC Naroda -Ahmedabad-GUJARAT India Phone- 0792282 1619 / 3369 FAX : Pincode : 382330 Email : dom.sales@mascotvalves.com
		EMERSON PROCESS MANAGEMENT CHENNAI LIMITED	147, KARAPAKKAM VILLAGE, CHENNAI Phone- 23722184, 23716242 Pincode : 600096 Email : jatinder.singh@emerson.com	Works-1->Mr. Rangarajan (Head - Lean and Manufact 147,Karapakkam Village, -Chennai-TAMIL NADU India Phone- 0444903 4395 FAX : Pincode : 600097 Email : Rangarajan.M@emerson.com
		Severn Glocon India Pvt. Ltd.	F96 & F97, Sipcot Industrial Park, Irungattukottai, Chennai, Phone- 044-47104200, Pincode : 602117, Email : info@severnglocon.co.in,	Works-1->Mr. K.Kaushik, F96 & F97, Sipcot Industrial Park,Irungattukottai, -Chennai-TAMIL NADU India Phone- 044-47104200, FAX : 044-47100073, Pincode : 602117, Email : info@severnglocon.co.in
		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	Works-1->Mr. K.M. Anklesaria/ Mr. R.M. Anklesaria Dir Plot No: 285/2, Panchratna Estate, Near Ramol Bridge, Vatva, -Ahmedabad-GUJARAT INDIA Phone- 079-40083825 FAX : Pincode : 382445 Email : info@bomafa-india.com
		FORBES MARSHALL ARCA PVT.LTD.	A-34/35 , MIDC ESTATE, H-BLOCK, PIMPRI, PUNE, Phone- 020-27442020, Pincode : 411018 Email : mnadgaundi@forbesmarshall.com	Works-1->Mr. Sanjeev Shinde A-34/35 MIDC Estate,H Block, Pimpri, -Pune-MAHARASHTRA India Phone- 9323176406 FAX : 020-27442040 Pincode : 411018 Email : sshinde@forbesmarshall.com
		INSTRUMENTATION LTD.	KANJIKODE WEST, PALALKKAD, PALAKKAD Phone- 2566127-130,2567128 Pincode : 678623 Email : icvldil@gmail.com;fa2@ilpgt.com	Works-1->D.SASIDHARAN, AGM(Works&PPC) KANJIKODE WEST, -PALAKKAD-KERALA INDIA Phone- 0491-2566536 FAX : 0491-2566135 Pincode : 678623 Email : sasidharan@ilpgt.com;mraj@ilpgt.com;gireesh@ilpgt.com, commercial@ilpgt.com;fa2@ilpgt.com;nazeera@ilpgt.com;pkv@ilpgt.com;remith@ilpgt.com
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		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	Works-1->R Gopinath 27 Nahur Udyog Industrial Premises,M.M.Malviya Road, Mulund(-MUMBAI-MAHARASHTRA INDIA Phone- +912225918567 FAX : +912225918566 Pincode : 400080 Email : sales@sigmainstruments.co.in
11	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	Works-1->Mr. Partha Bose 44, Saheed Hemanta Kumar Bose,Sarani, -Kolkata-WEST BENGAL India Phone- +91 33 2548 7220 FAX : +91 33 2548 0429, Pincode : 700074 Email : parthabosebpi@gmail.com bosepanda@vsnl.net
		A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in	Works-1->Mr. Gautam Mukherjee Kusumba,Sonarpur Station Road,P.O. -Narendrapur, -Kolkata-WEST BENGAL INDIA Phone- 9836878855 FAX : 033-24342748 Pincode : 700103 Email : gkm_ani@hotmail.com
		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	Works-1->NA NA -- Phone- FAX : Pincode : Email :
		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	Works-1->MR G.SRINIVASAN/MR ANUJ MALPANI PLOT NO:A-19/2 & T-4/2,I.DA. NACHARAM , -HYDERABAD-TELANGANA INDIA Phone- 09866550762 FAX : 040 27152193 Pincode : 560076 Email : gsbrinivasan@forbesmarshall.com
		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	Works-1->Mr. Hitesh Parmar/Mr. Hitesh Parmar Plot No.2306, Phase II, GIDC Chhatral, -Kalol-GUJARAT INDIA Phone- 9327359227 FAX : 02764-233440 Pincode : 382729 Email : hitesh.parmar@ashcroftindia.com

		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	Works-1->Mr. Shyam Warilani/Mr. V Suresh Babu Plot No 34 À GIDC À Phase 1, -VAPI-GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : pbajaj@baumer.com
		H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com	Works-1->Shikha Hazra/ Shyamal Hazra 32, Industrial Suburb,Yeshwanthpur -BANGALORE-KARNATAKA INDIA Phone- 080-23370300 FAX : 080-23379890 Pincode : 560022 Email : shikhahazra@hgurusouth.com
		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,	Works-1->Gauge Bourdon India Pvt. Ltd., Plot No-4, 5, 6,Jawahar Co-operative Industrial Estate, -Kalamboli Taluka Panvel-MAHARASHTRA India Phone- 022-27421095, FAX : 022-27421901, Pincode : 410209, Email : info@general-gauges.com
		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	Works-1-> Others 26/2, G Type, Global Ind. Park Near Nahuli Railway Crossing, -Vapi-GUJARAT INDIA Phone- 9920576002 FAX : Pincode : 396105 Email : sales@nesstech.co.in, bkapadia@nesstech.co.in
		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	Works-1->Scientific Center, Others By-Pass Junction,Near Kalsekar College kausa, mumbra,Thane -Mumbai-MAHARASHTRA INDIA Phone-022-25491409,9892230623 FAX : Pincode : 400612 Email : sdbpl@vsnl.com
12	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	Works-1->Mr. A.D.Solomon J-14, MIDC, TARAPORE, BOISER STN., -THANE-MAHARASHTRA India Phone- FAX : Pincode : Email : trivtech@vsnl.com
		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	Works-1-> Others 26/2, G Type, Global Ind. Park Near Nahuli Railway Crossing, -Vapi-GUJARAT INDIA Phone- 9920576002 FAX : Pincode : 396105 Email : sales@nesstech.co.in, bkapadia@nesstech.co.in
		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	Works-1->Mr. Raghavendra M. Kulkarni Survey No. 250A/B, Post-Mangaon,Tal.- Kudal, Dist.- Sindhudurg, --MAHARASHTRA India Phone-09322664709 FAX : 022-24455026 Pincode : 416519 Email : ramk@giconindia.com
		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	Works-1->Mr. S.D Deval B-188A ROAD NO.5 ,M.I.A -UDAIPUR-RAJASTHAN INDIA Phone- 9352501530 FAX : 0294-3057750 Pincode : 313003 Email : deval@tempsens.com
		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	Works-1->Mr. Shyam Warilani/Mr. V Suresh Babu Plot No 34 À GIDC À Phase 1, -VAPI-GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : pbajaj@baumer.com
		GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone-09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,	Works-1->Mr. S.G. Dixit D2/5, Mapusa Industrial Estate, -Mapusa-GOA INDIA Phone- 09326054551 FAX : 0832-2262331 Pincode : 403 507 Email : sumukh@goainstruments.com
		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	Works-1->A A KULKARNI/ VINOD C G PLOT NO. 71,BICHOLIM INDUSTRIAL ESTATE -BICHOLIM-GOA INDIA Phone- 9326114409 FAX : 91 832 2363381 Pincode : 403529 Email : pyroworks@pyro-electric.in
		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,	Works-1->Gauge Bourdon India Pvt. Ltd., Plot No-4, 5, 6,Jawahar Co-operative Industrial Estate, -Kalamboli Taluka Panvel-MAHARASHTRA India Phone- 022-27421095, FAX : 022-27421901, Pincode : 410209, Email : info@general-gauges.com
		TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,	Works-1-> Khasra No.: 218-230& 235, Industrial Estate,Makhupura, -Ajmer-RAJASTHAN India Phone- 9887865856, FAX : 0145-2695174, Pincode : 305002, Email : rajeev.gupta@tipl.com
		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	Works-1->Scientific Center, Others By-Pass Junction,Near Kalsekar College kausa, mumbra,Thane -Mumbai-MAHARASHTRA INDIA Phone-022-25491409,9892230623 FAX : Pincode : 400612 Email : sdbpl@vsnl.com
13	TEMPERATURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com	Works-1->Shikha Hazra/ Shyamal Hazra 32, Industrial Suburb,Yeshwanthpur -BANGALORE-KARNATAKA INDIA Phone- 080-23370300 FAX : 080-23379890 Pincode : 560022 Email : shikhahazra@hgurusouth.com
		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,	Works-1->Gauge Bourdon India Pvt. Ltd., Plot No-4, 5, 6,Jawahar Co-operative Industrial Estate, -Kalamboli Taluka Panvel-MAHARASHTRA India Phone- 022-27421095, FAX : 022-27421901, Pincode : 410209, Email : info@general-gauges.com
		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	Works-1->NA NA -- Phone- FAX : Pincode : Email :
		GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	FLAT -B , GF, HILL CROWN APTS., COLLEGE ROAD, MAPUSA Phone- Pincode : 403525 Email : gtilworks@pyro-electric.in	Works-1->Mrs Saanvi Naik BICHOLIM, -BICHOLIM-GOA INDIA Phone-9595855152 FAX : Pincode : 403 529 Email : saanvi.naik@thermostatic.in
		A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in	Works-1->Mr. Gautam Mukherjee Kusumba,Sonarpur Station Road,P.O. -Narendrapur, -Kolkata-WEST BENGAL INDIA Phone-9836878855 FAX : 033-24342748 Pincode : 700103 Email : gkm_ani@hotmail.com
		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	Works-1->MR G.SRINIVASAN/MR ANUJ MALPANI PLOT NO:A-19/2 & T-4/2,I.DA. NACHARAM , -HYDERABAD-TELANGANA INDIA Phone-09866550762 FAX : 040 27152193 Pincode : 560076 Email : gsbrinivasan@forbesmarshall.com
		GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone-09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,	Works-1->Mr. S.G. Dixit D2/5, Mapusa Industrial Estate, -Mapusa-GOA INDIA Phone- 09326054551 FAX : 0832-2262331 Pincode : 403 507 Email : sumukh@goainstruments.com
		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	Works-1->Mr. Hitesh Parmar/Mr. Hitesh Parmar Plot No.2306, Phase II, GIDC Chhatral, -Kalol-GUJARAT INDIA Phone- 9327359227 FAX : 02764-233440 Pincode : 382729 Email : hitesh.parmar@ashcroftindia.com

		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	Works-1->Mr. Shyam Warilani/Mr. V Suresh Babu Plot No 34 À GIDC À Phase 1, -VAPI-GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : pbajaj@baumer.com
14	TRANSMITTERS	YOKOGAWA INDIA LIMITED,	PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE, Phone- 080-41586000, Pincode : Email : uday.shankar@in.yokogawa.com,	Works-1-> PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, -BANGALORE-KARNATAKA INDIA Phone- 080-41586000, FAX : 080-28521442, Pincode : Email : uday.shankar@in.yokogawa.com
		ABB INDIA LIMITED	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com	
		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	Works-1->Mr. BHAGWAN SINGH/ Mr. NANDAN SINGH F-61, OKHLA INDL.AREA,PHASE-I -NEW DELHI-DELHI INDIA Phone- 011-47627200 Extn. 3 FAX : 011- 26819440 Pincode : 110 020 Email : production@vautomat.com
		Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com	
		TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,	Works-1-> Khasra No.: 218-230& 235, Industrial Estate,Makhupura, -Ajmer-RAJASTHAN India Phone- 9887865856, FAX : 0145-2695174, Pincode : 305002, Email : rajeev.gupta@tipl.com
		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,	Works-1-> M-171 to 173, MIDC, Waluj, -Aurangabad-MAHARASHTRA India Phone- 9881000474, FAX : 0240-2555179, Pincode : 431136, Email : Narendra.Kulkarni@wetzer.endress.com
		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	Works-1->MR. MOHAN PADWAL 691/A/2,BIBWEWADI INDL ESTATE -PUNE-MAHARASHTRA INDIA Phone- 918600042374 FAX : 912024215670 Pincode : 411037 Email : wm@sbem.co.in
		PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,	Works-1->Mr. Santosh Shukla Others R-628,TTC Industrial Area, MIDC Rabale, -Navi Mumbai-MAHARASHTRA India Phone- 9821350761, FAX : 022-27695559, Pincode : 400701, Email : sales@panamengineers.com
		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	
		SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com	Works-1->Ankit Varshney Kalwa Works, Thane-Belapur Road, Thane, -MUMBAI-MAHARASHTRA INDIA Phone- FAX : Pincode : 400708 Email :
		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	Works-1->Matt Moren/Gina Cruz 16650 Schoenborn St., North Hills -CALIFORNIA- USA Phone- +1 818 894 7111, ext FAX : +1 818 830 5588 Pincode : 91343 Email : gcruz@miinet.com
		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	Works-1->Kalpesh Chandan/Hrishikesh Aghor Plot No. A 145/4 TTC IND AREA,MIDC, PAWANE, -NAVI MUMBAI-MAHARASHTRA INDIA Phone- 9619688001 FAX : 022-66736000 Pincode : 400 705 Email : Kalpesh.chandan@emerson.com
		Honeywell Automation India Limited	Mr. Ritwij Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com	Works-1->Mr.Kedar Tillu 53, 54, 56 & 57,Hadapsar Industrial Estate -PUNE-MAHARASHTRA INDIA Phone- 9665034625 FAX : 020 66039905 Pincode : 411013 Email : kedar.tillu@honeywell.com
		NIVO CONTROLS PVT. LTD.	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com	Works-1->Mr. Praveen Toshniwal 104-115, Electronic Complex, -Indore-MADHYA PRADESH India Phone- 0731-4081305 FAX : 0731-255075 Pincode : 452010 Email : sales@nivocontrols.com
15	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	Works-1-> Others Plot No. 84, 85 & 86, Tiny Industrial Estate, Kondhwa Budruk -Pune-MAHARASHTRA INDIA Phone- 20-26932039 FAX : 20-26934122 Pincode : 411048 Email : ho@eeplindia.com
		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	Works-1-> Plot No 4,S.No.17/1-B Kothrud Industrial Estate -Pune-MAHARASHTRA india Phone- 020 25464551 FAX : Pincode : 411038 Email : info@adeptfluidyne.com
		FLEXIM Flexible Industriemesstechnik GmbH	Boxberger Str., 4, Berlin Berlin Phone- 0049 30 93 66 76 60 Pincode : 12681 Email : info@flexim.de	Works-1-> Others Boxberger Str. 4, -Berlin- GERMANY Phone- 0049 30 93 66 76 60 FAX : Pincode : 12681 Email : info@flexim.de
		Rockwin Flowmeter India Pvt. Ltd.	B-24, Site-IV, Sahibabad Industrial Area Ghaziabad, Phone- 9810129687 Pincode : 201010, Email : amiya@rockwin.com	Works-1->MR Rajiv PRAKASH B-24, Site-IV, Sahibabad Industrial Area, -Ghaziabad-UTTAR PRADESH India Phone- 9810129687 FAX : 01202895450 Pincode : 201010, Email : rajiv@rockwin.com
		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	Works-1-> Others M/s Endress & Hauser, Aurangabad, Maharastra -Aurangabad-MAHARASHTRA INDIA Phone- FAX : Pincode : Email : Works-2->+ Others M/s Endress & Hauser, Bhiwandi,Thane -Thane-MAHARASHTRA INDIA Phone- FAX : Pincode : Email :
		NIVUS GMBH	Mr. Marcus Fischer Im Taele 2, D - 75031 Eppingen Phone- 00491712233770 Pincode : Email : carolin.schuster@nivus.com	Works-1->Mr. Marcus Fischer CEO Im Taele 2, Eppingen, -Baden Wuerttemberg,-Foreign Country GERMANY Phone- 0049-726291910 FAX : Pincode : 75031 Email : carolin.schuster@nivus.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 1
FORMAT FOR PROVENNESS CERTIFICATE

Award/Contract Agreement/
Order enclosed

Sl.No.	Item Description	Plant No.1
5.00.00	**INSTRUMENTS (PRIMARY & SECONDARY)**	
(i)	Type of Instrument	
(ii)	Make / Model	
(iii)	Name of Power Station (Location & Address)	
(iv)	Unit Size (MW)	
(v)	Commissioning date	
	Whether above instruments have atleast one (1) year satisfactory operation in one (1) power station having unit rating of 200 MW or above.	Yes/No
(vi)	Client's certificate attached	Yes/No

Signature of authorized signatory.....

ANNUAL MAINTENANCE CONTRACT (AMC)

SERVICES FOR ANALYSER INSTRUMENTS DURING DEFECT LIABILITY PERIOD

1. The Bidder shall provide an unlimited warranty on all equipment's during the Defect liability period. This warranty shall include repair, replacement, replenishment of consumables (for e.g. reagents, calibration gases etc. as applicable) and correction of identified discrepancies including Analysers, Sample Handling System, Transmitters, (as applicable) etc. at no cost.

2. The Bidder shall provide warranty spares including components for each system based on (and keeping adequate over margin) normally experienced failure rate. Exhaustive list of all such items shall be submitted along with Datasheet for End customer's review and approval during details Engg stage regarding adequacy of the same. The warranty spares as per the list mentioned above will be dispatched by the bidder along with the main equipment consignment. However, for items which have a limited shelf life shall be dispatched in a phased manner during the warranty period. Unused spares/consumables shall be bidder's property after expiry of warranty period and shall be taken back.

SERVICES FOR ANALYSER INSTRUMENTS DURING ANNUAL MAINTENANCE CONTRACT (AMC) PERIOD

1. The Bidder shall provide complete maintenance services for each System under comprehensive Annual Maintenance Contract (AMC) for period of three years after the Warranty period.

2. The AMC shall cover total maintenance of all Analysers, Sample Handling System, Transmitters etc. coming under the scope of each system and shall include free repair/replacement of each items, replenishment of consumables, correction of problems (if any) and supply of expendable items.

3. Further, Bidder may note that during the AMC he will be allowed to use End customer's mandatory spares, but has to replenish the same within three months' time or before completion of AMC period whichever is earlier.

4. The Bidder shall prepare detailed list of faults corrected and parts, expendables utilized during AMC period and shall furnish the same to End customer, properly documented at the end of AMC period. Further, during AMC period the details as required by End customer/ Project Manager shall be made available by Contractor's personnel.

5. Bidder shall also provide a list of all required AMC spares which shall be finalized along with datasheet during detail Engineering stage. These spares will be dispatched by the Contractor at the beginning of AMC on yearly requirement basis. However, for items which have a limited shelf life shall

be dispatched in a phased manner during the AMC period. Unused spare/consumable shall be Contractor's property after expiry of AMC period and shall be taken back.

DEPUTATION OF TECHNICAL EXPERT FOR ANALYSER INSTRUMENTS

1. Bidder shall depute Technical Experts of the OAM/OEM/OES/ (Original Analyser Manufacturer/Original Equipment Manufacturer/Original Equipment supplier) for each of the above system at Site, who will be fully qualified to perform the required duties, supervision of maintenance, repair etc. for a period of six months. Employer will intimate the contractor two-week advance notice for start of deputation period.

2. After expiry of above six-month period, Technical expert for each system shall visit site on monthly basis for monitoring the performance and rectify the problem (if any) for each system for the remaining warranty period and during entire AMC period. In the event of any malfunction/fault/failure in the system or any component thereof contractor shall depute Technical expert of respective system to reach site within 48hrs of call raised by site during the remaining warranty period and entire AMC period.

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION	SPECIFICATION No: PE-TS-434-571-A102 SECTION : I Sub Section : D REV. 00 ANNEXURES

SECTION: I

SUB SECTION: D

ANNEXURES

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION SUB-VENDOR LIST	SPECIFICATION NO. PE-TS-434-571-A102	
		SECTION : I	
		SUB-SECTION : D	
		REV 00	Annexure-I
		SHEET 1 OF 1	

ANNEXURE-I

SUB-VENDOR LIST

1. REFER ELECTRICAL AND C&I SPECIFICATION FOR APPLICABLE SUB-VENDOR LIST FOR THE RELEVANT ELECTRICAL AND C&I ITEMS.

2. THE LIST OF ALL BOUGHT OUT ITEMS WITH MAKES AND PLACE OF ORIGIN AND CONTACT DETAILS OF THE MANUFACTURERS TO BE MENTIONED ALONG WITH OFFER TO BE SUBMITTED IN THE FORMAT ATTACHED AS ANNEXURE-VI OF SECTION-II, 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
MANDATORY SPARES LIST

Sl. No.	DESCRIPTION	Qty.
I.	**MECHANICAL**	
A	**Agitators (For Neutralisation tank)**	
1.	Impeller Assembly	1 no. of each type
2.	Bearing Assembly	2 no. of each type
3.	Motor	1 no. of each type
4.	Belt and Pulley (If applicable)	2 no. of each type
5.	Gear Box Assembly (If Applicable)	1 no. of each type
B	**Slurry Pumps**	
1.	Impeller Assembly	1 no. of each type
2.	Casing Liners	2 no. of each type
3.	Seals	4 set of each type
4.	Bearings	2 no. of each type
5.	Motor	1 no. of each type
6.	Motor-Pump Coupling	1 no. of each type
C	**For Integral Piping as defined in Specification**	
1.	Slurry Valves	2 no. of each type & size
2.	Slurry Line Bends	2 no. of each type & size
II.	**MEASURING INSTRUMENTS**	
i	**Electronic Transmitters**	
a.	Transmitters of all types, ranges and model no. (for the measurement of Pressure, differential pressure flow, level, etc.)	10% or 1 no. of each type and model, whichever is more
b.	Level Transmitters (Ultrasonic/ radar type)	50% of each type and length, including sensors
ii	**Temperature elements**	
a.	RTD's of each type and length (with head assembly, terminal block & nipple)	10% or 2 nos. of each type and length, whichever is more
b.	Thermocouples of each type like K-type, R-type, metal etc. (with head assembly, terminal block & nipple)	10% or 2 nos. of each type and length, whichever is more
c.	Thermowell for application like mill outlet temperature and SH/RH/Eco/ flue gas temp. in furnace	10% or 2 nos. of each type and length whichever is more
d.	Temperature transmitters	10% of each type & model
iii	Local Indicators like temperature gauges, pressure gauges, differential pressure gauges, flow gauges, flow meters etc.	5% or 1 no. of each make, model and type whichever is more (to be divided to various ranges in proportion to main of all make, model, type population)
iv	Process Actuated Switch Devices Includes all types of Pressure, differential pressure, flow, temperature, differential temperature, level switch Devices	5% or 1 no. of each type and model whichever is more

v	PD Type Flow Transmitters	1 no. of each type & model
vi	Any other instrument (If applicable)	10% or 1 no. of each type and model whichever is more
III.	**ELECTRICAL ACTUATORS**	
a.	Actuators	10% (or) 1 no. of each type, model & rating whichever is more

Note:

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.

ANNEXURE- III
INSPECTION AND TESTING

1.0 INSPECTION AND TESTS DURING MANUFACTURE

1.01. 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.

1.02 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.

1.03 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.

1.04 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 equipment. Type tests are also to be carried out on selected equipment as detailed in the specifications of the electrical equipment concerned.

1.05 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.

1.06 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.

1.07 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.

1.08 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 one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.

1.09 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.

1.10 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 but welding joints shall be radiographed unless otherwise stipulated.

Statutory payments in respect of IBR approvals including inspection shall be made by the bidder. Bidder's scope shall include to preparation of all necessary documents, co-ordination and follow-up for above approval. 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.

2.0 PERFORMANCE TESTS AT SITE

02.01 The full requirements for testing the 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.

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.

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.

All Statutory testing / clearance is in Bidder's scope including payment of all fees, etc. as required.

A)	**Minimum Test requirements**
	• Dimensional checks • Material test certificates • No load trial run of the equipment to be done at vendor works. • Performance test.
B)	**General Inspection requirements to be considered are as below:**

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION INSPECTION AND TESTING	SPECIFICATION No: PE-TS-434-571-A102 SECTION : I SUB-SECTION : D REV 00 ANNEXURE- III SHEET 3 OF 7

1.	Bidder shall furnish written copies of shop production, fabrication and quality test procedures and drawings to be used for review by NTPC prior to manufacture. Inspection of above mentioned tests by BHEL representative at bidder's works is envisaged.
2.	Items of Lime Feeding/Dosing system will be inspected at the Bidder's works before dispatch or where the test facilities are available.
3.	Acceptance tolerance shall be as per applicable standard.
4.	Items for Lime Feeding/Dosing system shall not be released for shipment, until tests/inspection have been approved by BHEL/NTPC.
5.	BHEL shall witness the test at Bidder's works and a notice of minimum three (3) weeks shall be given for attending the inspection.
6.	Bidder to arrange all calibrated gauges, Instruments during inspection.

3.0	SPECIFIC INSPECTION REQUIREMENT FOR COMPONENTS/EQUIPMENTS
1.	**Bucket Elevator / Screw Conveyor**
a.	Dimensional checks
b.	Material test certificates
c.	No load trial run of the equipment to be done at vendor works.
d.	Performance test.
2.	**Pumps :**
e.	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.
f.	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).
g.	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.
h.	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

i.	Vibration test and Noise level test shall be witnessed at shop. (as already stated above.)
j.	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.
k.	The Bidder shall conduct performance test for the remaining pump and submit the reports.

4. General Inspection Requirements to be considered are as below:

Sl.No.	Item	Inspection & Test Item	Remarks
1.	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
2.	Motors	Material certificate check	
		Non-Destructive Testing	
		Dimensional inspection	
		Balancing Test	Static & dynamic
		Function test	
3.	Vent Fan	Material certificate check	
		Dimensional inspection	
		Performance Test	
4.	Conveyor & Silo Extraction Device	Material certificate check	
		Dimensional inspection	
		Function Test	Short time no load test
5.	Rubber lining Pipe	Dimensional inspection	
		Visual Inspection	
		Spark Test	
6.	Flow Nozzles	Material certificate check	
		Dimensional Inspection	
7.	Control Panel	Insulation Resistance Test	
		Dielectric Strength Test	
		Function Test	

			Dimensional Inspection	
	8.	Control valves	Material certificate check	
			Hydrostatic test	
			Seat leak test	
			Function test	
			Dimensional Inspection	
	9.	RTD	Material certificate check	
			Performance test	
			Hydrostatic test	
	10.	Shut off valve	Material certificate check	
			Hydrostatic test	
			Seat Leak test	
			Function Test	
			Dimensional Inspection	
	11.	Flow meter	Material certificate check	
			Calibration Test	
			Dimensional Inspection	
			Hydrostatic test	
	12.	Butterfly Valve	Material Certificate check	
			Non-destructive testing	
			Hydrostatic test	
			Operation test	Motorized valve only
4.	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.			
5.	Pipes and fittings shall be tested as per relevant standards/ codes			
6.	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 detail engineering.			
7.	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			

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION INSPECTION AND TESTING	SPECIFICATION No: PE-TS-434-571-A102 SECTION : I SUB-SECTION : D REV 00 ANNEXURE- III SHEET 6 OF 7

8.	The Bidder shall furnish performance test procedure along with standard. The test procedure will be reviewed and approved by the BHEL / BHEL's Customer.
9.	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.
10.	Vibration levels shall be measured during shop running/performance tests.
11.	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.
12.	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.
13.	Test certificates shall be issued for each lot of raw material used in the coating, corresponding to specific weight and traction resistance.
14.	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.
15.	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.
16.	Equipment shall not be released for shipment, until shop tests data and performance tests curves have been approved by Owner.
17.	Bidder should furnish performance guarantee as per applicable standard guarantee for the design, manufacture, material and safe operation of the equipment's.
18.	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.
19.	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.
20.	Mechanical running test shall be carried out for Bucket Elevator & Lime Slurry Pump. Bidder to arrange Motor for the shop test and inspection.
21.	Bidder/supplier to note that no order is to be placed on any foreign vendor (i.e. supplies from outside India), and all supplies for lime dosing/feeding system shall be indigenous (so as to aid in promotion of Make in India initiative). For all supplies related to the Lime Feeding/Dosing System, 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 our review and acceptance.

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION INSPECTION AND TESTING	SPECIFICATION No: PE-TS-434-571-A102 SECTION : I SUB-SECTION : D REV 00 ANNEXURE- III SHEET 7 OF 7

QAP FORMAT

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	AGENCY W	AGENCY 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

The Quality Plan shall be finalized during the detailed engineering.

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION INPUT DRAWING LIST	SPECIFICATION No: PE-TS-434-571-A102 SECTION : I SUB-SECTION : D REV 00 | ANNEXURE-IV SHEET 1 OF 1

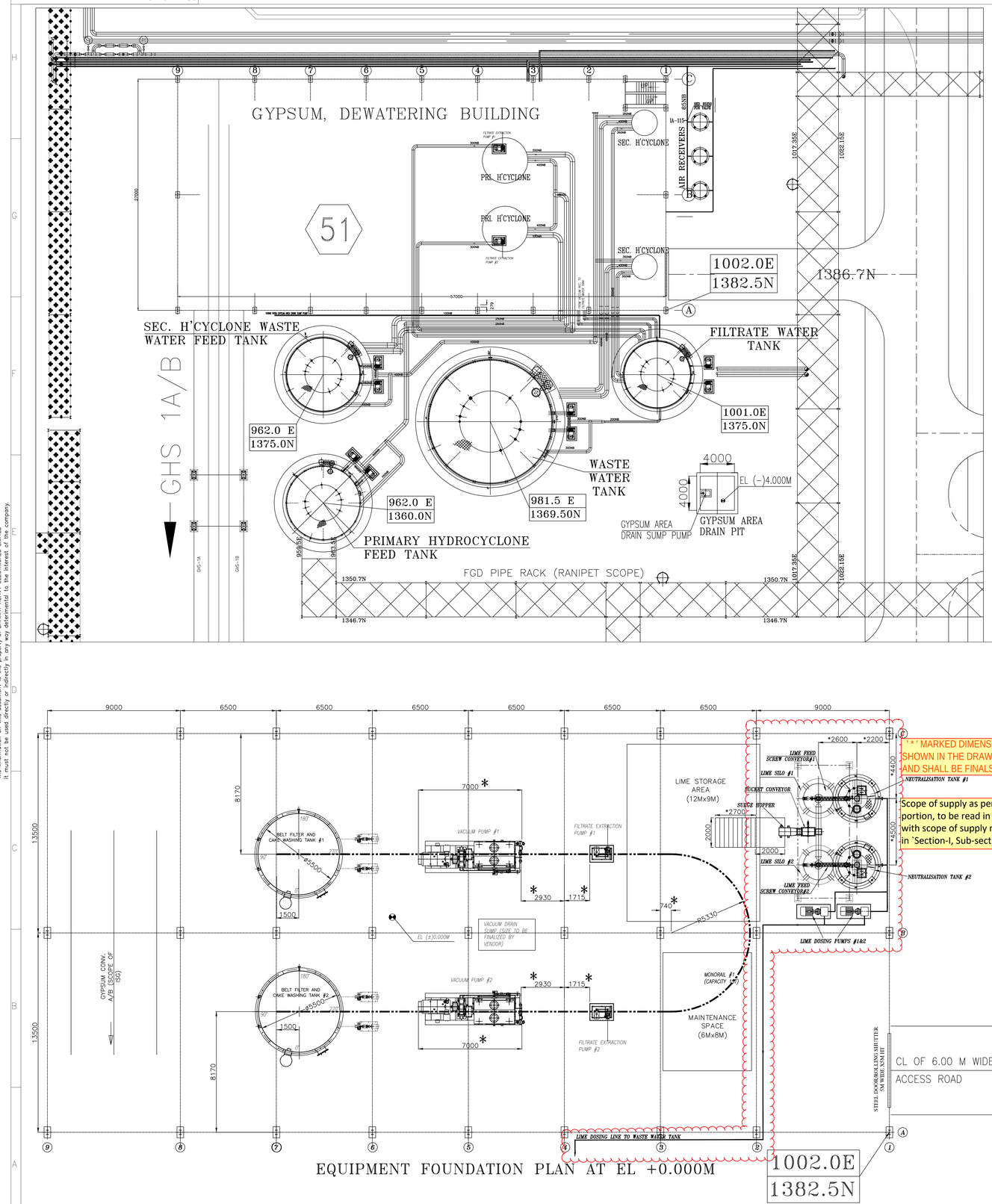
ANNEXURE-IV

INPUT DRAWINGS BY BHEL

Sl. No.	Drawing Title	PVUNL/NTPC Drawing No.
1.	Layout Details of Gypsum Dewatering building (2-Sheets)	9585-001-109-PVM-B-046
2.	P&ID – Waste Water System (Covering Lime Feeding /Dosing system) (2-Sheets)	9585-001-109-PVM-F-014
3.	P&ID - Legends & Notes (2-Sheets)	9585-001-109-PVM-F-025

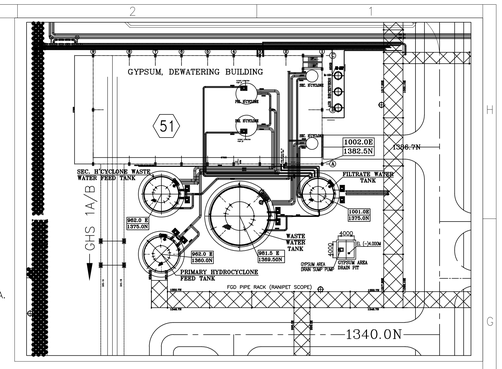
FIRST ANGLE PROJECTION | ALL DIMENSIONS ARE IN MM

DRAWING NO. 0-FW-000-01089



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS AND ELEVATIONS IN METERS, UNLESS OTHERWISE SPECIFIED.
2. EL (±)0.00M IS FFL OF POWER HOUSE BUILDING WHICH CORRESPONDS TO RL (+)375.50M
3. THIS DRAWING IS TENTATIVE CONSIDERING NOT-TO-EXCEED LOADS. BUILDING CIVIL DRAWING SHALL BE PREPARED ACCORDINGLY.
4. FLOOR OPENINGS, PIPE CROSSINGS SHALL BE FINALIZED DURING DETAILED ENGINEERING.
5. FLOOR ELEVATIONS INDICATED TO BE USED FOR CIVIL DESIGN. EQUIPMENT FINALIZATION AS PER GDS/LDS VENDOR DATA AFTER ORDER PLACEMENT.
6. DETAILS OF STAIRCASE, SUITABLE DOORS, WINDOWS, VENTILATORS SHALL BE PROVIDED IN DRAWINGS AT SL. 12, 13 & 14 OF REFERENCE DRAWING TABLE.
7. REFER NTPC DRG. NO 9585-001-155-PVM-B-034 FOR LOAD DATA OF GYPSUM BELT CONVEYOR.
8. DIMENSIONS MARKED AS * ARE TENTATIVE ONLY AND WILL BE CONFIRMED AS PER GDS/LDS VENDOR DATA.
9. IF REQUIRED, A SUITABLE CUTOUT WILL BE PROVIDED AT THE FLOOR (EL 14.00M) TO ACCOMMODATE BUCKET ELEVATOR OF LIME DOSING SYSTEM.



KEY PLAN

LIST OF EQUIPMENTS

EQPT NO	NOS	DISCRIPTIONS	APPX WEIGHT OF EACH EQPT UNDER OPRATION	LOCATION	REMARKS.
1	02	VACUUM BELT FILTER	140 MT	ON FIRST FLOOR EL(+)14.00	THE EQUIPMENT COLUMNS WILL BE SUPPORTED ON THE FLOOR
2	02	SECONDARY HYDRO CYCLONE – (SET)	20 MT (INCLUDING SUPPORTING PLATFORMS)	ON SECOND FLOOR EL(+)24.30	THE EQUIPMENT HAS 4 COLUMNS WHICH WILL BE SUPPORTED ON THE FLOOR
3	02	NEUTRALISATION (LIME DOSING) TANK WITH AGITATOR	7.5 MT	GROUND FLOOR @ EL(+)0.00	SEPARATE FOUNDATION OR FLOOR MOUNTED AS PER CIVIL DESIGN
4	02	LIME FEED SCREW CONVEYER	2.5 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	15 MT (COMBINED WEIGHT INCLUDING SUPPORTS)	ABOVE NEUTRALISATION (LIME DOSING) TANK	LIME SILO WILL BE SUPPORTED ON PLATFORM ON SUPPORTING STRUCTURE FROM GROUND FLOOR.
6	02	PRIMARY HYDROCYCLONE	15MT (INCLUDING SUPPORTING PLATFORMS)	ON SECOND FLOOR EL(+)24.30	PRIMARY HYDRO CYCLONE WILL BE SUITABLY SUPPORTED ON FLOOR
7	02	VACUUM PUMP & MOTOR	30 MT	GROUND FLOOR @ EL(+)0.00	FOUNDATION TO BE PROVIDED AS PER CIVIL DESIGN
8	02	VACUUM RECEIVER	15 MT	FIRST FLOOR @ EL(+)14.00	FLOOR MOUNTED
9	02	BELT FILTER(CLOTH) / CAKE WASH TANK WITH PUMPS & MOTORS	1 MT	GROUND FLOOR @ EL(+)0.00	SEPARATE FOUNDATION OR FLOOR MOUNTED AS PER CIVIL DESIGN
10	01	BUCKET CONVEYOR ASSY. (WITH DIVERTER FLAP GATE, SURGE HOPPER & VIBRATING FEEDER) FOR LIME FEED	20.5 MT	GROUND FLOOR @ EL(+)0.00	THE BUCKET CONVEYOR IS MOUNTED ON GROUND FLOOR AND WILL REACH TO LIME SILO TOP THROUGH SUPPORT STRUCTURE.
11	02	BAG FILTER WITH FAN	1 MT	FIRST FLOOR @ EL(+)14.00	FLOOR MOUNTED
12	02	LIME DOSING PUMPS	0.3 MT	GROUND FLOOR @ EL(+)0.00	FOUNDATION TO BE PROVIDED AS PER CIVIL DESIGN
13	01	PRIMARY HYDROCYCLONE FEED TANK & PUMPS WITH MOTORS	AS PER REFERENCE DRG	OUTSIDE GDW BUILDING	SEPARATE FOUNDATION OR FLOOR MOUNTED AS PER CIVIL DESIGN
14	02	SECONDARY HYDROCYCLONE FEED TANK & PUMPS WITH MOTORS	AS PER REFERENCE DRG	OUTSIDE GDW BUILDING	FOUNDATION TO BE PROVIDED AS PER CIVIL DESIGN
15	01	FILTRATE WATER TANK & PUMPS WITH MOTORS	AS PER REFERENCE DRG	OUTSIDE GDW BUILDING	SEPARATE FOUNDATION OR FLOOR MOUNTED AS PER CIVIL DESIGN
16	02	WASTE WATER STORAGE TANK & PUMPS WITH MOTORS	AS PER REFERENCE DRG	OUTSIDE GDW BUILDING	FOUNDATION TO BE PROVIDED AS PER CIVIL DESIGN
17	02	FILTRATE EXTRACTION PUMPS & MOTORS	3 MT	GROUND FLOOR @ EL(+)0.00	FOUNDATION TO BE PROVIDED AS PER CIVIL DESIGN
18	02	PLATFORM FOR VACUUM BELT FILTERS	25 MT	AS SHOWN	FOUNDATION TO BE PROVIDED AS PER CIVIL DESIGN
19	02	DISCHARGE CHUTE	– MT	VBF DISCHARGE @14.0M	FOUNDATION TO BE PROVIDED AS PER CIVIL DESIGN

EQUIPMENT FOUNDATION PLAN AT EL +0.000M

* * MARKED DIMENSIONS OF LIME FEEDING/DOSING SYSTEM SHOWN IN THE DRAWING ARE FOR GUIDANCE PURPOSE ONLY AND SHALL BE FINALSED DURING DETAIL ENGG. BY VENDOR.

Scope of supply as per clouded portion, to be read in conjunction with scope of supply mentioned in 'Section-I, Sub-section-C1'

LIST OF REFERENCE DRAWINGS

SL. NO	DRAWING NO.	DRAWING TITLE	AGENCY
1	9585-001-109-PVM-F-001	PLANT LAYOUT OF FGD SYSTEM	PEM/BAP
2	9585-001-109-PVM-Y-037	GENERAL ARRANGEMENT & DATA SHEET OF LIME DOSING SYSTEM INCLUDING SCHEME	PEM/VENDOR
3	9585-001-109-PVM-B-022	DATA SHEET & GENERAL ARRANGEMENT OF VACUUM BELT FILTER	PEM/VENDOR
4	9585-001-109-PVM-B-020	GA & DATA SHEET OF PRIMARY & SECONDARY DEWATERING HYDROCYCLONES	PEM/VENDOR
5	9585-001-155-PVM-L-003	FLOW DIAGRAM OF GYPSUM HANDLING SYSTEM	ISG
6	9585-001-155-PVM-B-034	GA OF CONVEYOR GBC 1A/1B	ISG/VENDOR
7	9585-001-155-PVM-B-019	GA DRAWING OF PRIMARY HYDRO CYCLONE FEED TANK	PEM/VENDOR
8	9585-001-155-PVM-B-023	GA DRAWING OF FILTRATE WATER TANK	PEM/VENDOR
9	9585-001-109-PVM-B-016	GA DRAWING OF SECONDARY HYDRO CYCLONE FEED TANK	PEM/VENDOR
10	9585-001-109-PVM-B-027	GA DRAWING OF WASTE WATER TANK	PEM/VENDOR
11	9585-001-109-PVM-B-023A (SHEET 3&4 OF 4)	GA DRAWING OF CAKE/BELT FILTER WASH TANKS	PEM/VENDOR
12	9585-001-315-PVC-C-1602	GYPSUM DEWATERING BLDG.– ARCHITECTURAL PLANS & FINISHING SCHEDULE	PEM
13	9585-001-315-PVC-C-1603	GYPSUM DEWATERING BLDG.– ARCHITECTURAL ELEVATIONS	PEM
14	9585-001-315-PVC-C-1604	GYPSUM DEWATERING BLDG.– ARCHITECTURAL SECTIONS	PEM

REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD

JOB NO. 434
STATUS CONTRACT
DISTRIBUTION
TO
No. OF

NTPC DRG No.: 9585-001-109-PVM-B-046

PROJECT: 3x800MW PATRATU SUPER THERMAL POWER PROJECT PHASE-I

OWNER: NTPC LIMITED

MAIN CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DRN	YK	-SD-	20.06.2021
	DES'N	RR	-SD-	20.06.2021
	CHD	SG	-SD-	20.06.2021
	APP'D	SKB	-SD-	20.06.2021

TITLE: LAYOUT DETAILS OF GYPSUM DEWATERING BUILDING

DEPT. | SCALE | SIGN | DATE

BAP DRAWING NO. 0-FW-000-01089

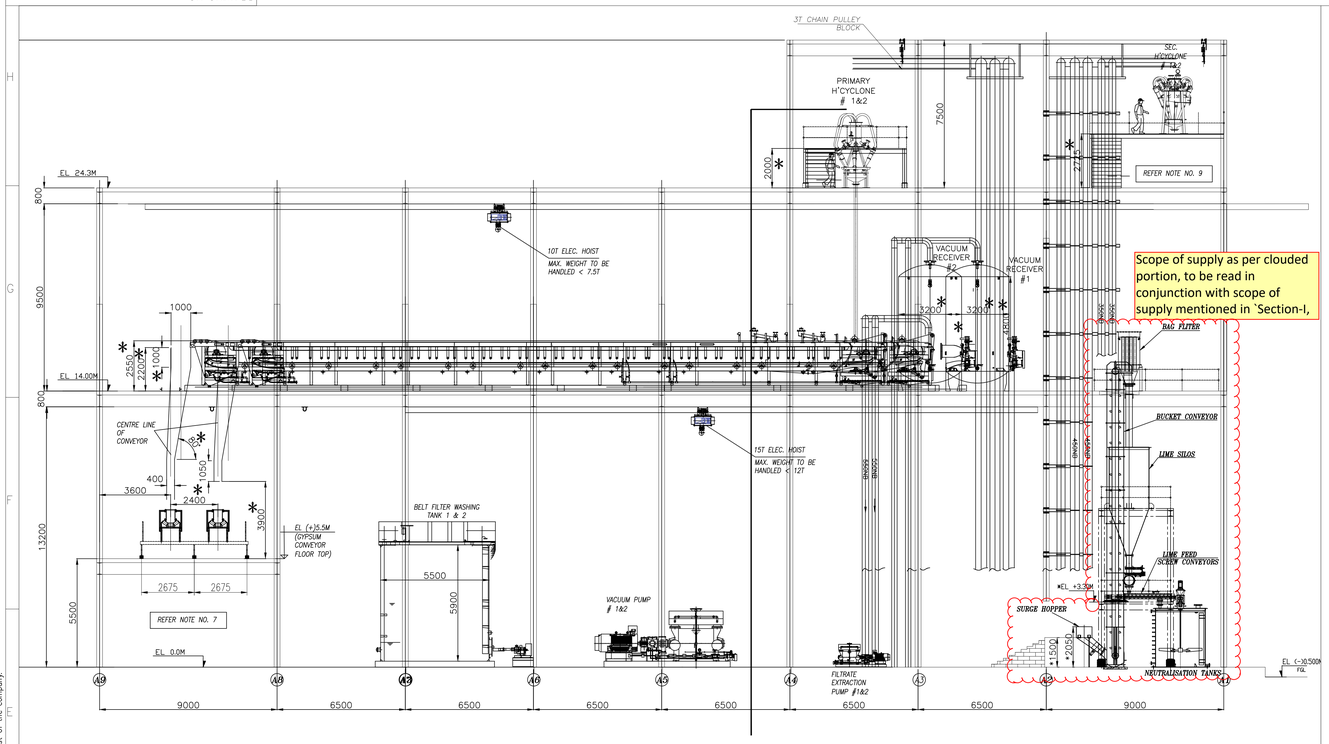
SHEET 01 OF 02 | REV. 04A

FORMAT SIZE A0

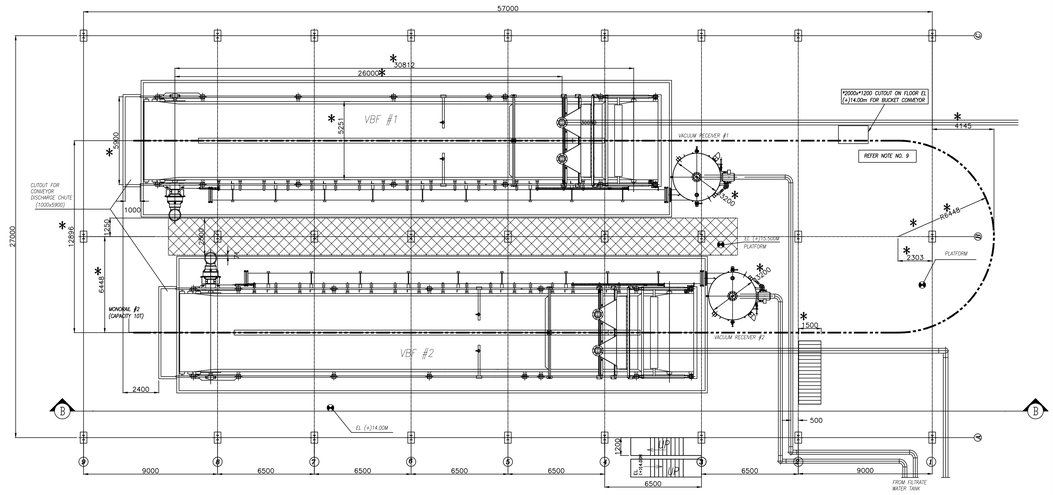
CAD FILE NAME: D:\Max Official\Projects\3X800MW Patratu (434) FGD\Patratu LDS new Indent\GDW patratu final_for LDS Tender (Without Pit).dwg
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it must not be used directly or indirectly in any way detrimental to the interest of the company.

FIRST ANGLE PROJECTION | ALL DIMENSIONS ARE IN MM

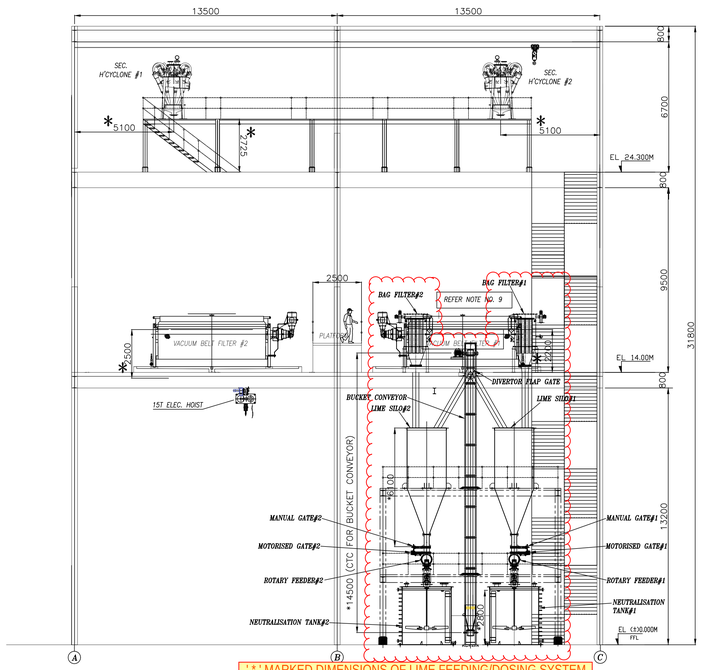
DRAWING NO. 0-FW-000-01089



SECTION – BB (TYPICAL)

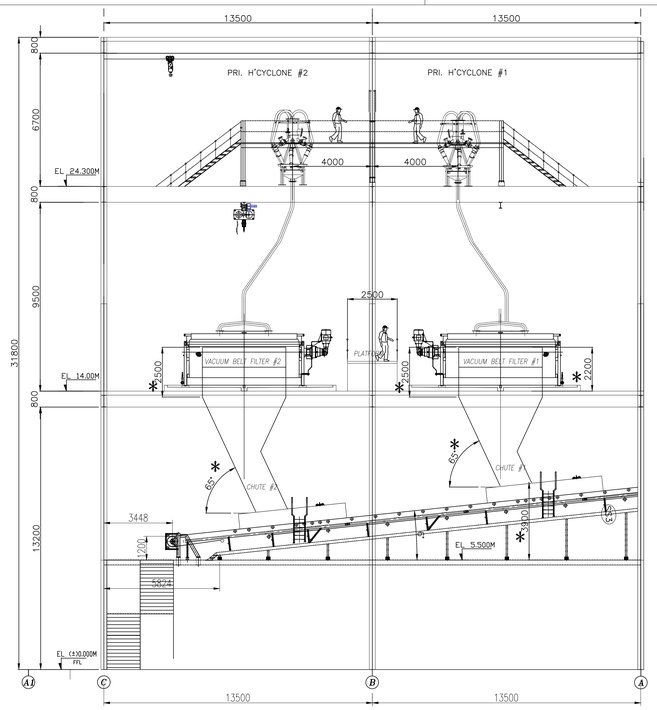


EQUIPMENT FOUNDATION PLAN AT EL (+)14.00M

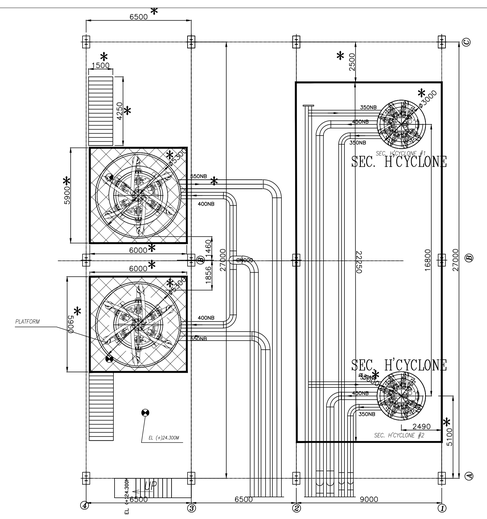


' * ' MARKED DIMENSIONS OF LIME FEEDING/DOSING SYSTEM SHOWN IN THE DRAWING ARE FOR GUIDANCE PURPOSE ONLY AND SHALL BE FINALSED DURING DETAIL ENGG. BY VENDOR.

SEC. H'CYCLONE TYPICAL VIEW



PRI. H'CYCLONE TYPICAL VIEW



EQUIPMENT FOUNDATION PLAN AT EL (+)24.300M

REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD

JOB NO. 434
STATUS CONTRACT
DISTRIBUTION
TO
No. OF

NTPC DRG No.: 9585-001-109-PVM-B-046

PROJECT: 3x800MW PATRATU SUPER THERMAL POWER PROJECT PHASE-I

OWNER: NTPC LIMITED

MAIN CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DRN	YK	-SD-	20.06.2021
	DESN	RR	-SD-	20.06.2021
	CHD	SG	-SD-	20.06.2021
	APPD	SKB	-SD-	20.06.2021

TITLE: LAYOUT DETAILS OF GYPSUM DEWATERING BUILDING

DEPT. | SCALE | SIGN | DATE

BAP DRAWING NO. 0-FW-000-01089

SHEET 02 OF 02 | REV. 04A

FORMAT SIZE A0

CAD FILE NAME: D:\Max Official\Projects\3X800MW Patratu (434) FGD\Patratu LDS new Indent\GDW patratu final_for LDS Tender (Without Pit).dwg
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THIRD ANGLE | No. REQ'D | A3 | DRAWING No.

LIME STORAGE SILO BAG FILTER A
00 HTS 00 AT 001

LIME STORAGE SILO BAG FILTER B
00 HTS 00 AT 002

00-25-AI-8207-BA01
INSTRUMENT AIR
B270-10231

00-100-LD-6003-CA01
00-100-LD-6001-CA01
00-100-LD-6002-CA01
00-100-LD-6013-CA01
00-100-LD-6011-CA01
00-100-LD-6012-CA01
00-100-LD-6004-CA01
00-100-LD-6014-CA01

PDS
LIA
LT
LS
M
H
x2
00HTS01CL021
00HTS01CL022
00HTS02CL021
00HTS02CL022

2-way Motorised
Diverter Flap Gate

00 HTS 00 AF 001
BUCKET ELEVATOR A
WITH TWIN FEEDER ARRANGEMENT

LIME SUPPLY

00 HTS 00 BB 001
LIME STORAGE SILO A

00 HTS 00 BB 002
LIME STORAGE SILO B

M.H.

00 HTS 01 AN 001
AIR BLOWER A

00 HTS 00 AN 002
AIR BLOWER B

SHUT-OFF GATE A (MANUAL)
00 HTS 00 AA 001

SHUT-OFF GATE B (MANUAL)
00 HTS 00 AA 002

LIME SILO SHUT-OFF GATE A
00 HTS 00 AA 003

00 HTS 00 AA 004 LIME SILO SHUT-OFF GATE B

OPEN/CLOSE
B240-00448
3130-109-PVM-F-046 2 of 2
NEUTRALIZATION TANK A LEVEL

OPEN/CLOSE
B240-00448
3130-109-PVM-F-046 2 of 2
NEUTRALIZATION TANK B LEVEL

00 HTS 00 AF 003
LIME SILO ROTARY FEEDER A

00 HTS 00 AF 004
LIME SILO ROTARY FEEDER B

03
04

B240-00448
3130-109-PVM-F-046 2 of 2
TO NEUTRALIZATION TANK A

B240-00448
3130-109-PVM-F-046 2 of 2
TO NEUTRALIZATION TANK B

Scope of supply as per clouded portion, to be read in conjunction with scope of supply mentioned in `Section-I, Sub-section-C1'.

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CUSTOMER NOS : R4R3, R4S3 & R4S4
CUSTOMER: PATRATU VIDYUT UTPADAN NIGAM LIMITED
PROJECT:PATRATU STPS EXP PHASE-I (3X800MW)
FGD SYSTEM PACKAGE

BHARAT HEAVY ELECTRICALS LIMITED,
UNIT: BOILER AUXILIARIES PLANT,
RANIPET:632 406.

DEPT CODE		NAME (BHEL)	DATE
M	DRN	RAJU.P	27.04.20
	CHD	P.N.REDDY	27.04.20
	APPD	ACR/RSB	27.04.20

MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

TITLE: P & ID-LIME SILO HANDLING SYSTEM-A

SCALE : NTS

NTPC DRAWING NO.9585-001-109-PVM-F-014 SHT. 01 OF 02

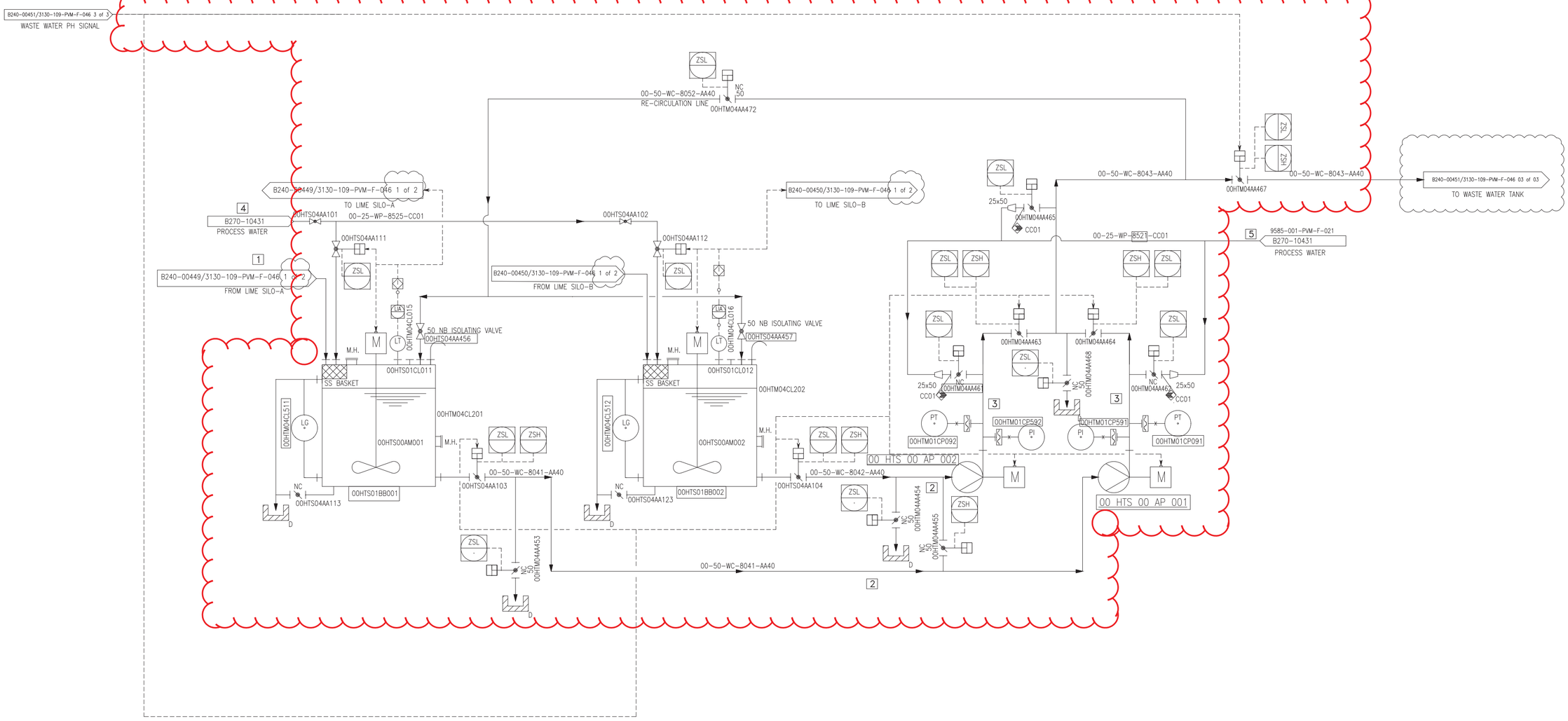
BHEL DRG NO	FILE NO	REV NO
3-W-000-00561	B240-00450	04

D/Y.T 20070315 (-)

THIRD ANGLE PROJECTION	No. REQ'D	A3

DRAWING No.

Scope of supply as per clouded portion, to be read in conjunction with scope of supply mentioned in `Section-I, Sub-section-C1'.



00 HTS 01 BB 001/002
LIME DOSING TANK

00 HTS 00 AM 001/002
LIME DOSING TANK AGITATOR

00 HTS 00 AP 001/002
LIME PUMP A/B

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CUSTOMER NOS : R4R3, R4S3 & R4S4
CUSTOMER: PATRATU VIDYUT UTPADAN NIGAM LIMITED
PROJECT:PATRATU STPS EXP PHASE-I (3X800MW)
FGD SYSTEM PACKAGE

BHARAT HEAVY ELECTRICALS LIMITED. UNIT: BOILER AUXILIARIES PLANT, RANIPET:632 406.	DEPT CODE		NAME (BHEL)	DATE
	M	DRN	RAJU.P	27.04.20
		CHD	P.N.REDDY	27.04.20
		APPD	ACR/RSB	27.04.20

MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

TITLE: P & ID-NEUTRALISATION SYSTEM

SCALE : NTS

NTPC DRAWING NO.9585-001-109-PVM-F-014 SHT. 02 OF 02

BHEL DRG NO	FILE NO	REV NO
3-W-000-00561	**B240-00451**	04

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

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
	MANHOLE
	PITOT TUBE
	SAMPLING POT
	SAMPLING NOZZLE

SYMBOLS FOR VALVE OPERATION

SYMBOLS	NAME
	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

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	IIR RUBBER LINED PIPING	LS, WP, WC
AA60	IIR RUBBER LINED PIPING	GS,FS,WW,DD
BA01	Gr.304 STAINLESS STEEL PIPING	AI, LOL
BA02	Gr.304 STAINLESS STEEL 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

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

CONFIDENTIAL & PROPRIETARY INFORMATION

CUSTOMER NOS: R4R3, R4S3 & R4S4

CUSTOMER:PATRATU VIDYUT UTPADAN NIGAM LIMITED

PROJECT: PATRATU STPS EXP PHASE-I (3X800 MW) FGD SYSTEM PACKAGE

BHARAT HEAVY ELECTRICALS LIMITED, UNIT: BOILER AUXILIARIES PLANT, RANIPET:632 406.

DEPT CODE	NAME (BHEL)	DATE
M	DRN R YUVARAJ	29.04.19
	CHD P NAVEEN	29.04.19
	APPD V KESAVAN	29.04.19

MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

TITLE: P & ID - LEGENDS & NOTES (1/2)

SCALE : NTS

NTPC DRG NO. 9585-001-109-PVM-F-025

SH 01 of 02

BHEL DRG NO 3-FW-000-00567

FILE NO B240 - 00001

REV NO 00

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THIRD ANGLE PROJECTION | No. REQ'D | A3 | DRAWING No.

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
I	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

CONFIDENTIAL & PROPRIETARY INFORMATION

CUSTOMER NOS: R4R3, R4S3 & R4S4

CUSTOMER:PATRATU VIDYUT UTPADAN NIGAM LIMITED

PROJECT: PATRATU STPS EXP PHASE–I (3X800 MW) FGD SYSTEM PACKAGE

BHARAT HEAVY ELECTRICALS LIMITED, UNIT: BOILER AUXILIARIES PLANT, RANIPET:632 406.

DEPT CODE	NAME (BHEL)	DATE
M	DRN R YUVARAJ	29.04.19
	CHD P NAVEEN	29.04.19
	APPD V KESAVAN	29.04.19

MITSUBISHI HITACHI POWER SYSTEMS, LTD.
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

TITLE: P & ID – LEGENDS & NOTES (2/2) | SCALE : NTS

NTPC DRG NO. 9585–001–109–PVM–F–025 | SH 02 of 02

BHEL DRG NO 3–FW–000–00567 | FILE NO B240 – 00002 | REV NO 00

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	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION	SPECIFICATION No: PE-TS-434-571-A102
		SECTION : I
		SUB-SECTION : D
		REV 00 / ANNEXURE-V
		SHEET 1 OF 5

ANNEXURE-V
MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION

1. DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER/AWARD OF CONTRACT:

The Bidder shall submit all documents, drawings, diagrams and all such information, which are necessary to fully understand the offer for techno – commercial evaluation as per Annexure-V. The above documents are required for proper evaluation purpose and vendors are requested to comply with above in all respect.

S.No	Description	Along with offer	After Award of Contract
1	Compliance of Specification	Yes	--
2	Deviation List	Yes	--
3	Data Sheet & General Assembly Drawing of complete Lime feeding System	Yes	Yes
4	Manufacturing Drawing & Part Drawing	--	Yes
5	Data sheet & Performance curve	--	Yes
6	Sub Vendor List	Yes	Yes
7	Test certificates	--	Yes
8	Erection check list	--	Yes
9	Pre-commissioning check list	--	Yes
10	Scope of supply	Yes	--
11	Quality plan	--	Yes
12	Operation & Maintenance manual	--	Yes
13	Spare list (Recommended)	Yes	Yes
14	Startup & Commissioning spare	Yes	Yes
15	List of special tools	Yes	Yes
16	Delivery Schedule	Yes	Yes
17	Test & Inspection Procedure	--	Yes
18	Catalogue	Yes	--

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION	SPECIFICATION No: PE-TS-434-571-A102	
		SECTION : I	
		SUB-SECTION : D	
		REV 00	ANNEXURE-V
		SHEET 2 OF 5	

2. DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT:

The Successful bidder shall submit necessary data, documents and drawings for review, approval with requirements specified here under.

Drawings that are reviewed by the NTPC / NTPC's Consultant will be returned to bidder with a transmittal letter with any comments and / or questions marked on the drawings or noted in the letter. All comments and questions must be resolved before a resubmission of drawings / documents. If the design has not developed enough to resolve some of the comments or questions, bidder shall place a "hold" on those items or areas of design. NTPC / NTPC's Consultant reserves the right to return drawings unprocessed to bidder if there exists any evidence that bidder has not acknowledged all comments and questions.

All necessary GA drawings, sections, sub-assembly drawings, specifications of main and sub components and necessary set of operation & maintenance manual as asked by NTPC must be furnished by bidder in soft and hard copy forms. For all document's softcopy format shall be searchable pdf, however in addition all drawings, diagrams like P&IDS shall be supplied in ACAD or other editable format and all lists in Excel format. Further break up of technical documents will be discussed during finalization of the purchase contract.

Unless agreed otherwise, Ten (10) hard copies and five (05) sets of electronic copies of all documents are to be submitted in the English language. Electronic Copies shall be submitted in primary original data format (e.g. DOC, XLS, DWG) as well as in a printable non-proprietary document format (e.g. PDF). Especially P&IDs shall be submitted as DWG files and PDF files. Bidder to ensure submission of hard copies as per NTPC's requirement for all engineering drg/doc and for all subsequent revisions along with a soft copy through email to concerned project team. However, all the engineering related information shall be furnished in soft form 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 latest edition. 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 / item indicating at least 3 trade names.

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/ 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:

k) 1st submission of drawings from date of LOI as per the submission schedule.

l) Every revised submission incorporating comments – within 7 days.

m) 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.

Sl.No.	Document required after award of contract	No. of hard copies after award of contract	Submission time*
1. #	Sub-Vendor list and Categorization of Lime Feeding/ Dosing System (LDS)	6	3
2. #	Equipment GA of Lime Feeding/ Dosing System (LDS)	6	3
3. #	Equipment Tech. Datasheet of Lime Feeding/ Dosing System (LDS)	6	3
4. #	Layout of Lime Feeding/ Dosing System (LDS)	6	3
5.	O&M of Lime Feeding/ Dosing System (LDS)	6	12

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION	SPECIFICATION No: PE-TS-434-571-A102 SECTION : I SUB-SECTION : D REV 00 ANNEXURE-V SHEET 4 OF 5

6.	Instrument Schedule & Valve Schedule	6	8
7.	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM WITH SET POINTS for LDS	6	8
8.	Electrical Load List	6	8
9.	Drawing for complete Piping Arrangement including Supports (Water, Slurry, Instrument Air) for LDS	6	10
10.	Hook-up Drawing for Instruments of LDS	6	10
11.	I/O List (Drives & Instruments) of LDS	6	10
12.	Painting Specification for LDS	6	6
13.	Cable Schedule & Cable Duct/Tray Routing Plan of LDS	6	8
14.	GA & Data Sheet of Motors for LDS	6	10
15.	GA & Data Sheet of Instruments of LDS	6	10
16.	GA & Data Sheet of Valves of LDS	6	10
17.	BOQ/BOM of LDS for Main Supply & Mandatory Spares	6	12
18.	Erection & Commissioning Manual of LDS	6	12
19.	Performance Test Procedure of LDS	6	12

Indicates Primary drawings.
***Within No. of Weeks after the placement of LOI/PO**

R-0 within 21 days from PO & subsequent revisions within 7 days of comments received from 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 latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION	SPECIFICATION No: PE-TS-434-571-A102	
		SECTION : I	
		SUB-SECTION : D	
		REV 00	ANNEXURE-V
		SHEET 5 OF 5	

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.:

   n) All drawings and documents shall indicate the list of all reference drawings including General Arrangement.

   o) 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.

   p) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / item indicating at least 3 trade names.

   q) 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.

   r) 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.

   s) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.

   t) 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.

   u) 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.

   v) 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.

   w) Bidder to follow the following the drawing submission schedule:

      (i) 1st submission of drawings from date of LOI as per the submission schedule.

      (ii) Every revised submission incorporating comments – within 7 days.

   (iii) 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.

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION PACKING PROCEDURE	SPECIFICATION No: PE-TS-434-571-A102	
		SECTION : I	
		SUB-SECTION : D	
		REV 00	ANNEXURE-VI
		SHEET 1 OF 2	

ANNEXURE-VI
PACKING PROCEDURE

1.0	PACKING AND FORWARDING
1.	Lime Dosing/Feeding System & sub system assembly shall be wrapped in polythene bags & packed in a strong rigid wooden crate. Rain water should not enter into the equipment packings during storage in the outer yard of power plant. Proper packing to be ensured.
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 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 (PVUNL).
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

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION	SPECIFICATION No: PE-TS-434-571-A102
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	PACKING PROCEDURE	SHEET 2 OF 2

	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 cases 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 handling)
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-434-571-A102
SECTION : I
SUB-SECTION : D
REV 00
Annexure VII - Pipe & Valve Material Specification (6 Pages)

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

   - 60 — Suffix Number
   - A — Second Pipe Material Symbol
   - A — First Pipe Material Symbol

   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

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION LIST OF DOCUMENTS TO BE SUBMITTED WITH BID	SPECIFICATION No: PE-TS-434-571-A102 SECTION : II ANNEXURE : 1 REV: 00 SHEET 1 OF 1

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:

Sr. 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	A) LIST OF COMMISSIONING SPARES B) LIST OF RECOMMENDED SPARES
9.	*	UNPRICED SCHEDULE IN THE PRICE FORMAT ISSUED ALONG WITH TENDER

***Bidder is required to submit signed & stamped copy all above annexures/documents along with bid.**

829742/2022/PS-PEM-MAX

ANNEXURE – 2

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.

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.

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal

829742/2022/PS-PEM-MAX

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

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION DEVIATION SCHEDULE	SPECIFICATION No: PE-TS-434-571-A102 SECTION : II ANNEXURE : 4 REV: 00 SHEET 1 OF 1

ANNEXURE - 4

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)

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION SCHEDULE OF GUARANTEES	SPECIFICATION No: PE-TS-434-571-A102 SECTION : II ANNEXURE : 5 REV: 00 SHEET 1 OF 1

ANNEXURE – 5

SCHEDULE OF GUARANTEES

1.0 PERFORMANCE GUARANTEE	
	1) All performance tests for LDS shall be carried out in accordance with the relevant latest international codes/standards. 2) Bidder shall furnish Performance guarantee for the design, manufacture, material, safe and trouble-free operation of the LDS and its accessories. 3) Vendor shall Guarantee and demonstrate Bucket Elevator design capacity (1.5 TPH). Further satisfactory operation of the downstream system of bucket elevator shall also be demonstrated by bidder in line with design capacities mentioned in the technical specifications. 4) Noise level ≤85 dB (A) at 1 m horizontal distance from equipment/enclosures & 1.5m above operating floor is to be guaranteed. 5) 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. Arrangement of calibrated equipment for measurement of vibration & noise levels shall be supplier’s responsibility. 6) Acceptance tests to be carried out as per the procedure defined by the bidder which shall be submitted for BHEL/ PVUNL approval. 7) 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.

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION SUB-VENDOR LIST	SPECIFICATION NO. PE-TS-434-571-A102 SECTION : II ANNEXURE : 6 REV 00 SHEET 1 OF 1

ANNEXURE – 6

LIST OF MAKES OF ITEMS

Sr. No.	ITEM NAME	MANUFACTURER	LOCATION

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION LIST OF SPECIAL TOOLS & TACKLES	SPECIFICATION No: PE-TS-434-571-A102 SECTION : II ANNEXURE : 7 REV 00 SHEET 1 OF 1

ANNEXURE – 7

LIST OF SPECIAL TOOLS & TACKLES

Sr. No.	ITEMS	QUANTITY

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION EQUIPMENT DATA SHEET/SCHEDULE	SPECIFICATION No: PE-TS-434-571-A102 SECTION : II ANNEXURE : 8 REV 00 SHEET 1 OF 7

ANNEXURE – 8
EQUIPMENT DATA SHEET/SCHEDULE

S.NO	DESCRIPTION	DATA
I	**GENERAL**	
1.	Client	BHEL-PEM, Noida
2.	Project	PVUNL Patratu 3x800 MW
3.	End Customer	PVUNL/NTPC
4.	Location	Ramgarh, Jharkhand
5.	Service	Continuous
6.	Installation	Inside the Building
7.	Quantity for all 3 FGD units	2 sets (1W+1S) Lime Feeding/Dosing system (1 no. twin feed Bucket Elevator with motorized Diverter Flap Gate.
II	**MANUFACTURER DETAILS**	
1.	a. Model	Bidder to Provide
2.	b. Type	Bidder to Provide
III	**OPERATING CONDITION**	
	Medium to be handled	Bulk Lime / Lime slurry
IV	**TECHNICAL DATA**	
A	**BUCKET ELEVATOR**	
1.	Qty.	1 No.
2.	Type	Continuous discharge type
3.	Material to be handled	Lime powder
4.	Bulk density	450 kg/m³ (volumetric) 640 kg/m³ (load/structural)
5.	Capacity Rated / Design (TPH)	1.5
6.	Speed (m/sec)	Bidder to specify
7.	Lift height (m)	To suit layout/ 15-16 m approx. (Bottom to Top of Lime Silo- As per enclosed drg) Bidder to accommodate ± 5 % variation in lift height without any price implication
8.	Bucket type	Bidder to specify

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION EQUIPMENT DATA SHEET/SCHEDULE	SPECIFICATION No: PE-TS-434-571-A102 SECTION : II ANNEXURE : 8 REV 00 SHEET 2 OF 7

9.	Bucket size	Bidder to specify
10.	Bucket thickness / MOC	4 mm thk./ SS 304
11.	Belt Specifications	Bidder to specify
12.	Casing material of construction	MS, 6 mm thick. Top/ bottom casing, 4mm thk. Middle and hood casing
13.	Pulley type	Bidder to specify
14.	Head /Boot Pulley dia.	Bidder to specify
15.	Bearing type	Spherical roller bearing of suitable size
16.	Take up type	Bidder to specify
17.	Motor type	As per Motor Specification
18.	Motor KW	Bidder to specify
19.	Gear box	Bidder to specify
20.	Gear box ratio	Bidder to specify
21.	High Speed coupling	Bidder to specify
22.	Low Speed coupling	Bidder to specify
23.	Hold back	Bidder to specify
24.	Drive base frame	Bidder to specify
25.	Zero Speed Switch	Required.
B	**2-Way Diverter Flap Gate for Bucket Elevator**	
1.	Qty.	1 Nos.
2.	Inlet Flange Size	Bidder to specify
3.	Outlet Flange Size	Bidder to specify
4.	Angle of each Discharge Flange from vertical	15 ° / to suit
5.	Motor rating of actuator (W/V/F)	Bidder to specify
6.	MOC of Diverter Flap Gate	Bidder to specify
7.	Weight of Diverter Flap Gate	Bidder to specify
C	**LIME SILO**	
1.	Qty.	2 Nos. (1W+1S)
2.	Service/Application	Lime powder handling
3.	Location	Indoor (Gypsum Dewatering Building)

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION EQUIPMENT DATA SHEET/SCHEDULE	SPECIFICATION No: PE-TS-434-571-A102 SECTION : II ANNEXURE : 8 REV 00 SHEET 3 OF 7

4.	Operating Pressure	Atmospheric
6.	Design Temperature	60 ^{O}C
7.	Design Code	IS 9178
9.	Silo Capacity	6.9 m^3 each/ To suit system requirement
10.	Silo Cylinder Diameter	2 m
11.	Silo Cylinder Height	3.1-3.3 m
12.	Total Silo Height	6.1-6.3 m
13.	Silo Bottom Cone Angle	70 ^{o}
14.	Material for Shell & Bottom Cone	IS 2062: 2011 E250 Quality BR
15.	Thickness of shell	10 mm (Min.) + 3 mm (min. corrosion
16.	Material of Silo cone internal lining (conical portion)	SS304
17.	Thickness 0f SS lining	4 mm
18.	Outlet of Cone Silo	To suit Screw conveyor
10.	Moisture contain in Lime powder	8%
11.	Lime Powder Particle size	During detailed engineering
12.	Bulk density of material	450 kg/m^3 (volumetric) 640 kg/m^3 (load/structural)
13.	Design Temperature	45°C / Ambient
D	**CHUTES AND HOPPERS**	
1.	Minimum Valley Angle	Bidder to Provide
2.	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	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
3.	Inspection Doors	Bidder to Provide
4.	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
E	**a) SCREW CONVEYOR (DUTY PARAMETERS)**	

	3x800 MW PATRATU TPP PHASE-I **LIME FEEDING / DOSING SYSTEM** **TECHNICAL SPECIFICATION** **EQUIPMENT DATA SHEET/SCHEDULE**	**SPECIFICATION No: PE-TS-434-571-A102** **SECTION : II** **ANNEXURE : 8** **REV 00** **SHEET 4 OF 7**

1.	Orientation of screw Axis	Horizontal
2.	Length of Screw Conveyor from Feed to Discharge end	2.5-3 m (approx.)/ To suit layout requirement
3.	Quantity of Limestone to be handled (Rated/ Design) TPH	0.25 TPH / 0.5 TPH
4.	Material to be handled	Hydrated Pulverized Lime
5.	Impurities	Traces of chloride
6.	Type of Inlet feed	Vertical
7.	Abrasiveness type	abrasive
8.	Shape of dust	Spherical.
9.	Hardness	Bond index = 3
10.	Moisture contain	8%
11.	Particle size	200 mesh
12.	Bulk density of material	550 kg/m³
13.	Design Temperature	45°C
14.	Type of operation	Batch/ continuous
15.	Place of application	Gypsum Dewatering Building
16.	Type of Screw	Continuous helical spirally welded on central
17.	Type of Trough	"U'' Trough
18.	Length of the screw flight and outlet spout size	Vendor to confirm
19.	Saddle supports for Trough	To be provided throughout the length of Trough.
20.	Hanger bearing	Not to be used.
21.	Diameter of the Screw and Pitch of the flight	Vendor to confirm
22.	Trough Ends	Trough end to be provided at both drive and tail ends to support the central screw, and bearings with Plummer block (anti friction type) and to hold the sealing arrangement to avoid air
23.	Seal type	Split gland type to be provided
24.	Moisture content	8% (approx.)
25.	Ambient Temperature	As per details in Project Information
26.	Angle of repose for the dust	70 degree
27.	Type of operation	Batch Operation

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION EQUIPMENT DATA SHEET/SCHEDULE	SPECIFICATION No: PE-TS-434-571-A102 SECTION : II ANNEXURE : 8 REV 00 SHEET 5 OF 7

28.	Measure for prevention of explosion	Not required
29.	Whether Hygroscopic	Yes
30.	Whether corrosive	Yes
E	**b) SCREW CONVEYOR (MOC)**	
1.	Trough	3.15mm. thick min. SS304 (suitable MS supports to be provided)
2.	End plate	SS304, thickness not less than 8mm
3.	Screw flight	SS304, 3.15 thick minimum.
4.	Central pipe (Holding the screw)	SS304, 3.15 thick minimum.
5.	End shaft	EN24 shrink fitted with central pipe and welded.
6.	Type of bearings	Spherical Roller Bearings
7.	Drive and tail end bearings	Anti-friction bearings with plumper block. Vendor to specify.
8.	Make of bearings	SAF/FAG/NTN / SIBCO / Equivalent
9.	Drive, Driven &Tightened Sprocket	EN24 (Forged with hardness 450 –500 BHN)
10.	Top cover with inspection door (for extension outside portion Flanged Type)	SS304
11.	Gasket	EPDM Rubber (5Thk)/ equivalent
12.	Connecting Chute	SS304
13.	Chain and sprocket should be of reputed make. Chain – EN24 Forged Hardness 350-400 BHN Sprocket – EN24 Forged Hardness 450-500 BHN	
F	**DETAILS OF DRIVE & DRIVE MOTOR (SCREW CONVEYOR)**	
1.	Type of drive	Geared motor directly coupled to screw end or connected by chain and sprocket with suitable chain adjuster.
2.	Type of gear box	Helical gear box (The gear motor assembly shall be of integral with flange mounted motor)
3.	Whether zero speed switch/monitor Required.	No.
4.	Support for Drive system	To be provided.
5.	Safety Guards	To be provided

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION EQUIPMENT DATA SHEET/SCHEDULE	SPECIFICATION No: PE-TS-434-571-A102 SECTION : II ANNEXURE : 8 REV 00 SHEET 6 OF 7

6.	Drive Rating	To be indicated by the vendor. Necessary backup calculation substantiating the same to be furnished along with the offer
G	**NEUTRALISATION TANK**	
1.	Qty.	2 Nos. (1W+1S)
2.	Service/Application	Lime Neutralisation Tank
3.	Location	Indoor
4.	Operating Pressure	Atmospheric
5.	Design Pressure	Design Liquid Level
6.	Design Temperature	60 ^{O}C
7.	Design Code	IS:803
8.	Hydro Test	Full of Water
9.	Tank Capacity Normal/Maximum	10 m^3 / 11.25 m^3 each
10.	Tank Diameter	2.5 m
11.	Tank Height	2.8 m / To suit
12.	Tank Top Style	Flat
13.	Tank Bottom Style	Flat
14.	Material for Shell, top & Bottom	IS 2062: 2011 E250 Quality BR
15.	Thickness of shell	As calculated from IS:803 + 3 mm (min. corrosion allowance)
16.	Material of Tank internal lining	Chlorobutyl/Bromobutyl Rubber
17.	Thickness 0f lining	5 mm
18.	Nozzle Schedule & Orientation	1 no. Inlet for service water, 1 no. outlet for Waste water tank & other nozzles as required in GA drg.
H	**AGITATOR**	
1.	Qty.	2 Nos. (1 no per neutralization tank)
2.	Type	Top entry
3.	Location	Indoor (In Neutralisation Tank)
3.	MOC	Impeller & Shaft - Alloy 926
4.	Impeller Tip Speed	Must not exceed 12m/s
6.	Reduction Gear	To be provided as per applicability
I	**LIME SLURRY PUMPS**	
1.	Qty.	2 Nos. (1W+1S) common for complete LDS
2.	Type	Radial Split, Centrifugal, Continuous Duty
3.	Location	Indoor

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION EQUIPMENT DATA SHEET/SCHEDULE	SPECIFICATION No: PE-TS-434-571-A102 SECTION : II ANNEXURE : 8 REV 00 SHEET 7 OF 7

4.	Rated Capacity Flow (m3/hr)	1.5 / to suit
5.	Rated Capacity Head (mWC)	25 / to suit
6.	Rated Capacity Power (KW)	Bidder to Provide
7.	Power consumption (KW)	Bidder to Provide
8.	Pump Speed (rpm)	Bidder to Provide
9.	Motor Rating (KW)	Bidder to Provide
10.	Motor Speed (rpm)	Bidder to Provide
11.	Margins (Flow/Head) (%/%)	Bidder to Provide
12.	Operating Pressure	Bidder to Provide
13.	Design Pressure	Bidder to Provide
14.	Material of Base plate	Bidder to Provide
15.	Material of Casing	Bidder to Provide
16.	Material of Shaft	Bidder to Provide
17.	Material of Impeller	Bidder to Provide
18.	No. of Bearings	Bidder to Provide
19.	Type of Bearings	Heavy duty ball bearings
20.	Type of coupling	Bidder to Provide
J	**SLURRY PIPES**	
1.	Pipe size (mm)	Bidder to Provide
2.	Type of Joints	Bidder to Provide
	Pipe to Pipe/Pipe to Fittings	Bidder to Provide
	Fittings	Bidder to Provide
3.	Material / Thickness (mm) of Pipe	MSRL/ for pipes size lower than 3-inch abrasive resistant FRP material (silicon carbide coating on slurry exposed surface)
4.	Material Thickness of lining	Bidder to Provide
5.	Estimated Life of liners (hrs.)	Bidder to Provide
6.	Slurry Solid concentration (w/w %)	Bidder to Provide
7.	Slurry Settling Velocity (m/s)	Bidder to Provide
8.	Pipe Velocity (m/s)	Bidder to Provide
K	**SUPPORTING STEEL STRUCTURE, PLATFORMS, RAILINGS, LADDERS**	
1.	Qty.	As per system requirements described in tech. spec. (for 2 no Lime Feeding/Dosing System)

Signature: _____ Name: _____ Designation: _____

Company: _____ Company Seal Date: _____

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION LIST OF COMMISSIONING SPARES	SPECIFICATION No: PE-TS-434-571-A102 SECTION : II ANNEXURE : 9 REV 00 SHEET 1 OF 2

ANNEXURE – 9

A) LIST OF COMMISSIONING SPARES

SR. NO.	ITEMS	QUANTITY

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal

	3x800 MW PATRATU TPP PHASE-I LIME FEEDING / DOSING SYSTEM TECHNICAL SPECIFICATION LIST OF COMMISSIONING SPARES	SPECIFICATION No: PE-TS-434-571-A102 SECTION : II ANNEXURE : 9 REV 00 SHEET 2 OF 2

ANNEXURE – 9

B) LIST OF RECOMMENDED SPARES

SR. NO.	ITEMS	QUANTITY

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal

829736/2022/PS-PEM-MAX

	PROJECT: 3x800 MW PATRATU TPP PHASE-I	DOC NO.: PE-PQ-434-571-A102	
	PRE-QUALIFICATION REQUIREMENT (PQR)	DATE	22.03.2022
	LIME FEEDING / DOSING SYSTEM	REV	00

1.	The bidder is required to meet the provenness criteria and / or qualification requirement for Lime Feeding / Dosing system as per criteria stipulated below: "Bidder should have engineered / got engineered, supplied, erected / got erected at least one (1) number bulk material handling plant (essentially comprising of material handling/ conveying using bucket elevator/ bucket conveyor of minimum 1 T/hr rated capacity or above, for lime or other material, which is in successful operation for a period of not less than one (1) year as on date of bid opening".
2.	The supplier has to submit following supporting documents meeting above mentioned pre-qualifying requirement: Copy of minimum one (1) performance certificate (in English) from end user along with copy of related Purchase Order (PO) or Letter of intent (LOI) or Letter of Award (LOA) or Work Order (WO), specifying that the product is running successfully for at least one (1) year from date of commissioning, in support of PQR clause mentioned at sr. no.- 1 above.
3.	Bidder shall submit design documents to substantiate technical parameters specified in PQR, if the same is not mentioned in performance certificate / purchase order / LOI / LOA / WO.
4.	Offers of the JV companies/ Joint Bidders/ bidders having collaboration/ licensing agreement/ MOU/ Indian subsidiaries shall also be acceptable (the same shall be **declared upfront during the bid submission**) and shall be evaluated as follows: a. If bidder happens to be an Indian subsidiary of foreign OEM, then the credentials of the foreign OEM can also be considered for meeting PQR. b. If bidder happens to be the Joint Venture Company, then the credentials of any of JV partners can be also considered for meeting PQR. c. If bidder happens to bid jointly with their partner, then credentials of both the partners will be considered for meeting PQR as per distribution of the work. In all such cases, lead bidder as specified in bid documents shall be responsible for overall execution of the contract and all guarantee/ warranty. d. If bidder happens to be the having valid collaboration agreement/ MOU/ licensing agreement with some other company, then the credentials of collaborator/ MOU partner/ licensing company can also be considered for meeting PQR. Note: If bidder(s) qualifies on the basis of credentials of his principal/ JV partner/ Collaborator/ joint bidder etc., then the principal/ JV partner/ Collaborator/ MOU partner/ joint bidder shall be responsible for overall design vetting and warranty/ guarantee of the package. The scope matrix clearly defining their respective roles including design vetting, manufacturing of critical component, E&C etc. etc. and warranty/ guarantee shall be submitted along with the offer. Also, to note that the arrangement of bidding (Joint Bid Partners/Collaborator/MOU partner/Licensing company etc.) once offered to BHEL as a part of bidding documents cannot be changed till the execution of the project.
5.	Minimum one (1) no. purchase order/ LOI / LOA / WO shall be submitted which should not be more than seven (7) years old as on date of bid submission, for establishing continuity in business. This is over and above the requirement of PO mentioned of PQR clause at S. No 2 above.
6.	Bidder to submit all supporting documents in English. If documents submitted by bidder are in language other than English, a translation of its pertinent passages in English language in which case, for purposes of interpretation of the bid, the translation shall govern. The English Translation of the documents shall be carried out by professional translators and the translator shall certify that he is proficient in both languages in order to translate the document and that the translation is complete and accurate. Further, translation shall be authenticated by the Indian Consulate located in the Country where the documents have been issued or the Embassy of that Country in India.
7.	Notwithstanding anything stated above, BHEL/PVUNL reserves the right to assess the capabilities and capacity of the bidder to perform the contract, should the circumstances warrant such assessment in the overall interest of BHEL/PVUNL.
8.	Consideration of offer shall be subject to customer's approval of the bidder.
9	After satisfactory fulfilment of all the above criteria/ requirement, offer shall be considered for further evaluation as per NIT and all the other terms of the tender.

Item Number	Item Title	Item Description	Item Quantity	Unit of Measure	Consignee ID	Delivery Period (In number of days)
1	Main Supply as per Technical Specification	Surge Hopper	1	No	PATRATU_CON1	999
2	Main Supply as per Technical Specification	Vibrating Feeder	1	No	PATRATU_CON1	999
3	Main Supply as per Technical Specification	Continuous Discharge Twin Feed Type Bucket Elevator with standard components like buckets, belt, drive/tail pulleys with shaft & bearing assemblies, middle/top/bottom casings, take up unit, drive base frame, drive unit- geared motor (IE3), chain for final power transmission, zero speed switch, complete along with all accessories, 2-way (motorised) Diverter Flap Gate, interconnecting flanges/chutes, hardwares & gaskets.	1	No	PATRATU_CON1	999
4	Main Supply as per Technical Specification	Lime Silos (MS with SS 304 lining on conical portion) complete with supporting steel structure, platforms, ladders, railings, level switches, air relief devices, aeration pads/ flexible vibro pads/ electro-magnetic vibrators (for conical portion of silo) along with all accessories, interconnecting flanges/chutes, hardwares & gaskets.	2	Nos	PATRATU_CON1	999
5	Main Supply as per Technical Specification	Self-cleaning Bag Filter System of suitable capacity along with blowers, automatic/on-load cleaning system.	2	Nos	PATRATU_CON1	999
6	Main Supply as per Technical Specification	Manual Knife Gates along with interconnecting flanges, hardwares & gaskets.	1	LOT	PATRATU_CON1	999
7	Main Supply as per Technical Specification	Motorized knife Gates along with accessories, interconnecting flanges, hardwares & gaskets.	2	Nos	PATRATU_CON1	999
8	Main Supply as per Technical Specification	Rotary vane feeders/ Rotary air lock feeders (MOC –Stainless Steel) along with motor(IE3), interconnecting flanges, hardwares & gaskets.	2	Nos	PATRATU_CON1	999
9	Main Supply as per Technical Specification	Screw Conveyors complete with screw flight with pipe, trough, end plates, inlet/outlet standard chutes, end shafts with bearings & plumber blocks, drive base frame, dust seals, drive geared motor (IE3), output coupling, zero speed switch, with interconnecting flanges, hardwares & gaskets along with all accessories.	2	Nos	PATRATU_CON1	999
10	Main Supply as per Technical Specification	Neutralisation Tanks (MSRL) with SS dissolving basket, drain, manholes and all necessary arrgt./nozzles.	2	Nos	PATRATU_CON1	999
11	Main Supply as per Technical Specification	Agitators of SS construction with motor/reduction gear and its mounting	2	Nos	PATRATU_CON1	999
12	Main Supply as per Technical Specification	Lime Slurry Dosing Pumps alongwith motor (IE3)	2	Nos	PATRATU_CON1	999
13	Main Supply as per Technical Specification	Complete interconnected piping slurry, air and water pipes along with valves, rubber lining wherever aplicable, supports, gaskets, fasteners and accessories which is integral to Lime Feeding or Dosing system-Process water piping from TP outside building to neutralisation tanks along with overflow and drain piping of tanks, back-flushing pipeline along with valves, fittings	1	LOT	PATRATU_CON1	999
14	Main Supply as per Technical Specification	Complete interconnected piping slurry, air and water pipes along with valves, rubber lining wherever aplicable, supports, gaskets, fasteners and accessories which is integral to Lime Feeding or Dosing system-Lime slurry piping from Neutralization Tanks to dosing pumps inlet & from feeding or dosing pumps outlet to Waste water tank inlet along with re-circulation line with all required valves, fittings	1	LOT	PATRATU_CON1	999
15	Main Supply as per Technical Specification	Complete interconnected piping slurry, air and water pipes along with valves, rubber lining wherever aplicable, supports, gaskets, fasteners and accessories which is integral to Lime Feeding or Dosing system-All Interconnecting pipe or ducts, valves and all chutes Instrument air, water line, slurry lines	1	LOT	PATRATU_CON1	999
16	Main Supply as per Technical Specification	Complete interconnected piping slurry, air and water pipes along with valves, rubber lining wherever aplicable, supports, gaskets, fasteners and accessories which is integral to Lime Feeding or Dosing system-Instrument air piping from TP outside building upto equipment related to the system	1	LOT	PATRATU_CON1	999
17	Main Supply as per Technical Specification	Supporting steel structure, platforms, ladders, railings, and holdback as applicable along with all accessories and necessary hardwares for complete Lime Feeding or Dosing System.	1	LOT	PATRATU_CON1	999

18	Main Supply as per Technical Specification	Complete instruments associated with equipment and integral piping as defined at 13-16 for Lime Feeding or Dosing system.	1	LOT	PATRATU_CON1	999
19	Main Supply as per Technical Specification	Special tools & Tackles or Erection and start-up or commissioning spares	1	LOT	PATRATU_CON1	999
20	COST OF SUPERVISION FOR SERVICES as per Technical Specification, Except 22 and 23	Total lump sum prices for visits -should include travel expenses to/ fro site, visa/ insurance ,if applicable, intermediary stay for Supervision of assembly, erection and commissioning, trial run at site & taining to O&M staffs including technical support during implementation of logic & FAT of BHEL DCS.	4	Nos	PATRATU_CON1	999
21	COST OF SUPERVISION FOR SERVICES as per Technical Specification, Except 22 and 23	Total lump sum prices for Supervision of assembly, erection and commissioning, trial run at site & training to O&M staffs -in days including visit charges, local transportation, boarding, lodging & other related exepenses for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.	60	days	PATRATU_CON1	999
22	COST OF SUPERVISION FOR SERVICES as per Technical Specification	Total Lump sump price for successful conductance of Performance Guarantee test and handover in flawless condition of the package to the customer at site visit charges, local transportation, boarding, lodging & other related exepenses.	1	LOT	PATRATU_CON1	999
23	COST OF SUPERVISION FOR SERVICES as per Technical Specification	Total Lump sump price for training of employees of customer at manufacturers works - 3 persons for 2 days including lodging and boarding	1	LOT	PATRATU_CON1	999
24	Mandatory spares as per Technical Specification	Mechanical-Agitators for neutralisation tank-Impeller Assembly-1 lot is equal to 1 no of each type	1	LOT	PATRATU_CON1	999
25	Mandatory spares as per Technical Specification	Mechanical-Agitators for neutralisation tank-Bearing Assembly- 1 lot is equal to 2 nos of each type	1	LOT	PATRATU_CON1	999
26	Mandatory spares as per Technical Specification	Mechanical-Agitators for neutralisation tank-Motor - 1 lot is equal to 1 no of each type	1	LOT	PATRATU_CON1	999
27	Mandatory spares as per Technical Specification	Mechanical-Agitators for neutralisation tank-Belt and Pulley If applicable- 1 lot is equal to 2 no of each type	1	LOT	PATRATU_CON1	999
28	Mandatory spares as per Technical Specification	Mechanical-Agitators for neutralisation tank- Gear Box Assembly If Applicable 1 lot is equal to 1 no of each type	1	LOT	PATRATU_CON1	999
29	Mandatory spares as per Technical Specification	Mechanical-Slurry Pumps for Dosing pump-Impeller Assembly- 1 lot is equal to 1 no of each type	1	LOT	PATRATU_CON1	999
30	Mandatory spares as per Technical Specification	Mechanical-Slurry Pumps for dosing pump-Casing Liners-1 lot is equal to 2 nos of each type	1	LOT	PATRATU_CON1	999
31	Mandatory spares as per Technical Specification	Mechanical-Slurry Pumps for dosing pump-Seals-1 lot is equal to 4 set of each type	1	LOT	PATRATU_CON1	999
32	Mandatory spares as per Technical Specification	Mechanical-Slurry Pumps for dosing pump-Bearings-1 lot is equal to 2 nos of each type	1	LOT	PATRATU_CON1	999
33	Mandatory spares as per Technical Specification	Mechanical-Slurry Pumps for dosing pump-Motor-1 lot is equal to 1 no of each type	1	LOT	PATRATU_CON1	999
34	Mandatory spares as per Technical Specification	Mechanical-Slurry Pumps for dosing pump-Motor-Pump Coupling 1 lot is equal to 1 no of each type	1	LOT	PATRATU_CON1	999
35	Mandatory spares as per Technical Specification	Mechanical-For Integral Piping As Defined In Specification-Slurry Valves- 1 lot is equal to 2 no of each type & size	1	LOT	PATRATU_CON1	999
36	Mandatory spares as per Technical Specification	Mechanical-For Integral Piping As Defined In Specification - Slurry Line Bends 1 lot is equal to 2 no of each type & size	1	LOT	PATRATU_CON1	999
37	Mandatory spares as per Technical Specification	Measuring Instruments-Electronic Transmitters-Transmitters of all types, ranges and model no for the measurement of Pressure, differential pressure flow, level, etc. 1 lot is equal to 10 percent or 1 no of each type and model, which ever is more	1	LOT	PATRATU_CON1	999
38	Mandatory spares as per Technical Specification	Measuring Instruments-Electronic Transmitters-Level Transmitters -Ultrasonic/ radar type -1 lot is equal to 50 percent of each type and length, including sensors	1	LOT	PATRATU_CON1	999
39	Mandatory spares as per Technical Specification	Measuring Instruments-Temperature elements-RTDs of each type and length -with head assembly, terminal block & nipple -1 lot is equal to 10 percent or 2 nos of each type and length, whichever is more	1	LOT	PATRATU_CON1	999
40	Mandatory spares as per Technical Specification	Measuring Instruments-Temperature elements-Thermocouples of each type like K-type, R-type, metal etc with head assembly, terminal block & nipple 1 lot is equal to 10 percent or 2 nos of each type and length which ever is more	1	LOT	PATRATU_CON1	999

41	Mandatory spares as per Technical Specification	Measuring Instruments-Temperature elements-Thermowell for application like mill outlet temperature and SH/RH/Eco/ flue gas temp in furnace -1 lot is equal to 10 percent or 2 nos of each type and length whichever is more	1	LOT	PATRATU_CON1	999
42	Mandatory spares as per Technical Specification	Measuring Instruments Temperature elements-Temperature transmitters. 1 lot is equal to 10 percent of each type and model	1	LOT	PATRATU_CON1	999
43	Mandatory spares as per Technical Specification	Measuring Instruments Temperature elements-Local Indicators like temperature gauges, pressure gauges, differential pressure gauges, flow gauges, flow meters etc-1 lot is equal to 5 percent or 1 no of each make, model and type whichever is more - to be divided to various ranges in proportion to main of all make, model, type population	1	LOT	PATRATU_CON1	999
44	Mandatory spares as per Technical Specification	Measuring Instruments-Temperature elements-Process Actuated Switch Devices Includes all types of Pressure, differential pressure, flow, temperature, differential temperature, level switch Devices -1 lot is equal to 5 percent or 1 no of each type and model whichever is more	1	LOT	PATRATU_CON1	999
45	Mandatory spares as per Technical Specification	Measuring Instruments-Temperature elements-PD Type Flow Transmitters 1 lot is equal to 1 no of each type and model	1	LOT	PATRATU_CON1	999
46	Mandatory spares as per Technical Specification	Measuring Instruments-Temperature elements-Any other instrument If applicable-1 lot is equal to 10 percent or 1 no of each type and model whichever is more	1	LOT	PATRATU_CON1	999

PEM / PG-III, BHEL, Noida

SPECIAL CONDITIONS OF CONTRACT (SCC) Rev-0

3 x 800 MW PVUNL PATRATU TPP PHASE-I (Job No. 434)

These Conditions shall be read and construed along with General Conditions of Contract (GCC) rev.06 & GST related Corrigendum to GCC rev.06, to be enclosed along with the tender enquiry. In case of any conflict or inconsistency, the conditions given in SCC shall prevail over the GCC and its corrigendum.

Sl No.	Title	Description
1.	Project Name	3 x 800 MW PVUNL PATRATU TPP PHASE-I (EPC)
2.	Nature of project & Type of Bidding	Non-Mega & ICB (International Competitive Bidding)
3.	Customer Order Ref No	01/PVUNL-CS-9585-001-2/NOA-FC dated 08.03.2018 01/PVUNL-CS-9585-001-2/NOA-SC dated 08.03.2018 01/PVUNL-CS-9585-001-2/NOA-TC dated 08.03.2018
4.	BHEL's Customer	PATRATU VIDYUT UTPADAN NIGAM LIMITED (subsidiary of NTPC Limited in joint venture with JBVNL)
5.	**PVUNL GST No.**	**20AAICP3718K1ZH**
6.	Customer Consultants	No consultant
7.	Consignee Address (Bill To)	For supply package: BHEL, Power Sector-Project Engineering Management, Power Project Engineering Institute, Plot No. 25, Sector-16A, Noida, Uttar Pradesh-201301. **GSTIN: 09AAACB4146P2ZC** **For turnkey packages** (where BHEL-PEM will issue only the LOA and Purchase Order shall be issued by BHEL-PSWR): Construction Manager, BHEL site office, Patratu Vidyut Utpadan Njigam Ltd , PO: PTPS , Patratu , Ramgarh, Jharkhand - 829119 **BHEL PSWR GSTIN No.- 27AAACB4146P1ZF**
8.	Delivery Address (Ship To)	Construction Manager, Bharat Heavy Electricals Limited, Patratu Vidyut Utpadan Njigam Ltd, PO: PTPS , Patratu , Ramgarh ,Jharkhand - 829119
9.	BHEL Site Office Address	Construction Manager, Bharat Heavy Electricals Limited, Patratu Vidyut Utpadan Njigam Ltd , PO: PTPS , Patratu , Ramgarh, Jharkhand - 829119
10.	Location of Plant	Site is Located just outside the coal belt of South Karanpura in Ramgarh District of Jharkhand State. The nearest Railway Station is Patratu which is at a distance of about 4 km on Barkakhana-Barwadih Railway line. **District: Ramgarh (state- Jharkhand)** **Next big cities to site: Ranchi** **Nearest Railway Station: - Patratu** **Nearest Airport: Ranchi (45 km by road from site)**
11.	Mode of Dispatch	Air, Road, Rail & Sea Transportation For indigenous supplies: By Rail/Road on door delivery and freight pre-paid basis. For imported supplies: On C&F basis. Transit Insurance will be in BHEL scope
12.	Road Permit /E-waybill	Road Permit / E-way bill, to be arranged by Supplier/ transporter/ BHEL (as per GOI mandate).
13.	BHEL GSTIN Details	For supply packages: BHEL-PEM is registered in the State of Uttar Pradesh with GSTIN 09AAACB4146P2ZC

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		For Turnkey packages: BHEL PSWR GSTIN No.- 27AAACB4146P1ZF
14.	Transit Insurance	In BHEL Scope. For each dispatch, vendor shall inform the following to the Underwriter under intimation to BHEL-PEM and BHEL Site office: (i) Policy No. (ii) Consignee Name. (iii) Consignment Details (items with their weights and value (in INR). (iv) Project Name and P.O. No. (v) LR No. and date, Dispatch origin and destination details, Invoice No. Vendors to intimate the underwriters quoting the insurance Policy No. as mentioned in Purchase Order.
15.	Dispatch intimation	Yes in writing, Not less than 30 (Thirty) days prior to date of shipment and dispatch details to be sent to: BHEL Site office (As mentioned in Sl. No. 9) BHEL PEM Noida (As mentioned in NIT) At the point of dispatch, vendor must furnish docs required as given below through Email / Fax i. Vendor's invoice ii. LR / RR / GR / Courier Receipt iii. Packing List/ Challan indicating the items dispatched (with their weights) iv. Insurance intimation letter informing the underwriters about the dispatches v. MDCC (of BHEL / NTPC) as applicable vi. Photograph of packing / boxes showing dispatch marking as per Sl. No. 26
16.	Document required for Vendor's payment.	**For materials originating from Indian territory** For claiming the payment against dispatch, MRC & Freight, documents as mentioned in GCC rev 06 & its corrigendum shall be submitted by vendor to BHEL. Original money receipt must be submitted for Freight payment. **Packing List** must comply to Clause No. ~~19.3 of General Commercial~~ Terms ~~& Conditions of~~ GCC rev.06. Description of items in packing list shall be as per PO such that proper correlation between PO & packing list must be furnished. Soft copy of documents for claiming payment shall be submitted by vendor as advance copy. **For materials originating from non-Indian Territory** Three (3) original and Three (3) copies of clean bill of lading or One (1) clean original Airway Bill & Three (3) copies, in case of air freight. One (1) original and Three (3) copies of signed Invoices One (1) original and Three (3) copies of Packing List (clearly showing number of packages, gross weight and net weight). Three (3) copies of certificate of country of origin. Copy of MDCC from BHEL / NTPC (as applicable) Three (3) copies of inspection certificate, if any, issued by the customer/his authorized representative. Three (3) of certificate from the vendor to the effect that drawings and catalogues for customs clearance purpose have been kept with the packages for shipment. Three (3) copies of certificate from the vendor to the effect that the contents in each case are not less than that entered in the invoices and guaranteed as new and as per the relevant technical specifications. Shipping Specification – One (1) copy. Quality Certificate – One (1) copy. Approved Test Certificates, if any. - Three (3) copies. Guarantee Certificate – One (1) Original + One (1) copy.

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		Inspection Reports – One (1) Original + One (1) copy. PVC Calculation and copy of all applicable indices, if PVC applicable. – Two (2) copies.
17.	Material Receipt Certificate (MRC)	A) For supply packages- BHEL-PEM will arrange MRC from BHEL site B) For Turnkey (Supply + Erection & Commissioning) – Original MRC duly signed by customer (PVUNL) & BHEL site is to be arranged by Vendor.
18.	Buyer and Paying Authority	For packages where PEM will issue the Purchase Order: **BHEL PEM** will be the paying authority. For packages where BHEL-PEM will issue only the LOA and Purchase Order shall be issued by BHEL-PSWR: **BHEL Patratu Site will be the paying Authority.**
19.	Demurrage charges	Demurrage charges shall be paid by supplier/ vendor only to the transporter. No claim shall be acceptable to BHEL in this regard.
20.	Unloading, Storage & Movement of material at site	a) By BHEL site office for supply packages. b) By vendors for Turnkey i.e. Supply and E&C packages
21.	Concessional custom duty against Essentiality certificate (EC)	The project has been qualified through Project Import route. Accordingly, the benefits applicable to PI project would be granted for this project In this regard applicable documents such as Essentiality certificate will be issued by NTPC (ultimate customer). Under this, Concessional rate of Customs Duty shall be applicable on the Import Contents of the supplier respectively. Based on the above EC, Customs Duty Benefits will be passed on to the vendor. The Bidder to indicate the Import contents i.e. list of the item, Currency of Import and Country of Import including CIF value in their offers. BHEL shall inform, the availability of CIF value for a particular package, if any, at the time of NIT. The benefits availed in Concessional Customs Duty must be passed on to BHEL in their offer. Vendor shall inform BHEL and provide the necessary documents to obtain required certificates from BHEL to avail exemption. Obtaining custom duty benefit in line with the Essentiality Certificate issued shall be in vendor's scope.
22.	Taxes & Duties (For Domestic Vendor)	As per General Conditions of Contract (GCC rev 06) & GST related Corrigendum to GCC rev.06
23. a	Taxes & Duties (For Order Directly to Foreign Bidders)- supply packages	In case of foreign vendors, quoted prices & Dispatches shall be on C & F (Port-Chennai) basis and the Taxes & duties in the country of dispatch shall be borne by Foreign vendor.
23. b	Taxes & Duties (For Order Directly to Foreign Bidders)- Turnkey packages	Complete responsibility of import including (but not limited to) import clearance, all taxes and duties in the country of export (origin), all taxes ~~and duties in India shall be to vendor's account~~.
24.	Inspection Agency	BHEL/ BHEL approved 3rd party inspection agencies and/or NTPC/ Customer Agency as applicable.
25.	Inspection procedure for Domestic supplies	<u>For Domestic supplies</u> Vendor shall raise inspection call at least 15 business days in advance on BHEL CQS website to applicable inspection agency (as mentioned in PO/LOI or to be informed later) and submit copy of inspection call to BHEL-PEM for arranging NTPC inspection/Joint inspection on the proposed date, as applicable. MDCC shall be issued on the basis of clear inspection report (CQIR). <u>For Foreign supplies</u> In case of Foreign supplies, if NTPC approved 3rd party inspection agency does not participate in the inspection, test certificates & inspection reports duly accepted by the agreed Inspection agency shall be submitted in soft copy to BHEL-PEM. The same shall be reviewed by PEM and then, sent to NTPC for clearance. The dispatch clearance (MDCC) by NTPC/ BHEL as applicable shall be given to the foreign supplier or representative in India after acceptance of above test certificates.

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26.	Packing, Identification & marking [if not specified in NIT]	Each box shall be marked with Capital Letters in "Red" indicating the **PEM SUPPLY (Main Supply/ Commissioning Spares/ Mandatory Spares) for** 3 x 800 MW PVUNL PATRATU TPP. **NOTE:** Main supply item and items for commissioning spares must be packed separately. Each package delivered under the Contract shall be marked by supplier and such marking must be distinct and in English language (all previous irrelevant markings being carefully obliterated). Such marking shall show the description and quantity of contents, the name and address of consignee, the Gross weight and Net weight of the package, the name of the Supplier, PEM P.O. reference number, with a distinctive number of mark sufficient for purposes of identification. Besides above necessary, packing shall bear a special marking `TOP', `BOTTOM', 'DO NOT TURN OVER", "KEEP DRY", "HANDLE WITH CARE", etc **IMPORTANT: -** • Two copies of respective standard manufacturer's erection instruction/operation instruction manual shall be kept in each package / container for immediate reference by BHEL site and same shall be reflected in packing slip also • The Packing list details for the consignment must be put inside the Box/Boxes. Items like pumps, Valves, Hoists, Cranes etc shall essentially have O&M Manuals and E&C guidelines duly enclosed in the packing box. Certificate to such effect shall also be reflected in packing slip. Mandatory spares shall be properly packed separately in separate box painted in Red, indicating **Mandatory Spares in bold letters** and each spare shall be properly tagged giving details i.e. item number of the equipment in line with the CUSTOMER approved BBU for Mandatory spares & Number per item (to match the description given ~~in the packing slip) to facilitate their proper~~ identification by PVUNL/ NTPC. One Copy of Packing list must be put inside the Box along with Manufacturing drawing no. reference, Catalogue reference etc.
27.	Submission of Final Drgs/Docs alongwith O&M Manual, Type Test Certificates (if any)	As per GCC rev.06/ Technical Specification/Kick-off meeting.

	Prepared by	Checked by	Reviewed by	Vetted by	Approved by
Name	Gaurav Garg				16/05/18
Designation	Sr. Engr/ PG III	DGM/ PG III	DGM/ PG III	Finance	AGM & DH/ PG III
Signature	Gaurav 08/5/18				DEEPAK GUPTA

Guidelines for Remote Inspection of PEM BOIs

1) OBJECTIVE:

To lay down the procedure for carrying out Remote Inspection of Bought-out Items (BOIs) for PEM suppliers wherever applicable.

2) SCOPE:

It will cover suppliers for packages of PEM BOIs for various project requirements.

Invitation is sent to the suppliers for remote inspection on applications like MS Teams, Webex, etc. by BHEL.

3) MINIMUM REQUIREMENTS AT SUPPLIER'S WORKS:

i. Uninterrupted internet services

ii. Good internet bandwidth (Min 100 Mbps)

iii. Good resolution camera (2 nos) – one preferably CCTV (static at one place) and one hand hold (moving)

iv. Smart phone with minimum 8MPi camera front and back both with optical zoom facility suitable for using web applications like Webex, MicroSoft (MS) Teams, etc.

v. Computer and Scanner with good resolution

vi. Digital signatures of supplier's Quality Engineer

vii. Availability of web applications like Webex, MicroSoft (MS) Teams, as required.

viii. All Test certificates, internal test reports, calibration reports, etc. for the items offered for inspection.

ix. Availability of the above to be submitted to BHEL two days in advance before inspection.

x. Dedicated team from supplier side for facilitating inspection requirements.

xi. For ensuring proper visibility, the suggested Portable lighting sources (torch/ electric LED bulb of minimum 15 W) with no glare is to be ensured at offered job, location for remote inspection/testing. This is to be verified before start of the inspection.

xii. The GPS location co-ordinates or any method to locate inspection location shall be captured indicating the location of the Vendor-Premises of remote inspection/testing.

4) MINIMUM REQUIREMENTS AT BHEL and CUSTOMER LOCATION :

i. Uninterrupted internet services

ii. Suitable internet bandwidth

iii. Digital signatures wherever required.

iv. Availability of web applications like Webex, MS Teams, etc. as required.

v. Clearance from customer for conducting remote inspection

5) PROCEDURE:

i. Supplier will raise the inspection call in BHEL - CQIR portal.

ii. Supplier shall ensure availability of minimum requirements at supplier's works as mentioned above at point 3.

iii. Before starting the inspection, the supplier shall submit the documents (TCs, internal test reports and calibration certificates as per approved QAP) two days before the date of inspection for review by BHEL and supplier shall coordinate with BHEL and if found satisfactory, inspection shall be considered for remote.

iv. Prior to commencement of remote inspection a pre inspection meeting shall be organised by BHEL inspector with supplier to ascertain the readiness for remote inspection.

6) During inspection, supplier shall share the location on Google maps for verifying the address of the manufacturer. Location may be captured by BHEL as screenshot.

i. Inspection shall be on the basis of approved Quality Plans and associated reference documents mentioned.

ii. For witnessing inspection, supplier shall bring the mobile video camera near to the surface of the equipment or as per requirement of the inspector for clarity in viewing the test/ equipment which shall be the responsibility of supplier. Supplier shall ensure that proper lighting in available during live video streaming.

iii. Before start of the inspection, inspector shall ensure that all instruments shall have valid calibration report. Supplier shall ensure use of digital instruments preferably for inspection to the extent possible.

iv. Details of suppliers's dedicated team handling the remote inspection shall also be incorporated in the CQIR.

v. All details of inspection/ testing referred documents shall be mentioned in the CQIR. Recording of remote inspection shall be maintained by the BHEL inspector and this recording (unedited) shall be maintained at BHEL system for a minimum period of 3 years or till the warranty period whichever is later.

vi. PEM (Engineering) shall accord final technical clearance, in case of any deviation in inspected item noticed during inspection.

vii. Inspection shall be conducted by PEM-Q&BE assigned inspector along with PEM-Engg (if required). CQIR shall be prepared and maintained by PEM-Q&BE.

viii. PG will issue MDCC on the basis of acceptance of inspected items along with accepted packing photographs as per contract provisions.

7) **UNDERTAKING BY VENDOR:** Material inspected through remote inspections is meeting all technical requirements of BHEL. In case of any discrepancy from the above procedure/ material inspected, if found later, vendor will replace the materials without any cost implication to BHEL.

8) Vendor shall provide the signed and stamped of the above guidelines to BHEL as a token of acceptance.

CORPORATE QUALITY ASSURANCE/ कॉरपोरेट गुणवत्ता आश्वासन

SUB-VENDOR QUESTIONNAIRE/ सब-वेंडर प्रश्नावली

i.	***Item/Scope of Sub-contracting*** **उप-संविदा(अनुबंध) का मद/ दायरा**	
ii.	***Address of the registered office*** पंजीकृत कार्यालय का पता	***Details of Contact Person*** संपर्क व्यक्ति का विवरण ***(Name, Designation, Mobile, Email)*** (नाम, पदनाम, मोबाइल, ईमेल)
iii.	***Name and Address of the proposed Sub-vendor's works where item is being manufactured*** प्रस्तावित उप-विक्रेता के कार्यों का नाम और पता, जहां मद का निर्माण किया जा रहा है	***Details of Contact Person:*** संपर्क व्यक्ति का विवरण ***(Name, Designation, Mobile, Email)*** (नाम, पदनाम, मोबाइल, ईमेल)
iv.	***Annual Production Capacity for proposed item/scope of sub-contracting*** **उप-संविदा(अनुबंध)** के प्रस्तावित मद / दायरे के लिए वार्षिक उत्पादन क्षमता	
v.	***Annual production for last 3 years for proposed item/scope of sub-contracting*** **उप-संविदा(अनुबंध)** के प्रस्तावित मद / दायरे के लिए पिछले 3 वर्षों का वार्षिक उत्पादन	
vi.	***Details of proposed works*** **प्रस्तावित कार्यों का विवरण**	
1.	***Year of establishment of present works*** वर्तमान फैक्टरी की स्थापना का वर्ष	
2.	***Year of commencement of manufacturing at above works*** उपरोक्त फैक्टरी में निर्माण कार्य शुरू होने का वर्ष	
3.	***Details of change in Works address in past (if any*** पूर्व में फैक्टरी स्थल में परिवर्तन का विवरण (यदि कोई हो)***)***	
4.	***Total Area*** कुल क्षेत्र	
	Covered Area शामिल क्षेत्र	
5.	***Factory Registration Certificate*** फैक्टरी पंजीकरण प्रमाण पत्र	***Details attached at Annexure – F2.1*** विवरण अनुलग्नक- एफ 2.1 पर संलग्न है
6.	***Design/ Research & development set-up*** डिजाइन / अनुसंधान और विकास सेटअप ***(No. of manpower, their qualification, machines & tools employed etc.)*** (श्रमिकों की संख्या, उनकी योग्यता, मशीन और उपलब्ध उपकरण आदि)	***Applicable / Not applicable if manufacturing is as per Main Contractor/purchaser design)*** ***Details attached at Annexure – F2.2*** ***(if applicable)*** लागू / लागू नहीं, अगर विनिर्माण मुख्य संविदाकार / खरीददार के डिजाइन के अनुसार है) विवरण अनुलग्नक –एफ 2.2 पर संलग्न है । (यदि लागू हो)
7.	***Overall organization Chart with Manpower Details (Design/Manufacturing/Quality etc)*** मैनपावर विवरण के साथ समग्र संगठन का चार्ट(डिजाइन / विनिर्माण / गुणवत्ता आदि)	***Details attached at Annexure – F2.3*** विवरण अनुलग्नक – F2.3 में संलग्न है ।
8.	***After sales service set up in India, in case of foreign sub-vendor(Location, Contact Person, Contact details etc.)*** भारत	***Applicable / Not applicable*** लागू / लागू नहीं

	में बिक्री सेवा की स्थापना के बाद, विदेशी उप-विक्रेता के मामले में(स्थल , संपर्क व्यक्ति, संपर्क विवरण आदि)	***Details attached at Annexure – F2.4*** विवरण अनुलग्नक -2.4 पर संलग्न है ।
9.	***Manufacturing process execution plan with flow chart indicating various stages of manufacturing from raw material to finished product including outsourced process, if any*** फ्लोचार्ट सहित विनिर्माण प्रक्रिया निष्पादन योजना , जिसमें आउटसोर्स प्रक्रिया, यदि कोई हो, सहित कच्चे माल से तैयार उत्पाद तक विनिर्माण के विभिन्न चरणों को दर्शाया गया हो,	***Details attached at Annexure – F2.5*** विवरण अनुलग्नक - F2.5में संलग्न है ।
10.	***Sources of Raw Material/Major Bought Out Item*** कच्चे माल के स्रोत / खरीदे हुए मुख्य मद	***Details attached at Annexure – F2.6*** विवरण अनुलग्नक - F2.6में संलग्न है।
11.	***Quality Control exercised during receipt of raw material/BOI, in-process , Final Testing, packing*** कच्चे माल / खरीदे हुए मद, प्रक्रियाबद्ध, अंतिम परीक्षण, पैकिंग करते समय गुणवत्ता नियंत्रण	***Details attached at Annexure – F2.7*** विवरण अनुलग्नक - F2.7 पर संलग्न है
12.	***Manufacturing facilities (List of machines, special process facilities, material handling etc.)*** विनिर्माण सुविधा(मशीनों की सूची , विशेष प्रक्रिया सुविधाएं, सामग्री रख-रखाव आदि)	***Details attached at Annexure – F2.8*** विवरण अनुलग्नक - F2.8में संलग्न है ।
13.	***Testing facilities (List of testing equipment)*** परीक्षण सुविधाएं(परीक्षण उपकरण की सूची)	***Details attached at Annexure – F2.9*** विवरण अनुलग्नक – F2. 9 में संलग्न है ।
14.	***If manufacturing process involves fabrication then-*** यदि निर्माण प्रक्रिया में फेब्रिकेशन की गई है तो-	***Applicable / Not applicable*** लागू / लागू नहीं ***Details attached at Annexure – F2.10*** विवरण अनुलग्नक - F2.10में संलग्न है। ***(if applicable)*** लागू / लागू नहीं
	List of qualified Welders पात्र वेल्डर की सूची	
	List of qualified NDT personnel with area of specialization विशेषज्ञता के क्षेत्र सहित पात्र एनडीटी कार्मिकों की सूची	
15.	***List of out-sourced manufacturing processes with Sub-Vendors' names & addresses*** सब-वेंडर द्वारा बाह्य स्रोतों (उनके नाम और पते सहित)से करवाएं गए निर्माण प्रक्रियाओं की सूची	***Applicable / Not applicable*** लागू / लागू नहीं ***Details attached at Annexure. –F2.11*** विवरण अनुलग्नक - F2.10में संलग्न है। ***(if applicable)*** (यदि लागू हो)
16.	***Supply reference list including recent supplies*** नवीनतम आपूर्ति सहित आपूर्ति संदर्भ सूची	***Details attached at Annexure – F2.12*** विवरण अनुलग्नक - F2.12 में संलग्न है । ***(as per format given below)*** (नीचे दिए गए प्रारूप के अनुसार)

Project/ package परियोजना /पैकेज	***Customer Name*** ग्राहक का नाम	***Supplied Item (Type/Rating/Model /Capacity/Size etc)*** आपूर्ति की गई वस्तु (प्रकार / रेटिंग / मॉडल / क्षमता / आकार आदि)	***PO ref no/date*** पीओ संदर्भ सं. / तिथि	***Supplied Quantity*** आपूर्ति की मात्रा	***Date of Supply*** आपूर्ति की तारीख

17.	***Product satisfactory performance feedback letter/certificates/End User Feedback*** उत्पाद के संतोषजनक प्रदर्शन संबंधी फीडबैक पत्र / प्रमाण पत्र / अंतिम उपयोगकर्ता फ़ीडबैक	***Attached at annexure - F2.13*** अनुलग्नक F2. 3पर संलग्न है
18.	***Summary of Type Test Report (Type Test Details, Report No, Agency, Date of testing) for the proposed product***	***Applicable / Not applicable*** लागू / लागू नहीं

	(similar or higher rating) प्रस्तावित उत्पाद (एक समान या उच्च रेटिंग वाले) के लिए टाइप टेस्ट रिपोर्ट (टाइप टेस्ट विवरण, रिपोर्ट संख्या, एजेंसी, जांच की तारीख) का सारांश नोट: - रिपोर्ट प्रस्तुत करने की आवश्यकता नहीं है ***Note:- Reports need not to be submitted***	***Details attached at Annexure – F2.14*** विवरण अनुलग्नक - F2.1 4में संलग्न है ***(if applicable)*** (यदि लागू हो)
19.	***Statutory / mandatory certification for the proposed product*** प्रस्तावित उत्पाद के लिए वैधानिक / अनिवार्य प्रमाणीकरण	***Applicable / Not applicable*** लागू / लागू नहीं ***Details attached at Annexure – F2.15*** ***(if applicable)*** (यदि लागू हो)
20.	***Copy of ISO 9001 certificate*** आईएसओ 9001 प्रमाण पत्र की प्रति ***(if available***(यदि उपलब्ध हो)	***Attached at Annexure – F2.16*** अनुलग्नक में संलग्न - F2.1 6 है
21.	***Product technical catalogues for proposed item (if available)*** प्रस्तावित मद के लिए उत्पाद तकनीकी कैटलॉग (यदि उपलब्ध हो)	***Details attached at Annexure – F2.17*** विवरण अनुलग्नक - F2.1 7 में संलग्न है

Name: ***नाम:***		***Desig:*** ***पदः***		***Sign:*** ***हस्ताक्षरः***		***Date:*** ***तिथि:***	

Company's Seal/Stamp:- कंपनी की मुहर/ मोहरः -

3 x 800 MW PVUNL PATRATU TPP PHASE-I

Item: Lime feeding/dosing System

GeM Bid Number:

(INSTRUCTIONS TO PACKING LIST)

For faster verification of bills, successful bidder to submit detailed Bill of Material (BOM) at the time of drawings/ documents submission after placement of PO. Each item of the BOM to be uniquely identified with item code no. or item Sl. No. Supplier to ensure that all items which will find separate mention in the packing list are covered in this detailed BOM.

Supplier to also give the following undertaking in the BOM:
"The BOM provided herewith completes the scope (in content and intent) of material supply under PO No. ……. Dated …… Any additional material which may become necessary for the intended application of the supplied items/package will be supplied free of cost in most reasonable time.

Packing List must indicate:

a) Packing size
b) Gross weight and net weight of each package
c) Contents of the package with cross reference to BOM item code no. / Sl. No.
d) Quantity of each items separately.

The packing list must cover all the BOM items.

Supplier to give following undertaking in the packing list:

The Packing list provided herewith is as per BOM approved under PO No. -----