2 X 800 MW - NTPC GADARWARA STPP STAGE I .

TECHNICAL SPECIFICATION

FOR CONDENSER ON LOAD TUBE CLEANING SYSTEMS (COLTCS).

Specification No. : PE-TS- 394-165-N001 (REV. 0)

VOLUME -IIB

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
PPEI BLDG., SEC-16A, PLOT NO. 25
NOIDA – 201301 (UP)

1.0 The tender document contains three (3) volumes. The bidder shall meet the requirements of all the three volumes.

1.1 **Volume -I CONDITIONS OF CONTRACT**

This consists of four parts as below :

Volume - I A : This part contains instructions to bidders for making bids to BHEL.

Volume - I B : This part contains general commercial conditions of the tender and include provision that vendor shall be responsible for the quality of item supplied by their sub-vendors.

Volume - I C : This part contains special conditions of contract.

Volume - I D : This part contains commercial conditions for erection and commissioning site work, as applicable.

1.2 **Volume - II TECHNICAL SPECIFICATIONS**

Technical requirements are stipulated in Volume II which comprises of :

Volume - II A : General Technical Conditions

Volume - II B : Technical specification including drawings, if any

1.2.1 Volume - II B :

This volume is sub-divided into following sections:

Section - A : This section outlines the scope of enquiry.

Section - B : This section provides "Project Information"

Section - C : This section indicates technical requirements specific to the contract, not covered in Section-D.

Section - D : This section comprises of standard technical specifications of equipments complete with data sheet A, B & C.
Data sheet-A specifies data and other requirements pertaining to the equipment.
Data sheet - B specifies data to be filled by the bidder (Data Sheet B is contained in Volume - III)
Data sheet - C indicates data documents to be furnished after the award of contract as per agreed schedule by the vendor (as applicable).

1.2.2 **Volume - III TECHNICAL SCHEDULES**

1.0 This volume contains technical schedules and Data Sheets - B, which are to be duly filled by the bidder and the same shall be fumished with the technical bid as per instructions given in Document No.PES-100-901 in Volume-III.

2.0 The requirements mentioned in Section C/Data Sheets-A of Section-D shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section -D.

INDEX

SECTION - A
SCOPE OF ENQUIRY

	TITLE : TECHNICAL SPECIFICATION FOR CONDENSER ON LOAD TUBE CLEANING SYSTEMS (COLTCS).	SPEC. NO. PE-TS-394-165-N001	
		VOLUME : II B	
		SECTION : A	
		REV. NO. 0	DATE : 16.08.2013
		SHEET 1of 1	

1.00.0 **SCOPE**

This enquiry covers the design, manufacture, assembly, inspection and testing at manufacturer's and/or his sub-contractors works properly packed for delivery of the items as follows:

1.01.0 **Condenser On Load Tube Cleaning Systems :**

Condenser On Load Tube Cleaning Systems (COLTCS) complete with all accessories as per the requirements specified in different sections of this specification ***for :***

- **2 X 800 MW - NTPC GADARWARA STPP STAGE I .**

The bidder's scope also includes installation checks, commissioning, trial runs & PG Testing at site of COLTCS.

1.01.0 **The bids shall be evaluated as per NIT.**

2.00.00 **GENERAL TECHNICAL INSTRUCTIONS:**

2.01.00 It is not the intent to specify herein all the details of design and manufacture. However the equipment shall conform in all respects to high standard of design, engineering and workmanship, and shall be capable of performing the required duties in a manner acceptable to Engineer/ Owner, who will interpret the meaning of drawing and specifications, and shall be entitled to reject any component or material, which in his judgement is not in full accordance herewith.

2.0.2.00 The omission of specific reference to any component/ accessory necessary for the proper performance of the equipments shall not relieve the bidder of the responsibility of providing such facilities to complete the supply of the equipments at quoted prices.

2.03.00 In case of any deviation from this Technical specification (Vol. IIB) and General Technical Conditions (Vol. IIC), the same shall be indicated in the schedule of deviations enclosed in Volume-III, Part-A. In the absence of duly filled schedules it will be assumed that the bid strictly conforms to the specification.

2.04.00 BHEL's/ Customer's representatives shall be given full access to the shop in which the equipments are being manufactured or tested and all test records shall be made available to him.

2.05.00 The equipments covered under this specification shall not be despatched unless the same have been finally inspected, accepted and shipping release issued by BHEL/ Customer

2.06.00 Un-priced copy of price bid shall be furnished alongwith the technical bid.

SECTION – B

PROJECT INFORMATION

INTRODUCTION

1.00.00 BACKGROUND

Gadarwara Thermal Power Project (Gadarwara TPP) is being set up as a regional power project for the benefit of States/UTs of Western Region. This project is being set up in two stages. Each stage shall comprise of two units of 800 MW.

1.01.00 **Location and**

The site is located rfear villages Gangal & Umaraiya (about 9 Kms from Gadarwara town in Narsingpur district of Madhya Pradesh.The major cities Bhopal & Jabalpur are located at about 210 Kms & about 140 kms respectively from proposed project site. The nearest BG Railway Station, Gadarwara, on Jabalpur- Itarsi Section on central railway main Line is about 9 Kms from proposed project site.

The nearest commercial airport, Bhopal and Jabalpur are located about 240 Kms and about 155 Kms respectively from site. The plant latitude and longitude are 22° 51' 42" N and 78° 52' 08" respectively.

Vicinity plan of the proposed project is placed at **Annexure –A-I**

1.02.00 **Land**

About 1844 acres of land (Private Land- about 1480 acres nd Govt. Land- about 364 acres) has been envisaged for the project. In-principle land availability clearance has been obtained from Govt. of Madhya Pradesh vide letter dated 19.05.08.

1.03.00 **Water**

The make-up water requirement is estimated as 4680 Cubic Meter/Hr with ash circulation system and about 5980 Cubic Meter/Hr with once through ash water system. The source of water for the Project is Narmada River at a distance of about 30 Kms from the project site.

Govt. of Madhya Pradesh vide dated 19.05.08.has accorded water commitment from Narmada river for the project. CWC vide letter dated 27.07.12 have concurred water availability confirmation accorded by State Govt.

1.04.00 **Capacity**

2 x 800 MW - Present proposal

2 x 800 MW - In Future

1.05.00 **Meteorological data**

Important meteorological data from nearest observatory at Narsinghpur is placed at **Annexure-A-II.**

1.06.00 **Plant Water Scheme**

The Plant water scheme is described below.

1.06.01 **Condenser Cooling (CW) Water System**

It is proposed to provide recirculating type CW system with induced draft type cooling towers. For the recirculating type CW system it is proposed to supply clarified water as make up. Raw water from the make-up water pump house shall be pumped to a Water Pretreatment Plant (PT - CW system). The treated clarified water shall be led to the cold water channel of CW system. Designed Clarified Water Analysis is given in this subsection.CW system shall be operated at a C.O.C of about 4.0. Chemical treatment programme (using acid dosing and scale cum corrosion inhibitors dosing) may be employed in addition to blow down of CW water to control the CW system chemistry in case CW system is required to be operated beyond 4.0 COC. CW blow down shall be drawn from the discharge of CW pumps and the same shall be led to a Service water Tank. For carrying circulating water from CW pump house to TG-area and from TG area to cooling tower, steel lined concrete encased duct would be provided. For interconnecting CW duct with CW pump, condenser and cooling towers, steel pipes would be used. Cooled water from cooling tower will be led to CW pump house through the cold water channel by gravity.

1.06.02 **Equipment Cooling Water (ECW) System (Unit Auxiliaries)**

The plant auxiliaries of Steam Generator and Turbine Generator shall be cooled by Demineralised (DM) water in a closed circuit. The primary circuit DM water shall be cooled through plate type heat exchangers by Circulating Water tapped from CW system in a closed secondary circuit. The hot secondary circuit cooling water shall be cooled in the cooling towers and shall be returned back to the system. It is proposed to provide independent primary cooling water circuit for Steam Generator & auxiliaries and TG & its auxiliaries.

1.06.03 **Station Auxiliaries Cooling Water System**

The station auxiliaries such as Air compressors, Compressors of ash handling plant, Cooling water circuit of Air Conditioning system, compressor of mill reject system etc. shall be cooled by separate cooling water System using separate set of pumps and cooling towers.

1.06.04 **Ash Water System**

It is proposed to operate ash water system in a closed circuit. The ash water from the ash dyke shall be recirculated after treating a part of the quantity in a side stream lime softening plant as the case may be. Make up to the ash water system (to compensate for the ash water system blow down and evaporation loss in ash dyke) shall be supplied from excess CW blow down water (Service water) and raw water supply from water source of the plant. In addition, provision shall be kept to supply treated water from Central Monitoring Basin of Liquid Effluent Treatment Plant.

1.06.05 **Other Miscellaneous Water Systems**

a) CW system blow down water shall be used for the plant service water requirement, dust suppression system of coal handling plant, makeup to the Ventilation system, ash slurry pumps sealing, sealing of Vacuum pumps (if applicable) of Ash Handling plant, make-up to fire water storage tanks and cooling water requirement of hydrogen generation plant. The service (wash water) water collected from various areas shall be treated using oil water separators, tube settlers, coal settling pits etc. as per requirement and treated water from liquid effluent treatment plant shall be recycled back to the service water system for re-use. The excess service water shall be led to central monitoring basin for disposal.

b) Separate water Pre-treatment plants are proposed for Circulating Water (PT-CW) system, Demineralisation Plant (PT-DM) plant and potable (PT-Pot) water systems.

c) The drinking water requirement of the plant and colony shall be provided from the above mentioned Water (PT-Pot) pretreatment plant.

d) Steam Cycle make-up water, makeup to the primary circuit of ECW (unit auxiliaries) system, boiler fill water and makeup to the hydrogen generation plant shall be provided from Demineralising plant.

e) The quality of clarified water & DM water is given in this sub-section at **Annexure-A-III**.

1.07.00 **Criteria for Earthquake Resistant Design of Structures and Equipment**

All power plant structures and equipment, including plant auxiliary structures and equipment shall be designed as per the criteria specified in sub-section-D1 of Section-VI (Part-A).

In case the acceleration criteria considered by the Bidder for the design of anchorage bolts of Steam Turbine and Generator with TG Deck in his bid is different with respect to above criteria, he shall indicate the same in his bid. The same will be discussed with the Bidder and finalized considering the following:

a) The earthquake design acceleration for the steam turbine and generator acting at the centre of gravity depends upon the layout/configuration/size of TG deck supporting columns and beams which are to be jointly decided by NTPC and the bidder.

b) As the data regarding Foundation GA & loading data to be furnished by Bidder may not be available at tender stage, the acceleration criteria proposed by the bidder can not be confirmed for acceptance at the award stage. The same can be confirmed after jointly finalizing the TG substructure arrangement by NTPC and Bidder.

c) TG deck acceleration values will be limited to the design values adopted by Bidder by suitably increasing the size of the TG supporting columns/beams during detailed engineering.

Accordingly Bidder has to make equipment/piping layout clearing the TG column/beams.

1.08.00 **Criteria for Wind Resistant Design of Structures and Equipment**

All structures and equipment of the power plant, including plant auxiliary structures and equipment, shall be designed for wind forces as given as given in sub-section-D1 of Section-VI (Part-A).

ANNEXURE–A-I


JABALPUR
MAIN PLANT
ASH POND-I
78 - 30
GADARWARA
22° - 55'
ITARSI
22° - 50'
NTPC Limited

ANNEXURE-A-II
PAGE 1 OF 2

EXHIBIT - 1

जलवायवी सारणी
CLIMATOLOGICAL TABLE

स्टेशन : नरसिंहपुर STATION :Narsinghpur — अक्षांश LAT 22°57' N — देशांतर LONG 79°11' E — समुद्री तल माध्य से ऊँचाई HEIGHT ABOVE M. S. L. 358 मीटर METRES

1962 से 1980 तक के प्रेक्षणों पर आधारित BASED ON OBSERVATIONS FROM 1962 TO 1980

मास MONTH	स्टेशन का स्तर दाब STATION LEVEL PRESSURE एच.पी.ए. hPa	AIR TEMPERATURE वायु तापमान — MEAN माध्य: शुष्क बल्ब DRY BULB डि.से. °C	आर्द्र बल्ब WET BULB डि.से. °C	दैनिक अधिकतम DAILY MAX डि.से. °C	दैनिक न्यूनतम DAILY MIN डि.से. °C	माह में उच्चतम HIGHEST IN THE MONTH डि.से. °C	माह में निम्नतम LOWEST IN THE MONTH डि.से. °C	EXTREMES चरम: उच्चतम HIGHEST डि.से. °C	दिनांक और वर्ष DATE AND YEAR	निम्नतम LOWEST डि.से. °C	दिनांक और वर्ष DATE AND YEAR	HUMIDITY आर्द्रता: सापेक्ष आर्द्रता RELATIVE HUMIDITY प्रतिशत %	वाष्प दाब VAPOUR PRESSURE एच.पी.ए. hPa	CLOUD AMOUNT मेघ की मात्रा: समस्त मेघ ALL CLOUDS आकाश के अष्टमांश Oktas of sky	निम्न मेघ LOW CLOUDS	RAINFALL वर्षा: मासिक योग MONTHLY TOTAL मि.मि. mm	वर्षा के दिनों की संख्या NO. OF RAINY DAYS	सर्वाधिक वर्षा वाले महीने का योग TOTAL IN WETTEST MONTH WITH YEAR मि.मि. mm	सर्वाधिक शुष्कतम महीने का योग TOTAL IN DRIEST MONTH WITH YEAR मि.मि. mm	24 घंटों में सबसे भारी वर्षा HEAVIEST FALL IN 24 HOURS मि.मि. mm	दिनांक और वर्ष DATE AND YEAR	माध्य पवन गति MEAN WIND SPEED कि.मी. प्र. घं. Kmph
जनवरी JAN I / II	976.0 972.4	12.0 24.6	9.8 16.6	26.8	8.2	30.9	3.0	34.0	08 1973	1.2	23 1963	74 40	10.6 12.3	1.6 1.5	0.6 0.4	11.0	1.2	46.0 1970	0.0	27.8	05 1966	2.4
फरवरी FEB I / II	974.2 970.5	15.7 26.5	12.2 18.5	30.3	11.1	34.8	4.9	37.8	25 1960	1.4	07 1974	64 35	11.5 13.3	1.4 1.5	0.7 0.4	17.3	1.2	106.4 1973	0.0	71.0	04 1973	3.0
मार्च MAR I / II	972.1 967.7	21.7 33.6	15.5 21.0	35.3	15.6	40.0	9.9	42.8	31 1977	6.0	02 @ 1971	50 30	12.8 15.2	1.3 2.0	0.5 0.7	12.1	1.1	38.6 1969	0.0	27.8	14 1968	3.8
अप्रैल APR I / II	966.6 964.1	27.9 38.3	19.0 23.1	40.3	21.4	43.5	15.8	47.4	09 1960	10.0	03 1968	40 25	15.1 16.0	1.3 2.5	0.5 0.9	6.2	0.6	35.0 1963	0.0	24.4	06 1973	4.4
मई MAY I / II	965.0 960.5	32.2 40.3	20.1 24.4	42.5	25.9	45.1	20.5	47.0	28 1973	17.0	12 1968	39 24	18.9 17.7	1.3 2.8	0.4 1.0	7.0	0.8	31.8 1976	0.0	13.4	25 1976	5.8
जून JUN I / II	961.8 957.9	29.7 35.0	24.6 25.6	36.1	26.1	43.9	21.8	47.2	09 1979	18.0	09 1971	66 49	26.7 25.3	4.2 5.4	2.6 3.8	168.9	7.4	432.6 1977	24.2 1969	217.6	27 1977	8.0
जुलाई JUL I / II	961.1 958.2	26.1 29.0	24.3 25.2	31.4	23.9	38.7	21.4	42.4	01 1960	18.8	12 1973	85 74	28.8 28.3	6.2 6.8	5.0 5.7	394.8	14.4	600.4 1960	123.7 1962	154.9	02 1970	6.8
अगस्त AUG I / II	962.3 958.4	25.2 27.7	23.9 24.0	29.7	24.1	34.2	21.3	36.9	03 1972	[illegible]	10 1969	90 80	28.8 29.2	6.4 6.7	6.4 5.8	423.6	19.7	774.0 1972	182.0 1965	224.2	30 1972	6.6
सितम्बर SEP I / II	966.3 962.9	25.5 29.4	23.6 24.3	31.9	22.5	35.1	20.0	36.8	18 1974	18.4	23 @ 1972	84 66	27.5 26.1	3.8 5.0	2.8 3.8	180.8	8.4	319.7 1962	17.2 1979	133.4	05 1973	3.8
अक्तूबर OCT I / II	971.7 968.0	23.1 30.7	19.6 21.5	33.5	17.9	36.1	12.9	36.4	07 1960	9.8	31 1969	70 42	20.0 18.3	1.3 2.0	0.8 0.8	23.5	1.4	188.8 1971	0.0	188.8	04 1977	2.2
नवम्बर NOV I / II	975.0 971.5	17.4 27.7	14.3 15.1	30.7	12.4	33.9	7.6	37.6	25 1979	2.2	30 1970	78 41	14.1 15.2	1.3 1.7	0.7 0.7	14.3	0.8	125.2 1977	0.0	78.8	24 1977	2.2
दिसम्बर DEC I / II	976.6 973.1	12.8 24.8	10.8 17.1	27.3	8.8	30.7	*3.6	33.0	01 1969	-1.4	28 1968	79 45	11.4 13.6	1.4 1.6	0.7 0.8	12.6	0.9	130.4 1967	0.0	62.0	11 1967	2.0
वार्षिक योग या माध्य ANNUAL TOTAL OR MEAN I / II	969.2 965.5	22.4 30.8	18.3 21.8	33.2	18.1	45.4	2.5	47.4		-1.4		67 46	18.8 18.3	2.6 3.3	1.7 2.0	1195.3	53.9	1902.8 1977	646.2 1966	224.2		4.2
वर्षों की संख्या NUMBER OF YEARS I / II	19 19	19 19	19 19	19	19	19	19	19		19		19 19	18 19	19 19	19 19	19	19	19	19	19		15

531

ANNEXURE-A-II
PAGE 2 OF 2

जलवायवी सारणी
CLIMATOLOGICAL TABLE

स्टेशन : नरसिंहपुर
STATION : Narsinghpur

मौसम परिघटना / WEATHER PHENOMENA — No. OF DAYS WITH

MONTH	PPT 0.3mm or more	HAIL	THUNDER	FOG	DUST STORM	SQUALL
जनवरी JAN	1.5	0.0	0.4	0.4	0.0	0.0
फरवरी FEB	2.5	0.0	1.1	0.0	0.0	0.5
मार्च MAR	2.2	0.0	0.9	0.0	0.0	0.0
अप्रैल APR	1.2	0.1	0.4	0.0	0.1	0.0
मई MAY	1.5	0.0	0.7	0.0	0.1	0.0
जून JUN	9.9	0.0	3.9	0.0	0.0	0.0
जुलाई JUL	19.1	0.1	4.3	0.0	0.0	0.0
अगस्त AUG	20.2	0.0	4.8	0.0	0.0	0.0
सितम्बर SEP	11.3	0.0	1.5	0.0	0.0	0.0
अक्तूबर OCT	2.6	0.0	0.4	0.0	0.0	0.0
नवम्बर NOV	1.3	0.0	0.4	0.0	0.0	0.0
दिसम्बर DEC	1.2	0.0	0.3	0.8	0.0	0.0
वार्षिक योग या माध्य ANNUAL TOTAL OR MEAN	74.5	0.2	19.5	1.0	0.2	0.5
वर्षों की सं. NUMBER OF YEARS			19			

पवन / WIND

MONTH		No. OF DAYS WITH WIND SPEED (Km. p. h.) 62 or more	20-61	1-19	0	PERCENTAGE No. OF DAYS WIND FROM N	NE	E	SE	S	SW	W	NW	CALM
JAN	I	0	0	18	13	4	31	4	12	1	2	4	1	41
	II	0	0	18	13	2	27	2	2	1	6	9	8	43
FEB	I	0	0	15	13	2	24	4	10	1	4	8	2	45
	II	0	0	20	8	3	21	2	3	0	11	18	15	27
MAR	I	0	0	17	14	2	20	6	10	2	5	7	4	44
	II	0	0	25	6	3	17	2	4	1	14	24	13	22
APR	I	0	0	20	10	2	13	4	11	2	10	19	4	35
	II	0	0	26	4	4	14	1	5	2	17	20	15	12
MAY	I	0	0	26	5	2	8	3	5	2	17	30	11	13
	II	0	0	28	3	3	10	2	3	0	20	36	17	9
JUN	I	0	1	26	3	2	4	2	4	2	24	45	9	8
	II	0	0	27	3	3	10	3	3	2	22	33	14	10
JUL	I	0	0	27	4	1	2	2	3	3	24	45	8	14
	II	0	0	27	4	2	5	2	2	3	32	32	6	16
AUG	I	0	0	26	5	2	2	4	2	3	24	43	5	15
	II	0	0	26	5	2	4	4	3	1	30	29	10	17
SEP	I	0	0	22	8	3	4	3	4	1	19	34	6	26
	II	0	0	24	6	4	13	3	4	1	20	27	8	20
OCT	I	0	0	16	15	2	14	4	6	2	7	13	2	50
	II	0	0	20	11	8	29	3	3	1	4	9	5	36
NOV	I	0	0	13	17	4	21	3	8	1	1	3	2	57
	II	0	0	12	18	5	21	1	2	0	2	6	3	60
DEC	I	0	0	16	15	4	28	5	8	0	2	3	1	49
	II	0	0	11	20	3	17	2	1	1	2	6	2	66
ANNUAL TOTAL OR MEAN	I	0	1	242	122	3	14	4	7	2	12	22	4	32
	II	0	0	204	101	4	18	2	3	1	15	22	10	27
NUMBER OF YEARS	I		19							20				
	II		19							20				

मेघ / CLOUD and दृश्यता / VISIBILITY

MONTH		No. OF DAYS WITH CLOUD AMOUNT (ALL CLOUDS) OKTAS 0	T-2	3-5	6-7	8	No. OF DAYS WITH LOW CLOUD AMOUNT OKTAS 0	T-2	3-5	6-7	8	FOG 8	No. OF DAYS WITH VISIBILITY UP TO 1 Km	1-4 Kms	4-10 Kms	10-20 Kms	OVER 20 Kms
JAN	I	20	3	4	2	2	28	0	1	1	1	0	0.3	1.3	6.9	11.1	11.4
	II	19	4	5	2	1	29	0	0	1	1	0	0.0	0.1	5.9	8.6	16.4
FEB	I	20	2	3	2	1	25	0	1	1	1	0	0.0	0.7	4.4	9.0	13.9
	II	17	4	5	1	1	26	0	0	1	1	0	0.0	0.2	2.3	6.2	19.3
MAR	I	21	3	4	2	1	29	0	0	1	1	0	0.0	0.4	5.3	4.2	21.1
	II	16	4	8	2	1	28	0	1	1	1	0	0.0	0.1	2.3	5.9	22.1
APR	I	21	3	3	2	1	27	0	1	1	1	0	0.0	0.0	4.2	2.7	23.1
	II	11	5	10	3	1	25	1	2	1	1	0	0.0	0.0	2.7	5.7	21.8
MAY	I	22	3	3	2	1	29	0	0	1	1	0	0.0	0.1	4.2	2.9	23.8
	II	9	4	12	4	2	25	1	3	1	1	0	0.0	0.0	2.2	5.2	23.6
JUN	I	6	5	6	5	8	8	5	2	3	7	5	0.0	0.7	11.2	4.7	13.4
	II	1	3	10	7	9	13	1	4	4	8	0	0.0	0.4	12.1	7.2	10.3
JUL	I	2	4	4	4	17	11	1	1	2	16	0	0.3	2.9	15.2	5.7	6.9
	II	1	1	6	5	17	7	0	4	4	16	0	0.3	1.9	17.4	8.4	3.0
AUG	I	2	2	5	3	19	7	1	2	3	18	0	0.0	5.3	15.3	4.3	6.1
	II	0	0	5	5	21	5	0	4	4	18	0	0.0	3.2	18.5	6.7	2.8
SEP	I	8	6	5	3	8	18	1	2	2	7	0	0.0	1.2	10.2	4.9	14.6
	II	2	4	11	5	8	12	1	5	4	8	0	0.1	1.7	10.8	9.4	8.0
OCT	I	21	4	3	2	1	26	0	1	1	1	0	0.0	0.1	5.6	4.2	21.1
	II	17	4	7	2	1	26	1	2	1	1	0	0.0	0.2	3.6	7.7	19.5
NOV	I	21	3	3	1	2	27	0	0	1	2	0	0.1	0.5	4.8	5.3	19.3
	II	19	2	6	2	1	27	0	1	1	1	0	0.0	0.5	5.5	4.6	19.4
DEC	I	22	2	3	2	2	27	0	1	1	2	0	0.8	1.2	6.8	10.1	12.3
	II	19	3	5	3	1	28	0	1	1	1	0	0.3	0.4	8.7	5.5	16.1
ANNUAL TOTAL OR MEAN	I	186	40	46	30	63	284	8	12	18	58	5	1.3	14.4	94.1	68.2	187.0
	II	131	38	93	42	84	251	5	27	24	58	0	0.7	8.7	92.8	81.1	191.9
NUMBER OF YEARS	I			19					19						19		
	II			19					19						19		

532

ANNEXURE-A-III

DESIGN CLARIFIED WATER ANALYSIS

Sl. No.	Constituent	as	mg per litre
1.	Calcium	$CaCO_3$	102
2.	Magnesium	$CaCO_3$	41
3.	Sodium	$CaCO_3$	35
4.	Potassium	$CaCO_3$	3
5.	Total Alkalinity	$CaCO_3$	113
6.	P-Alkalinity	$CaCO_3$	Nil
7.	Chloride	$CaCO_3$	43
8.	Sulphate	$CaCO_3$	25
9.	Silica (Reactive)	SiO_2	16
10.	Iron	Fe	0.3 mg/l
11.	pH Value	-	6.8 - 8.5
12.	Turbidity	NTU	10

Note- Clarified water shall be used as make up water for cooling water system.

ANNEXURE – A-III

ANALYSIS OF DM WATER TO BE USED FOR MAKE-UP WATER TO CONDENSER

Sl.No.	Characteristics	Value
1.	Silica (Max.)	0.01 ppm as Sio2
2.	Iron as Fe	Nil
3.	Total hardness	Nil
4.	pH value	6.8 -7.3
5.	Conductivity	Not more than 0.1micro mho/cm excluding the effects of free CO2

ANNEXURE-WL(GADARWARA)

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.

ANNEXURE-B

SITE SPECIFIC DESIGN PARAMETERS

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

a) The basic wind speed "V_b" at ten metres above the mean ground level : 39 metres/second

b) The risk coefficient "K_1" : 1.06

c) Category of terrain : Category-2

Note: Notwithstanding the values of the above mentioned parameters, the design wind pressure so computed at any point shall not be taken less than 1500 N/Sq. metre for all classes of structures, i.e. A, B & C, as defined in IS: 875 (Part-3).

Gadarwara Thermal Power Project

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:

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

Method of Analysis

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

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

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 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.

ANNEXURE – 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)	: 0.18 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	: 0.0525
b)	for braced steel frames designed and detailed as per IS:800	: 0.039
c)	For special moment resisting RC frames designed and detailed as per IS:456 and IS:13920	: 0.0315
d)	for steel chimney	: 0.079
e)	for design of structures not covered under 2 (a) to 2 (d) above and under 3 below	: 0.0525
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	: 0.105

Note: g = Acceleration due to gravity

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

ANNEXURE – I

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

Time Period (Sec)	Damping Factor (as a percentage of critical damping)	
	2%	5%
0	1	1
0.03	1	1
0.04	1.287	1.178
0.05	1.564	1.337
0.06	1.835	1.482
0.07	2.101	1.618
0.08	2.361	1.746
0.09	2.618	1.866
0.1	2.871	1.982
0.105	2.996	2.037
0.11	3.121	2.092
0.115	3.245	2.145
0.12	3.368	2.198
0.123	3.442	2.229
0.127	3.500	2.270
0.13	3.500	2.300
0.135	3.500	2.500
0.14	3.500	2.500
0.145	3.500	2.500
0.15	3.500	2.500
0.2	3.500	2.500
0.25	3.500	2.500
0.3	3.500	2.500
0.35	3.500	2.500
0.4	3.500	2.500
0.43	3.500	2.500
0.45	3.500	2.500
0.48	3.500	2.500
0.49	3.369	2.500
0.5	3.302	2.500
0.52	3.175	2.212
0.555	2.975	2.072
0.56	2.948	2.054
0.565	2.922	2.035
0.57	2.896	2.018
0.575	2.871	2.000
0.58	2.847	1.983
0.585	2.822	1.966

ANNEXURE – I

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

Time Period (Sec)	Damping Factor (as a percentage of critical damping)	
	2%	5%
0.59	2.798	1.949
0.595	2.775	1.933
0.6	2.752	1.917
0.65	2.540	1.769
0.7	2.359	1.643
0.75	2.201	1.533
0.8	2.064	1.438
0.85	1.942	1.353
0.9	1.834	1.278
0.95	1.738	1.211
1	1.651	1.150
1.05	1.572	1.095
1.1	1.501	1.045
1.15	1.436	1.000
1.2	1.376	0.958
1.25	1.321	0.920
1.3	1.270	0.885
1.35	1.223	0.852
1.4	1.179	0.821
1.45	1.139	0.793
1.5	1.101	0.767
1.55	1.065	0.742
1.6	1.032	0.719
1.65	1.001	0.697
1.7	0.971	0.676
1.75	0.943	0.657
1.8	0.917	0.639
1.85	0.892	0.622
1.9	0.869	0.605
1.95	0.847	0.590
2	0.826	0.575
2.05	0.805	0.561
2.1	0.786	0.548
2.15	0.768	0.535
2.2	0.750	0.523
2.25	0.734	0.511
2.3	0.718	0.500
2.35	0.703	0.489
2.4	0.688	0.479

ANNEXURE – I

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

Time Period (Sec)	Damping Factor (as a percentage of critical damping)	
	2%	5%
2.45	0.674	0.469
2.5	0.660	0.460
2.55	0.647	0.451
2.6	0.635	0.442
2.65	0.623	0.434
2.7	0.611	0.426
2.75	0.600	0.418
2.8	0.590	0.411
2.85	0.579	0.404
2.9	0.569	0.397
2.95	0.560	0.390
3	0.550	0.383
3.05	0.541	0.377
3.1	0.533	0.371
3.15	0.524	0.365
3.2	0.516	0.359
3.25	0.508	0.354
3.3	0.500	0.348
3.35	0.493	0.343
3.4	0.486	0.338
3.45	0.479	0.333
3.5	0.472	0.329
3.55	0.465	0.324
3.6	0.459	0.319
3.65	0.452	0.315
3.7	0.446	0.311
3.75	0.446	0.307
3.8	0.435	0.303
3.85	0.423	0.299
3.9	0.413	0.295
3.95	0.402	0.291
4	0.392	0.286

SECTION – C

SPECIFIC REQUIREMENTS

SECTION C1 : CONDENSER ONLOAD TUBE CLEANING

SECTION C2 : ELECTRICAL SYSTEMS

SECTION C3 : C&I SYSTEMS

SECTION C1

CONDENSER ONLOAD TUBE CLEANING SYSTEMS

(MECHANICAL DETAILS)

1.0 GENERAL

The Condenser On load Tube Cleaning Systems (COLTCS) complete with all accessories shall conform to the standard technical specifications (Section-D) and Data Sheet-A enclosed herewith. In addition the requirements of this section C shall also be complied with. However, wherever the details given in Section-D and Data Sheet-A are different, the requirements of Data Sheet-A shall prevail. Similarly in the event of contradictions between Section-C & Section-D/ Data Sheet-A, Section-C shall prevail.

Section C consists of 3 parts viz. Sec. C1, C2 and C3 for Mechanical, Electrical and C&I respectively, the requirements of all 3 sections shall be complied with.

2.0 DESCRIPTION OF EQUIPMENTS :

2.1 **Condenser on load tube cleaning systems (COLTCS) :**

The condenser on load tube cleaning system (COLTCS) is intended to prevent formation of various forms of fouling and scaling in the condenser tubes. The cooling water system is of closed circuit type with cooling towers or open circuit type as specified. The water analysis is indicated in project information in section B.

3.0 SCOPE OF SUPPLY UNDER THE SPECIFICATION IN THE BIDDER'S SCOPE FOR COLTCS.

3.1 The scope of supply for COLTCS covered under this specification is as under.

The size, MOC's and other particulars of the equipments for various projects are detailed in Data Sheet A annexed with Section – D of the specification.

SI.NO.	PROJECT	COLTCS
1.	2 X 800 MW NTPC GADARWARA STPP STAGE I – (STG PKG).	2 SETS PER UNIT viz. TOTAL 4 SETS FOR BOTH UNIT.

3.2 SCOPE OF SUPPLY IN THE BIDDER'S SCOPE FOR COLTCS:

3.2.1 Each set of COLTCS for each projects shall comprise following :

a) One No. Ball Separator at Condenser CW outlet pipe.
b) One No. Ball recirculation pump with drive motor.
c) One No. Ball collector.

d) One No. Manual ball sorter (Bucket type sorter with sieves to manually sort out the undersized balls by shaking the sieved bucket manually) for each set of COLTCS.

e) Differential pressure measuring system for ball separator. DP measuring system shall comprise 1 no. DPT +1 no. DPS + 1 no. DPG for each COLTCS. Instrument shall be with *Remote seal* arrangement. Stubs for DPT, DPS and DPG shall be independent.

f) Ball monitoring system comprising an independent balls recirculation monitor and an independent balls oversize monitor. If bidder is not manufacturing Ball over size monitor then they can offer other alternatives like automatic ball sorter etc.

g) Length of Ball separator, Scope of Counter Flange, Nuts and bolts shall be as per Annexure- I of section C1.
Thickness of body flange and counter flange shall be as per Drg no PE-DG-999-141-MO17 enclosed at enclosures at Annexure-II.

h) Complete Pipe work, including interconnection piping, flanges/counter flanges for valves & pipes, bends, fittings, distributors, nozzles and support installation materials shall be in Bidder's scope. Bidder shall finalize the pipework to suit the layout at contract stage in such a way that no site welding is required for his pipework otherwise the same shall be carried out by bidder at site.

i) The Electrical and C&I item / accessory as specified in succeeding clause/ respective sections herein.

j) Power and Control cables between starter Panel (Switch Gear) and various drives in bidder's scope of supply for all projects.

k) Starter Panel (Switch Gear Panel) shall be as follows:

a) 2 Sets of COLTCS shall have one Common Starter Panel (Switch Gear Panel) for DCS based control system.

Switch Gear Panel should have suitable arrangement like Bus Coupler for providing redundancy to incoming supply feeder (1Working + 1 Standby feeder).

l) Control cables between field instruments and control panel.

m) All the field instruments stipulated in this specification shall be in Bidder's scope.

n) Commissioning balls and other commissioning spares on "As required basis".

o) Set of mandatory spares as indicated in Data Sheet A.

p) Supporting arrangement complete with foundation plates, anchor bolts, nuts, sleeves, inserts, all installation materials, fixing bolts, clamps and other accessories etc for complete equipment supplied under this package.

q) Finish paints for touch up painting of equipment after erection at site, in sealed containers.

r) Set of special tools and tackles if required for maintenance and erection of the equipment supplied.

s) Various drawings, data test reports/ certificates instruction manuals for erection operation and maintenance etc. as specified in Data Sheet-C. and cables schedule indicating BOQ for power & control cables.

t) Panels & Instruments: Scope and Type as specified in C&I section wherever required.

Any item not specified but required to make COLTCS a complete package shall also be in bidder's scope.

4.0 SCOPE OF SERVICES INCLUDED IN THE BIDDER'S SCOPE :

The bidder's scope also includes following services at site, for scope under this specification for COLTCS for respective projects

a) Installation checks (Erection in BHEL's scope).
b) Commissioning of equipment.
c) Trial run for requisite period
d) Performance Testing.

The trial run of equipment shall be generally conducted immediately after commissioning while PG testing shall be conducted at a later date. These activities for different units shall be timed separately.

The no. of visits may be suitably assessed by bidders as per their experience with site stay periods on as required basis.

In the event of order number of visits as follows shall be made as a minimum with charges included in the bidder's base price itself.

- **For drawings/documents approval**
  In the event of order all drawings / documents in soft as well as hard copy shall be submitted as per NIT.

  Further on receipt of Customer comments, if required bidder's engineer shall visit BHEL/ Customer alongwith soft copy to resolve all issues and incorporate comments in the soft copy for across the table finalisation and Category-I approval.

- **Site Visits :**

  i. No. of site visits for combined activities of erection checks and commissioning for COLTCS as applicable shall be one per unit - for both sets of equipments of one unit. Time duration for erection and commissioning shall be "on as required basis" with equipments run for trial operation thereafter for requisite period to demonstrate satisfactory operation.

  However the no. of visits may be suitably assessed by bidders as per their experience with site stay periods on as required basis.

  ii. Bidder shall demonstrate guarantees including balls recovery, life of balls, pressure drops, etc. at site during subsequent visit for COLTCS of each unit.

  iii. For trouble shooting on "as required basis".

5.0 EXCLUSIONS :

The following are excluded from the bidder's scope .

5.1 Civil foundation works required for installation
5.2 Erection of Equipment at site.

6.0 DESIGN CONSTRUCTION :

In addition to the requirements of Section-D the following shall also be complied with for packages/ projects under scope of this specification:

6.1 For COLTCS - Layout Piping Arrangement Drg. are enclosed in the specifications and same is enclosed at Annexure-III.

6.2 Thickness of body flange and counter flange of COLTCS shall be as per Drg no PE-DG-999-141-MO17 enclosed at enclosures at Annexure-II.

6.3 The materials of construction specified in Data Sheet-A are minimum requirements and materials of construction for other components not specified shall be similarly selected by the bidder for the intended duty which shall be subject to purchaser's approval during detailed engineering in the event of order.

6.4 Housing/ body of COLTCS shall be designed and manufactured as per the applicable codes for pressure vessels and to take care of force and moments as enclosed in the specification. However in no case thickness of housing/ body shall be less than connecting pipe thickness as specified in Data Sheet-A of COLTCS.

6.5 Adequate provision for future installation of Cathodic Protection for COLTCS (Sacrificial type) shall be kept by the bidder in the equipment.

6.6 Any flow straightner for streamlining the CW flow in balls collecting strainer if required shall be supplied by the bidder along with mounting arrangement and the fixing details.

6.7 Velocity in the pipe work shall be less than 1.5 m/ sec for pump suction and less than 2.2 m/ sec. in other pipe work. All valves upto 150 NB shall be ball valves. For higher sizes, gate/ globe/ B.F. valves shall be provided. All instrument valves shall be needle valves.

7.0 Performance Guarantee and Testing :

The Tube Cleaning Systems shall be guaranteed to meet the performance requirements specified in Section-D and also for trouble free operation after commissioning. Schedule of performance guarantees (enclosed in Volume III) duly filled and signed shall be furnished with the bid.

The Performance guarantees of equipments shall stand valid till the satisfactory completion of performance testing & its acceptance by BHEL/ Consultant/Customer. If the guarantee period specified in the Commercial Specification is higher, same shall prevail.

8.0 Performance Guarantee and Bid Evaluation criteria for Condenser on Load Tube Cleaning System.

8.1 **Condenser On Load Tube Cleaning Systems.**

8.1.1 Performance Parameters to be guaranteed by bidders for COLTCS ~~of all projects~~ shall be as under :

i) Pressure drop in ball separator in clean condition viz. after back washing.

ii) Percentage recovery of balls (min. 90% recovery)

iii) Life of Sponge Rubber Ball (Min. 3 weeks).

Any deviation to above balls life and percentage recovery will not be accepted.

Bidder to indicate the life of sponge rubber ball and nos. of balls lost during 1000 hours of plant operation and pressure Drop in Ball seperator in clean condition in the Guarantee schedule and shall demonstrate same at site.

In case the successful bidder fails to demonstrate any of these parameters he shall carry out modifications at his own cost, to purchasers approval.
In case bidder fails to demonstrate above parameters to purchaser's satisfaction even after modification carried by him at site, the purchaser has the right to reject the equipment out rightly.

8.1.2 Bidder to note that bids shall be evaluated on account of pressure drop across ball collecting strainer (in clean condition) and liquidated damages on account of not meeting the same during PG test shall be in accordance with following:

A) Bid Evaluation Criteria & Liquidated Damages:

The bids received shall be evaluated for Pressure drop across balls collecting strainers:

- The permissible limit of pressure drop across balls collecting strainers in clean condition shall be 0.15 MWC.
- If the pressure drops quoted are higher than above limit, the bids shall be technically loaded @ Rate as mentioned in Data Sheet-A for respective project per **0.05 MWC** pressure drop across each balls collecting strainer.
- However no advantage shall be given for pressure drops quoted less than above permissible limit.
- The maximum acceptable limit for pressure drop across balls collecting strainer shall be (with technical loadings) 0.2 MWC.
  The bids will be technically rejected for pressure drops quoted higher than above maximum limit.
- The guaranteed pressure drops shall be demonstrated at site by bidder and if found higher shall be subject to LD @ Rate as mentioned in Data Sheet-A.

9.0 SPARES :

9.1 **Recommended Spares :**

The supply of spare parts as necessary recommended by the manufacture for three (3) years of reliable operation and maintenance of COLTCS of respective projects shall be supplied. List of such spares along with the unit price shall not be included in base price but indicated separately in the schedule of prices for recommended spares enclosed in Vol. -III.

9.2 **Mandatory Spares**

Mandatory Spares shall be as per Data Sheet-A or annexure enclosed with data sheet of the respective packages applicable for specific projects, prices for same shall be included by bidder in the equipment base price itself.

10.0 Quality Plan

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 and 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. Charges for 3rd party inspection (TUV/ equivalent) for imported components wherever required shall be included by bidder in the base price itself. Witness for all the test identified under agency "C" & "N" in Quality plan shall be by third party.

If BHEL or BHEL customer decides to witness the tests along with third party, the cost of travel of BHEL or BHEL customer shall be borne by BHEL or BHEL customer themselves.

11.0 DELIVERY & DRAWINGS/ DOCUMENTS DISTRIBUTION SCHEDULE :

a. Delivery of Equipment for each project shall be as per NIT.

b. The drawings to be submitted by bidder in event of award of contract for COLTCS shall be as follows:

- Technical Data Sheets, P&ID, Installation Plan , for COLTCS.
- GA drawings, Details of BR Skid and C&I Document(Part-I & II) of COLTCS as applicable.
- Quality Plan.
- O & M Manual.

c. Drawings submission schedule shall be as per NIT/as advised by Project Group.:

12.0 The makes of various bought out items shall be subjected to purchaser's approval in the event of order.

13.0 It is mandatory for the bidders to submit along with the bid the deviations if any whether major or minor in the schedule of deviations only. ***In the absence of deviations listed in the schedule of deviations the offer shall be deemed to be in full conformity with the specification "non-withstanding" any thing else stated elsewhere in bidder's offer, data sheets etc. The implied/ indirect deviations in data sheets etc. Shall not be binding on the purchaser.***

14.0 The following documents shall be furnished by the bidder with his offer :

- Compliance certificate duly signed and stamped (Enclosed at Schedules).
- Guarantee schedule duly signed and stamped (Enclosed at Schedules).

- GA drawings of following with empty/ filled-ups.
  - Balls Collecting Strainers (as applicable).
  - Balls recirculating Skids.
  - Debris Flushing pumps (if applicable)
  - Other equipments considered necessary for Layout/ Civil.

- Electrical Load Data (Enclosed at Vol. III of Specification)
- Schedule of Deviation (Enclosed at Schedules).

The bidder to note that load requirement furnished and finalised during tender stage shall only be provided by BHEL and any changes or additional requirement of Electrical load by bidder during contract stage shall be provided by BHEL with cost repercussions to the bidder.

NOTE: Apart from above, no other drawing/ document/ data sheet etc. shall be submitted along with the offer. If any drawing/ document etc. is submitted with the offer, same shall be considered as for 'Reference' purpose only and shall not be reviewed/ commented upon and any deviation, exclusion to scope, etc. taken in documents but not highlighted in the deviation schedule shall not be taken cognizance of.

ANNEXURE- I

COLTCS

SL.NO.	Projects	Size (NB)	Length of Ball Seperator (Including Counter Flange)	Scope of Counter Flange	Scope of nuts and bolts.
1	2 X 800 MW NTPC GADARWARA STPP STAGE I – (STG PKG).	2500 NB	4000 mm	In Purchaser's Scope.	In Bidder's Scope

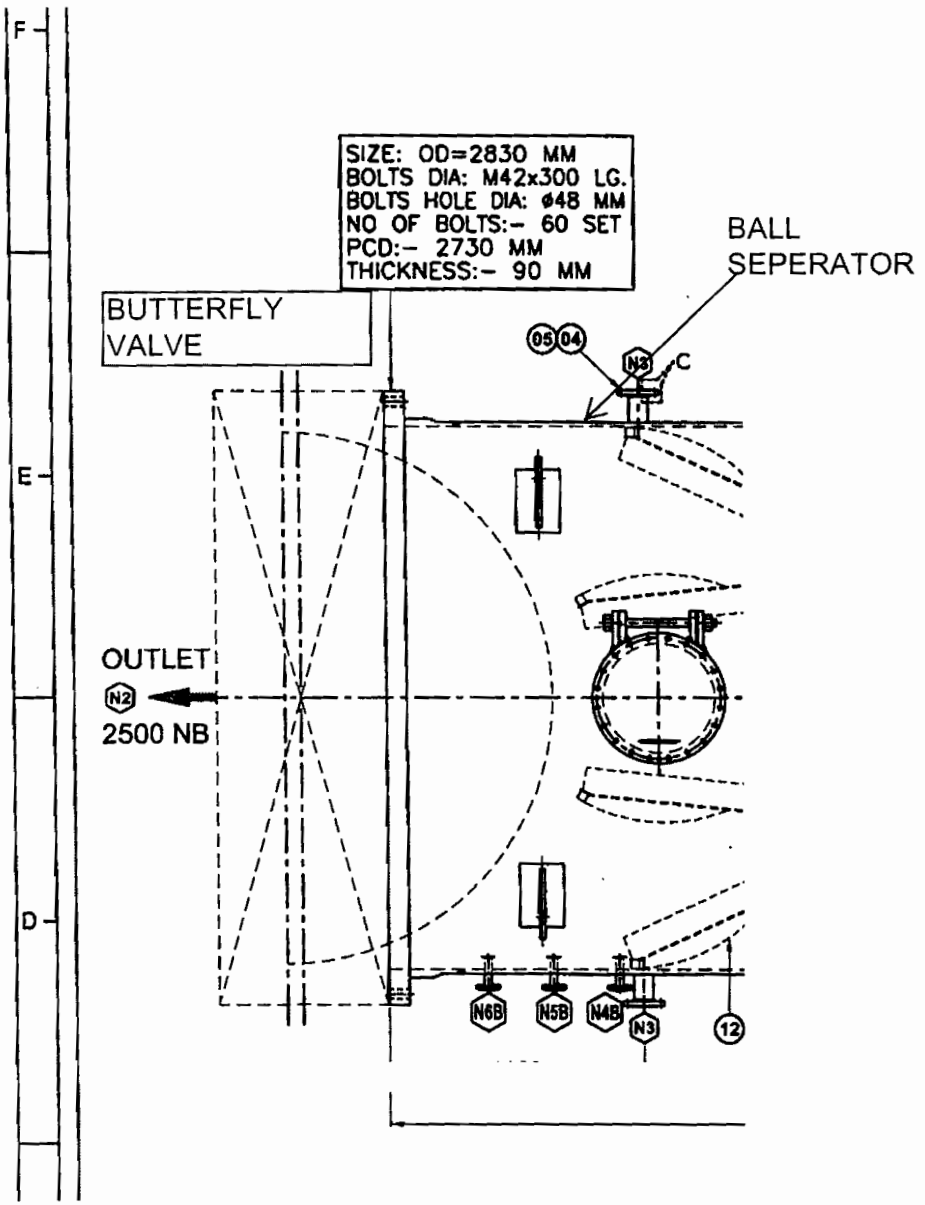
Note:

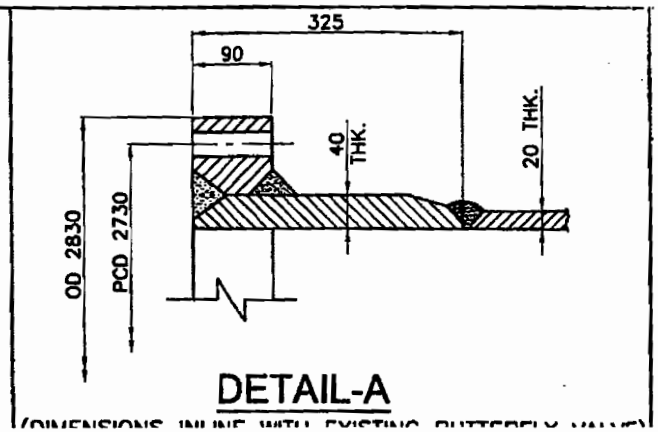
1. Upstream side of the Ball separator shall be directly mounted on the Butterfly valve. Flap of the Butterfly valve shall be extended upto 950~1000 mm (tentative) inside the ball separator.

2. Fasteners on both side of the Ball seperator shall be in Bidder scope of supply. Details of the mating flange (counterflange) shall be provided during detail engineering.

3. Bidders to match Ball Separator Flange (holes and PCD) with flange of BFV. Reference drg enclosed as Annexure-IV may be referred for PCD, OD etc for counterflange supplied by purchaser. The details shall be finalized during contract stage.

REFERENCE DRG FOR COUNTERFLANGE O.D. & PCD.

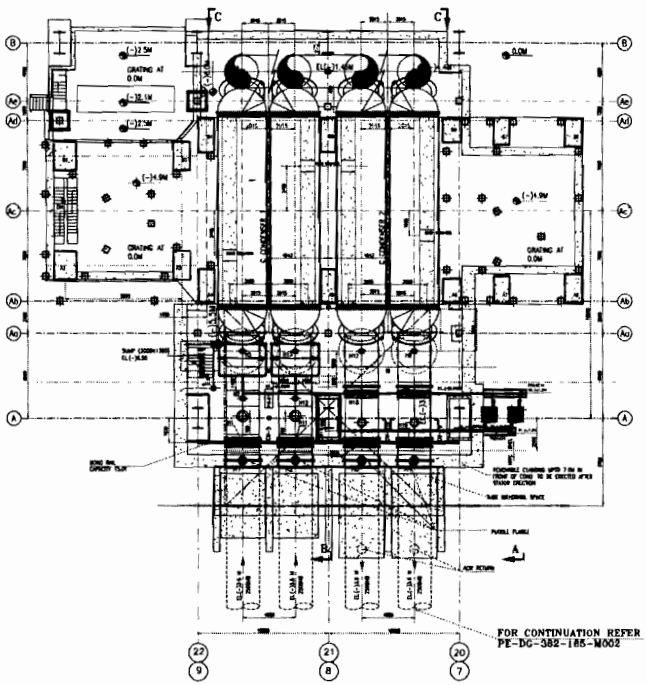


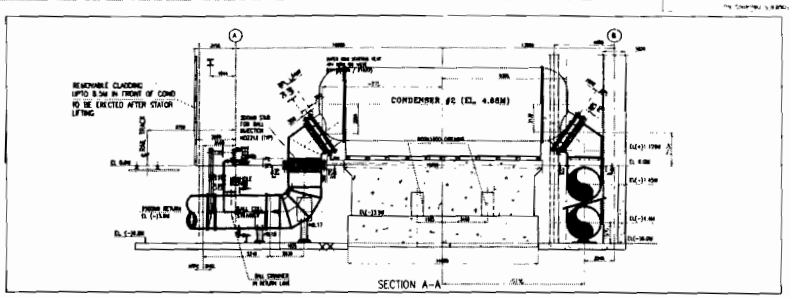


ANNX – IV

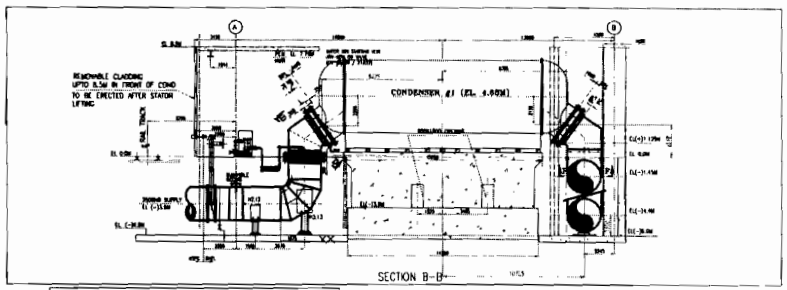
ANNEXURE-II

NORTH

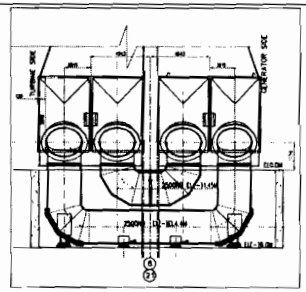




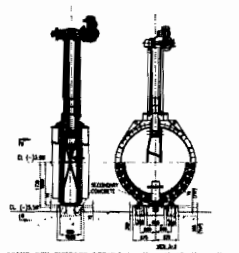
SECTION A-A



SECTION B-B



SECTION C-C



700NB RFV SUPPORT DETAILS for H-1, H-10, H-11, H-19

PRELIMINARY DRAWING

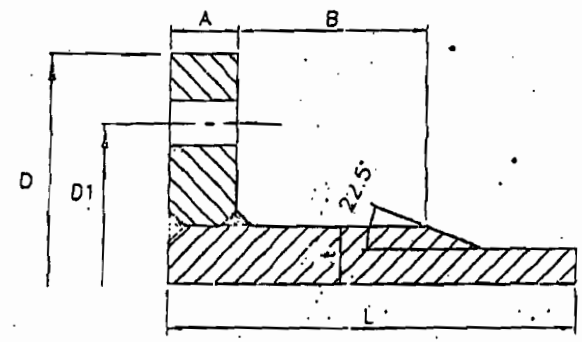
NTPC DRG. No.	
NTPC	NATIONAL THERMAL POWER CORPORATION LTD. BADARPARA SUPER THERMAL POWER PROJECT STAGE-I (3 x 800MW) UNIT # 1 & 2
	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA
JOB NO. 394	
CONTRACT	
TITLE	CW PIPING INSIDE TG HALL
	DRG. NO. PE-DG-394-165-M001

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

DRAWING NO. PE-DG-999-141-M017

ANNEXURE-II



NOTES:-

Flange thicknesses listed are for Design pressure=5Kg/cm²(g) and Flange dimensions as given in the table. Final thickness of the flange is to be checked for actual OD/Bolting PCD/Neck dimensions.

PIPE SIZE	PIPE THK.	FLANGE OD 'D'	Bolt PCD 'D1'	WELD NECK FLANGE				SLIP-ON FLANGE THICKNESS
				FLANGE THK. 'A'	NECK THK. 't'	NECK Length 'B'	Appx. Total Length 'L'	
1200	10-12	1465	1380	40	24	70	200	90
1400	14	1675	1590	50	24	70	200	100
1600	14	1915	1920	60	32	80	220	110
1800	14-16	2115	2020	70	32	90	250	120
2200	18	2550	2420	80	36	100	300	140
2300	20			90	38	110	325	150
2500	20			90	38	110	325	150
2700	20			90	38	110	325	150

DRAWING FOR BALL SEPARATOR COUNTER FLANGE

REV.	DATE	ALTD	CHD	APPD

JOB NO. 999

STATUS -

DISTRIBUTION

BHARAT HEAVY ELECTRICALS LTD
POWER GROUP
PROJECTS ENGINEERING MANAGEMENT
PPEI, NOIDA

DEPT CODE		NAME	SIGN	DATE
	DRN	PK		25.06.07
	DSGN	PK		25.06.07
	CHD	SPV		25.06.07
	APPD	SK		25.06.07

TITLE: COUNTER FLANGE DETAILS

DRAWING NO. PE-DG-999-141-M017

SHEET 01 OF 01 REV 00

4039

SECTION C2

CONDENSER ONLOAD TUBE CLEANING SYSTEMS

ELECTRICAL DETAILS

ANNEXURE – I TO SECTION – C : STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE : COLTCS / SCS

PROJECT:

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415 V DOL STARTER CUM CONTROL PANEL(SCCP) (Switchgear starter panel)	Vendor	NTPC/ BHEL site	1. NTPC will provide two suitable Power supply feeders to incoming terminal point of SCCP. Termination of input from NTPC switchgear is in vendor scope. 2. Interposing relays (RE 302 of Jyoti make or equivalent), if required for PLC and microprocessor based systems, shall be provided by Vendor in Starter cum control panel.
2	Local Push Button Station (for motors)	Vendor	NTPC/ BHEL site	Located near the motors.
3	Power cables, control cables and screened control cables for a) both end equipment in vendor's scope b) one end equipment in vendor's scope & another end in NTPC/BHEL (in case of C & I cables of DCS)	 Vendor NTPC/ BHEL	 NTPC/ BHEL site NTPC/ BHEL site	1. Incoming cable to SCCP from NTPC supplied MCC will be informed by NTPC. Screened control cable between DCS & field equipment will be informed by NTPC. Vendor shall provide lugs & glands accordingly. 2. Termination at Vendor equipment terminals by Vendor.
4	Any special type of cable like compensating, co-axial, prefab, MICC, fibre optical etc	Vendor	NTPC/ BHEL site	
5	Cable trays, accessories & cable trays supporting system	NTPC (Main tray) Vendor (Branch Tray)	NTPC/ BHEL site	NTPC will supply and erect the cable trays and its supporting structure in the Main cable routes both for their & vendor's cable. Vendor shall provide tray and support arrangements for his cables in the branch routes (i.e. route to each eqp, instruments, JB's, etc from the nearest main route).
6	Cable glands and lugs for equipments supplied by Vendor	Vendor	NTPC/ BHEL site	1. Tinned brass, double compression cable glands. 2. Solder less crimping type heavy duty tinned copper lugs for power cables 3. Solder less crimping type heavy duty copper lugs for control cables.
7	Conduit and conduit accessories for cabling between equipments supplied by vendor	Vendor	NTPC/ BHEL site	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537. Makes of conduits shall be subject to NTPC/ BHEL approval at contract stage.
8	Lighting	NTPC	NTPC	
9	Equipment grounding & lightning protection	NTPC	NTPC	
10	Below grade grounding	NTPC	NTPC	
11	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to NTPC/ BHEL approval at contract stage.
12	Mandatory spares	Vendor	-	Vendor to quote as per specification.
13	Recommended O & M spares, E & C spares, erection & maintenance tools & tackle	Vendor	-	As per specification

ANNEXURE – I TO SECTION – C : STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE : COLTCS / SCS

14	Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system).	Vendor	NTPC/ BHEL site	
15	a) Input cable schedules (C & I) b) Cable interconnection detail for the above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for control cables for vendor supplied equipment (soft copies in the BHEL cable schedule format) shall be furnished during detail engineering by vendor.
16	Equipment layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipments requiring cabling, and shall incorporate cable routing details marked on the drawing as per PEM interface comments. Electrical equipment layout drawing shall be to BHEL approval.
17	Electrical equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipments/items supplied shall be reputed make & shall be subject to approval of BHEL/NTPC after award of contract.
2. All QPs shall be subject to approval of BHEL/NTPC after award of contract without any commercial implication.
3. For skid mounted system, 2 nos. (1W+1S) supply of 415 V, 3 phase, 3 wire AC shall be provided by BHEL. Complete skid including changeover between feeder/starters/LCP/inter-locks/protection devices / any other supply etc. shall be in bidder's scope only.

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

1.0	Design ambient temperature		:	50 °C
2.0	Maximum acceptable kW rating of LV motor		:	200 KW
3.0	Installation (Indoors/ Outdoors)		:	As required
4.0	Details of supply system			
	a)	Rated voltage (with variation)	:	415V ± 10%, 11/3.3kV ± 6%,
	b)	Rated frequency (with variation)	:	50 Hz ± 5%
	c)	Combined voltage & freq. variation	:	10% (sum of absolute values)
	d)	System fault level at rated voltage	:	40 kA for 1 sec for 11kV & 3.3kV 45 kA for 1 sec for 415V system
	e)	LV System grounding	:	Solidly
5.0	Class of insulation		:	Class 'F', with temp rise limited to Class B.
6.0	Minimum voltage for starting (As percentage of rated voltage)		:	80% of rated voltage
7.0	Power cables data		:	Details attached
8.0	Earth Conductor Size & Material		:	Details attached
9.0	Space heater supply		:	240 V, 1¢ , 50 Hz
10.0	Rating up to which Single phase motor		:	Acceptable below 0.2 kW
11.0	Locked rotor current			
	a)	Limit as percentage of FLC	:	Details as per spec attached
	b)	Permissible tolerance, if any	:	±20%
12.0	Energy Efficient Motors		:	Details as per spec attached
13.0	Additional tests		:	As per QP
14.0	Flame-proof motor			
	a)	Enclosure suitable (As per IS:2148)	:	As per requirement
	b)	Classification of Hazardous area (As per IS: 5572 part-I)	:	As per requirement
15.0	Makes		:	ABB/ Bharat Bijlee/ CGL / KEC/ NGEF/Siemens/ALSTOM (SUBJECT TO CUSTOMER APPROVAL DURING DETAILED ENGG)

Note: **Motor name plate rating at 50°C shall have at least 10% margin over input power requirement at rated duty point unless otherwise stated in driven equipment specification**

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) Erection and Commissioning spares.
e) Erection & Maintenance tools & tackles.
f) Electrical load requirement for mill reject system.
g) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
h) 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
i) 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.
j) Motor shall meet minimum requirement of motor specification.
k) LT power & control cables shall meet minimum requirement of LT power & control cables specification.
l) Cabling, earthing & lightning protection shall meet minimum requirement of cabling, earthing & lightning protection specification.

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 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/quality assurance requirements stipulated. In line with this two signed and stamped copies of the following shall be furnished by the bidder as technical offer:

a) A copy of this sheet "Electrical equipment Specification for Condensate Polishing Unit" and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.
b) List of Erection and Commissioning spares.
c) List of Erection & Maintenance tools & tackles.
d) Electrical load requirement

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 NTPC & vendor.
b) Technical specification, datasheets & quality plans for 415V Electric motors.
c) Technical Specification, datasheets & quality plans for LT power & control cables.
d) Technical Specification, datasheets & quality plans for cabling, earthing & lightning protection.
e) Electrical Load data format.

SECTION C3

CONDENSER ONLOAD TUBE CLEANING SYSTEMS

C&I DETAILS

		2X800 MW GADARWARA
1.00	**SYSTEM**	COLTCS
2.00	**COMMON / PER UNIT**	PER UNIT
3.00	**CONTROL SYSTEM**	DCS (TG C&I)
3.10	**PROCESSOR CONFIGURATION FOR PLC SYSTEM**	NA
4.00	**LOCATION OF CONTROL SYSTEM**	CCR
4.10	**CONTROL SYSTEM SCOPE (BIDDER/ BHEL/ CUSTOMER)**	BHEL
5.00	**HARDWIRED INTERFACE WITH DCS (Y/N)**	NA
5.10	**PURPOSE OF HARDWIRED INTERFACE WITH DCS**	
5.11	***a) COMMAND FROM DCS (Y/N)***	NA
5.12	***b) STATUS FEEDBACK TO DCS (Y/N)***	NA
5.13	***c) GROUP FAULT ALARM TO DCS (Y/N)***	NA
6.00	**SOFTLINK TO DCS (Y/N)**	NA
6.10	***PURPOSE OF SOFTLINK TO DCS***	
6.11	***a) COMMAND INTERFACE WITH DCS (Y/N)***	NA
6.12	***b) STATUS MONITORING IN DCS (Y/N)***	NA
7.00	**PROTECTION CLASS FOR PLC / RIO PANEL**	NA
8.00	**CONTROL FROM PB's ON LCP/OWS ON LCP**	NA

9.00	ANNUNCIATION ON LCP (Y/N) -- IF Y, MIN NO. OF HARDWIRED ALARMS / INDICATIONS	NA
9.10	MIMIC ON LCP (Y/N)	NA
10.00	CONTROL FROM DCS IN CCR (Y/N)	Y
11.00	TYPE OF SOFTLINK (TP/OFC)	NA
11.10	COMMUNICATION CABLE SCOPE (BIDDER/ PEM/ EDN/ CUSTOMER)	NA
11.20	REDUNDANT CABLE (Y/N)	NA
11.30	PROTOCOL	NA
12.00	RIO / RPU (Y/N)	NA
13.00	## NO. OF OWS / LAPTOP	NA
13.10	SIZE OF OWS/ CRT OR LCD	NA
14.00	NO. OF PRINTER	NA
14.10	PRINTER SIZE AND TYPE	NA
15.00	$$ POWER SUPPLY AVAILABLE FOR BALL MONITOR (24V DC / 110 V AC UPS / 230 V AC UPS)	24V DC
15.10	&& POWER SUPPLY AVAILABLE FOR PLC PANEL (3PHASE, 415 V AC/ 1PHASE, 110 V UPS/ 1PHASE, 230 V UPS)	NA
15.20	REDUNDANT FEEDERS (R) / NON-REDUNDANT (NR) FEEDERS FOR POWER SUPPLY	NA
15.30	UPS BATTERY CONFIGURATION (1X100% / 2X100%)	NA
15.40	BATTERY TYPE (LEAD ACID/ NI-Cd)	NA
15.50	BATTERY BACK-UP TIME (in minutes)	NA

16.00	ACTUATOR WITH INTEGRAL STARTER (Y/N)	Y
17.00	PG/ DPG/ PS/ DPS/ PT/ DPT per Balls Collecting Strainer	DPT = 1 no. DPG = 1 no. DPS = 1 no.
18.00	REMARKS	
19.00	PROJECT SPECIFIC INFO	

19.00 **NOTES:**

1. $$ THIS IS APPLICABLE FOR DCS CONTROLLED SYSTEMS ONLY.
2. [illegible]
3. [illegible]
4. IN CASE OF DCS CONTROLLED SYSTEMS, BIDDER TO TERMINATE ALL INSTRUMENTATION AND CONTROL ELEMENTS IN JUNCTION BOXES FOR FURTHER CABLING TO DCS BY BHEL/CUSTOMER. BIDDER TO PROVIDE INPUT/OUTPUT LIST, DRIVES LIST, JUNCTION BOX SCHEDULE AND TERMINATION DETAILS, RECOMMENDED CONTROL LOGICS / WRITE-UP ETC. DURING DETAILED ENGINEERING
5. [illegible]
6. [illegible]
7. [illegible]
8. [illegible]
9. INSTRUMENT RACK AND JUNCTION BOXES SHALL BE IN BIDDER'S SCOPE OF SUPPLY. NECESSARY STRUCTURAL STEEL FOR MOUNTING THE INSTRUMENTS(DPG,DPT,DPS),JUNCTION BOX, INSTRUMENT RACK,SWGR PANEL, ETC. SHALL BE IN BIDDER'S SCOPE.
10. BIDDER TO FURNISH ELECTRICAL LOAD DATA DURING DETAILED ENGINEERING.
11. ALARM FACIA SHALL BE UNDER BIDDER'S SCOPE. NO. OF FACIA SHALL BE DECIDED DURING DETAILED ENGINEERING.

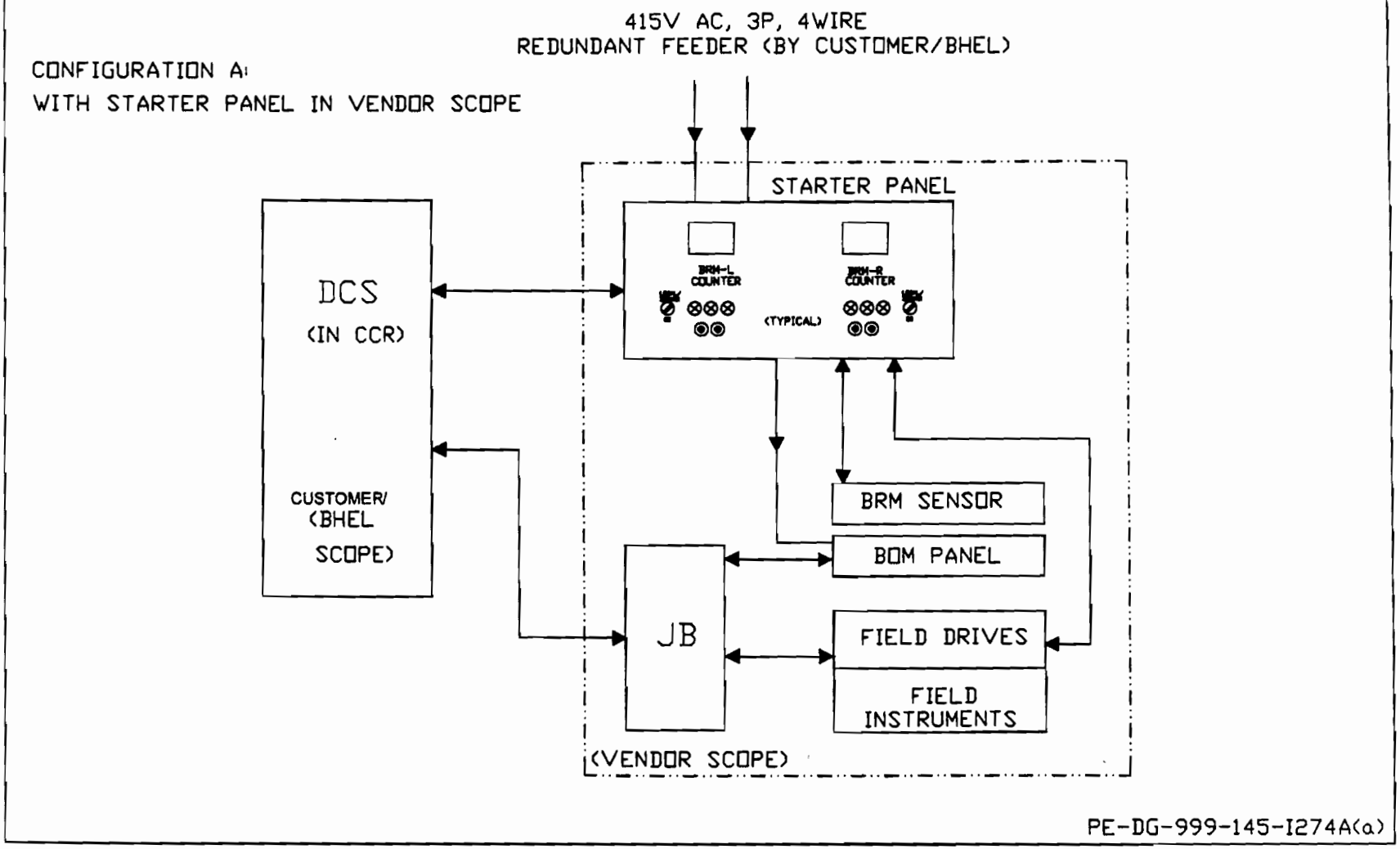
LEGEND:

DCS- DISTRIBUTED CONTROL SYSTEM

PLC- PROGRAMMABLE LOGIC CONTROLLER

RPU - REMOTE PROCESSING UNIT

STANDARD BLOCK DIAGRAM FOR COLTCS PACKAGE WITH DCS CONTROL



SECTION – D

STANDARD TECHNICAL SPECIFICATION

SECTION D1 : CONDENSER ONLOAD TUBE CLEANING SYSTEM

SECTION D2 : ELECTRICAL SYSTEMS

SECTION D3 : C&I SYSTEM

SECTION D1

STANDARD TECHNICAL SPECIFICATION FOR CONDENSER ONLOAD TUBE CLEANING SYSTEMS

	TITLE : STANDARD TECHNICAL SPECIFICATION CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)	SPECIFICATION NO.PE-TS-999-165-N001	
BHEL		VOLUME : II B	
		SECTION : D	
		REV. NO. 00	DATE :27.09.07
		SHEET 1 OF 14	

1.00.00 **GENERAL**

This specification covers the design, performance and operational requirements, configuration and constructional features, manufacture, assembly, inspection and testing at the manufacturer's and/or his sub-contractor's works and painting for delivery of condenser on-load tube cleaning system (sponge rubber balls type) complete with all accessories as specified hereinafter. Each half of the condenser shall be provided with an independent tube cleaning system.

2.00.00 **CODES AND STANDARDS**

2.01.00 The design, materials, manufacture, inspection and testing of the condenser on-load tube cleaning system complete with all accessories, shall comply with the requirements of the latest versions of the following appropriate codes and standards.

2.01.01 IS/BS/DIN/US Standards regarding pressure vessels, pumps, piping, flanges and others as necessary.

2.01.02 IS/BS/DIN/ASTM Standards for materials specification and testing procedures.

2.01.03 IS/BS/DIN/AWWA Standards for valves and the testing.

2.02.00 In case of any conflict between the above codes/standards and this specification, the later shall prevail and in case of any further conflict in the matter, the interpretation of the specification by the Engineer shall be final and binding.

3.00.00 **DESIGN AND CONSTRUCTION**

3.01.00 General Requirements

3.01.01 Unless otherwise necessary, manufacturer's standard and proven models of the tube cleaning system shall be supplied.

3.01.02 The tube cleaning system shall be capable of safe, continuous and trouble-free operation for removal of fouling and scaling materials from condenser tubes. Vibration, noise, mechanical stresses shall be kept within allowable limits specified by relevant codes/standards. In design, due attention shall be given to ease of maintenance, repair and cleaning.

3.01.03 Suitable Corrosion allowance shall be provided whenever necessary. Adequate provision for future installation of cathodic protection shall be provided.

3.01.04 The tube cleaning system shall consist of ball separator at condenser outlet, recirculating pump, ball collector, differential pressure measuring system for ball separator, ball monitoring system, cleaning balls, piping valves, distributors, injection nozzles, instrumentations, control panel, interconnecting cables and others as necessary. The configuration of the tube cleaning system shall be as described in section C and / or as per the scheme enclosed.

3.02.00 **Performance Requirements.**

3.02.01 The tube cleaning system with all accessories shall be designed and guaranteed to meet the following requirements :

The tube cleaning system shall perform satisfactorily under the flow and pressure drop conditions (in the condenser) specified in Data Sheet - A and shall be capable of removing the various forms of fouling and scaling from condenser tubes.

3.02.02 The ball separator at the condenser outlet, shall be designed such that the pressure drop across the ball separator under clean conditions shall not be more than that specified in Data Sheet - A. The performance of the ball separator shall be continuous with minimum number of backwashing operations.

3.02.03 The power consumption by ball recirculation pump during various operations shall be minimum possible.

The quantity of cleaning balls worn out and / or lost, shall be minimum possible.

3.03.00 **Operational Requirements.**

The tube cleaning system and other accessories shall be designed for the following operation modes :

3.03.01 Complete automatic start-up of tube cleaning system initiated by pressing the push button (manual command).

3.03.02 Complete automatic shut-down of tube cleaning system with ball collection, effected by the following :

- Push button (manual command).
- Adjustable timer (after a defined cleaning period).
- Ball monitoring system (when the number of oversized balls falls below a set value).

3.03.02 Complete automatic backwashing of ball separator with ball collection, effected by the following :

- Differential pressure measuring system at a pre-determined differential across the ball separating strainer/ screen.
- Adjustable timer
- Push button

3.03.04 Complete automatic emergency backwashing of ball separator with alarm indication, effected by differential pressure measuring system.

3.03.05 Manual operation for start-up, shut-down with ball collection backwashing of ball separator, flushing of differential pressure measuring system etc., in case of failure of control system.

3..04.00 **Ball Separator**

3.04.01 Ball separator body shall be of rigid construction and shall be designed and manufactured as per the applicable codes for pressure vessels. It shall house the ball separating screen / strainer and shall have flanged inlet, outlet, ball extraction opening and pressure measuring tappings etc. Body shall be designed and manufactured as per the applicable codes for pressure vessels and to take care of forces and moments as enclosed in the specification. However in no case thickness of housing/body shall be less than the connecting pipe thickness as specified in data sheet A

3.04.02 The ball separator shall be provided with manhole with bolted cover and sight glass to observe its internals.

3.04.03 If specified in Data Sheet -A, ball separator body shall be Epoxy lined.

3.04.04 The ball seperating screen / strainer shall be designed for the maximum differential pressure across the separator and shall be securely mounted in the body. Screen / strainer shaft shall be sized adequately considering the overloading of screens / strainer due to debris accumulation.

3.04.05 The ball separating strainers / screens shall have electric actuators for swivelling to allow for their backwashing. Also suitable handwheels shall be provided to enable manual swivelling of strainers / screens.

3.05.00 **Ball Recirculating Pump**

3.05.01 The ball recirculating pump shall be horizontal centrifugal type. The casing shall be designed to withstand 1.5 times the shut-off pressure or twice the operating pressure, whichever is higher.

3.05.02 The impeller shall be non-clog type and shall be contoured suitably to avoid damage to the cleaning balls. The impeller shall be secured suitably to the shaft and shall be retained against circumferential movement by keys, pins or lock rings. Loctite compound shall be applied after tightening of locknuts to prevent dislocation of impeller.

3.05.03 Replaceable type wearing ring shall be provided to prevent damage to the casing and impeller.

3.05.04 Pumps shall be provided with mechanical seals to the extent feasible. If Gland packing is provided it should be of good quality to be provided to prevent leakage of water from pump glands.

3.05.05 Shaft size selected shall take into Consideration the critical speed which shall be away from the operating speed as recommended in applicable codes / standards. Renewable type fine finished shaft sleeves shall be integral with water thrower plates at the end and the length must extend beyond the outer faces of gland packing so as to distinguish between the leakage between shaft and the shaft sleeve and that past the seals / glands.

3.05.06 Bearings of adequate design shall be provided for taking the entire pump load arising from all probable conditions of continuous operation through its range of operation. The bearings shall be designed on the basis of 20,000 working hours minimum for the load corresponding to the duty point. Proper lubricating element does not contaminate the liquid being pumped. Bearings shall be easily accessible without disturbing the pump assembly

3.05.07 Stuffing box of suitable design to permit replacement of packing without removing any part other than the gland shall be provided. The stuffing boxes shall be sealed / cooled by the fluid being pumped.

3.05.08 Pumps shall be of self-lubricated, self - sealed and self-cooled type. All pipework, fitters etc., for sealing, cooling and lubricating purpose shall be supplied and no external cooling/lubricating/sealing water will be supplied. Pump capacity shall take into account the cooling/lubricating/sealing water requirement.

3.05.09 All rotating components shall be statically and dynamically balanced.

3.05.10 The pump shall be designed such that pump impellers and other accessories of the pump, are not damaged due to flow reversal.

3.05.11 The pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the head Vs. flow characteristic curve over a range or 40% of rated flow to 120 -130 % of rated flow.

3.05.12 The pump shall preferably be non-overloading type. The total head Vs. capacity curve shall be continuously rising from the maximum flow point towards shut-off without any zone of instability.

3.05.13 The pump shall run smoothly without undue noise and vibration. Peak to peak vibration limits and noise level shall be within the acceptable values of applicable codes/standards.

3.05.14 The pump and motor shafts shall be connected through a pin and rubber bush flexible type of couplings. Suitable coupling guards shall be provided for the couplings.

3.05.15 The pump shall be capable of being started with discharge valve fully opened. Motor rating shall be adequate for this condition. The output KW rating of the pump drive motor shall not be less than the larger of the following :

a) Maximum power input to the pump over the entire range for maximum flow to shut-off condition.
b) 125% of power input to the pump at duty point corresponding to 103% of the rated speed.

3.06.00 **Ball Collector**

3.06.01 The body of the ball collector shall be designed to withstand 2.0 times the operating pressure or 1.5 times the recirculating pump shut-off pressure, whichever is higher.

The ball collector shall be designed and manufactured as per the applicable codes for pressure vessels.

3.06.02 Ball collector shall be provided with an inspection window/sight glass for visual inspection of the cleaning balls.

3.06.03 Ball collector shall be provided with suitable ports with covers for ball feeding and removal.

3.06.04 The ball collector shall be provided with vent and drain connections with isolating valves.

3.06.05 Provision shall be made in the ball collector for separating the undersized balls and ball collector shall have a separate chamber for collecting the undersized balls.

3.06.06 If specified in Data Sheet -A, ball collector body shall be lined with suitable resilient material.

3.06.07 The differential pressure measuring system shall be provided with D.P. transmitter ,DPS & DPGof remote seal arrangement.

3.07.00 **Differential Pressure Measuring System.**

3.07.01 The ball separator shall be provided with a measuring system for differential pressure across the ball separating strainer/screen, to check debris accumulation and to initiate ball catching and backwashing operations. This shall consist of a differential pressure switch/transmitter for automatic backwashing operation, a differential pressure guage for manual observation with adequate number of tappings with isolating valves.

3.07.02 The contacts for differential pressure switch/transmitter and for differential pressure guage shall be independent so that in the event of failure of one, the other is available.

3.07.03 The differential pressure measuring system shall be with remote seal arrangement .

3.08.00 **Ball Monitoring System**

3.08.01 Ball monitoring system shall be provided for continuously monitoring the quantity and size of the cleaning balls in circulation. The monitoring system shall perform the following functions :

a) Continuously counting the oversize balls in circulation and giving an alarm calling for investigation of ball losses, when the number of oversize circulating balls falls below a set valve.

b) Continuously measuring the size of the balls in circulation and initiating the shut-down of the tube cleaning system with alarm calling-for replacement of balls when the number of oversized balls falls below a set valve.

c) Bidder's if not manufacturing ball oversized monitor,can supply automatic ball sorter in lieu of same for automatic sorting of the undersized balls.

3.08.02 The monitoring system shall be of proven and reliable design and shall be complete with necessary transducers, amplifiers, transmission lines, power cables and electronic processor etc.

3.08.03 The electronic processor of the ball monitoring system shall be housed in the control panel and shall consist the following : -

a) Indicators for
- required basic ball charge.
- recirculating ball quantity.
- oversized ball quantity.

b) Time counters for
- total cleaning system operating hours.
- cleaning system operating hours with sufficient number of oversized balls.

c) Recorder for ball consumption.

3.08.04 The ball monitoring system shall have provisions for self-testing and self-calibration.

3.09.00 **Cleaning Balls**

3.09.01 The sponge rubber cleaning balls shall be slightly oversized to the internal diameter of condenser tubes and should be able to remove all fouling and scaling deposits in the condenser tubes.

3.09.02 The specific gravity of the cleaning balls shall be such that good distribution of balls across the tube sheet and cleaning of all tubes are ensured.

3.09.03 The composition of the cleaning balls shall be based on natural rubber and shall be suitable for temperature upto 100°C. Hardness of the cleaning balls shall be compatible to tube material and corrosion/fouling behaviour. If cleaning balls consist of abrasive coated balls, the abrasive material shall also be compatible for use with the tube material.

3.09.04 Calculations and basis for selection of cleaning balls circulation quantity, type, size, hardness, cleaning frequency etc., shall be furnished during contract stage.

3.10.00 **Piping, Valves, Distributors and Injection Nozzles.**

3.10.01 Interconnecting piping, valves, injection nozzles and other fittings shall be designed to withstand 2.0 times the operating pressure or 1.5 times the pump shut-off pressure whichever is higher.

3.10.02 Interconnecting piping shall be sized and routed optimally. Velocity in the pipe work shall be less than 1.5 m/s for pump suction and less than 2.2 m/s in other pipe work.

3.10.03 Necessary isolation valves, vent and drain valves for various equipments shall be provided. Valves shall conform to appropriate standards. Valves provided in ball transport piping shall be ball type. Gland packing of all valve shall be of superior quality to avoid leakage. All valves upto 150 Nb shall be ball valves. For higher sizes ,

gate / globe /B.F. valves shall be provided. All instrument valves shall be needle valves.

3,10.04 Adequate number of ball injection nozzles shall be provided for proper distribution of cleaning balls in condenser inlet. Ball injection nozzles shall be flanged type and shall have two sets of flanges, one for connecting to ball transport pipe and other for connecting to the stub on condenser inlet pipe for ease of removal during repairs or checking.

3.10.05 Distributors (if applicable) with sight glass shall be provided wherever ball transport piping branching out or joining together for proper guidance of cleaning balls.

3.10.6 Type of valves shall be ball valves, no diaphragm type valve shall be used.

3.11.00 **Actuators**

3.11.00 Tube cleaning system shall be provided with actuators wherever necessary for various automatic operations. The actuators shall be electric motor operated and shall meet the requirements of the enclosed specification. The actuator shall be provided with auxiliary handwheel for manual operation in the event of control system failure.

3.12.00 **Electric Motors**

The drive motors for recirculating pump and differential pressure measuring system flushing pump shall conform to the requirements of the enclosed specification.

3.13.00 **Instrumentation and Control System.**

3.13.01. Complete instrumentation and control system for automatic operation of tube cleaning system, protection, interlocking, indication / annunciation of differential pressure and other malfunctions etc., shall be provided. This shall consist of adequate operational hardware, local control panel (As applicable) and interconnecting control and power cabling between the control panel and various equipments in the tube cleaning system.

3.13.02 The control panel shall house all necessary instruments, indicating / annunciation lamps, alarms, differential pressure indicator, timer, function selection switches, ball monitoring system processor, relays, protection and interlocking systems, start / stop push button etc., and shall be complete with internal wiring. The control panel shall meet the requirements of the enclosed specification.

3.13.03 Pressure guages shall be provided at recirculating pump suction and discharge. All instrumentation shall be of reputed make and shall meet the requirements of the enclosed specifications.

3.14.00 **Other Accessories.**

3.14.01 Counter flanges, complete with gaskets, bolts and nuts etc., shall be supplied for ball separator inlet, outlet connections and all other terminal points Fabrication, dimensions and drilling of the flanges shall conform to the codes/standards specified in

Data Sheet-A / Section -C.

3.14.02 Ball recirculating pump, ball collector with interconnecting piping and valves, shall be mounted on a frame. For fixing the frame, necessary foundation plates, bolts, nuts etc. shall be provided.

3.14.03 Suitable lifting arrangement shall be provided for various equipments of the tube cleaning system, for handling during erection and maintenance.

3.15.00 **Materials of Construction**

Materials of various equipments in the tube cleaning system shall be corrosion resistant and consistant with the fluid handled. However, material specification for various components shall be equal to or superior to those specified in Data Sheet-A.

4.00.00 **PAINTING**

4.01.00 The surface preparation of the various equipments / components of the tube cleaning system shall be done as per the standard mentioned in Data Sheet - A and shall include the following :

a) Removal of oil, grease, dirt and swarf etc.

b) Removal of rust and scale etc.

c) Sand blasting / shot blasting.

4.02.00 All internal surfaces of the various equipments / components of the tube cleaning system, which are subjected to immersion or water spray and which are not made of stainless steel or other corrosion resistant materials after surface preparation, shall be coated with epoxy paint of approved make and quality over a coat of zinc chromite primer, unless otherwise specified in Data Sheet - A.

4.03.00 The external surfaces of the various equipments / components of the tube cleaning system after surface preparation, shall be coated with synthetic enamel paint of approved make and quality over two coats of red oxide primer, unless otherwise specified in Data Sheet -A.

5.00.00 **SHOP INSPECTION AND TESTS**

5.01.01 **General**

5.01.01 Manufacturer shall conduct all tests and stage inspections as per the approved

quality plan to ensure that the various equipments and other accessories of the tube cleaning system shall conform to the requirements of this specification and of the applicable codes / standards.

5.01.02 All materials used for manufacture /fabrication of the various equipments of the tube cleaning system shall be of tested quality. Relevant test certificates for chemical analysis, mechanical tests and heat treatment shall be made available before the final shop inspection. In case the relevant test certificates are not available, the manufacturer shall arrange to carry out the necessary tests as per the approved quality plan and applicable codes at his cost for which samples shall be identified by BHEL's representative.

5.01.03 All shop tests shall be conducted as per approved quality plan and test certificates / reports for the same shall be furnished to BHEL for approval.

5.01.04 Qualification of welding procedures and welders shall be as per ASME B&PV code, Section - IX / applicable codes.

5.2.00 **Ball Separator**

5.02.01 Chemical analysis, mechanical tests shall be carried out on materials used for body, strainer / screen, strainer / screen shaft and other appurtenances as per the applicable material specification standards.

5.02.02 All butt welded joints shall be subjected to radiographic/ ultrasonic testing as per applicable codes. However, all welded joints shall be subjected to 100% magnetic particle / penetrant testing to ensure freedom from defects.

5.02.03 Strainer / screen shaft shall be subjected to ultrasonic test as per ASTM-A388 for subsurface defects with acceptance norms as per ASME B&PV code, Section VIII, Division 1.

5.03.00 **Ball Recirculating Pump**

5.03.01 Chemical analysis, mechanical tests shall be carried out on materials used for casing, impeller, shaft, sleeves, wear rings etc., as per the applicable material specification standards.

5.03.02 The casting used for pump casing and impeller shall be sound, clean and free from porosity, blow holes, hard spots, cold shuts, distortion and other harmful defects. All accessible surfaces of the impeller shall be subjected to penetrant test as per ASTM-E165 for surface defects with acceptance norms as per ASME B&PV code, Section VIII, Division 1. No welding or repairs shall be carried out without prior permission of BHEL.

5.03.03 Pump shaft and sleeves shall be subjected to ultrasonic test as per ASTM - A388 for sub-surface defects and penetrant test after finish machining as per ASTM-E165 for surface defects.

5.03.04 Wear rings shall be subjected to penetrant test as per ASTM-E165.

5.03.05 Pump impellers and rotor assembly shall be statically and dynamically balanced as

per ISO-1940

5.04.00 **Ball Collector**

5.04.01 Chemical analysis, mechanical tests shall be carried out on materials used for body and other appurtenances / accessories as per the applicable material specification standards.

5.04.02 All but welded joints shall be subjected to radiographic / ultrasonic testing as per applicable codes. However, all welded joints shall be subjected to 100% magnetic particle / penetrant testing to ensure freedom from defects.

5.05.00 **Piping, Valves, Distributors, and Injection Nozzles.**

5.05.01 Chemical analysis, mechanical tests shall be carried out for materials used for piping, fittings, valves, distributors and injection nozzles.

5.05.02 All welded joints of distributors & injection nozzles shall be subjected to penetrant test as per ASTM-E165 for surface defects with acceptance norms as per ASME B&PV code, Section VIII, Division 1.

5.05.03 Inspection and testing of valves including leakage test shall be carried out as per the requirements of the applicable standards. Valve stem and ball shall be subjected to penetrant test as per ASTM-E165.

5.05.04 All materials for various nozzles, stubs, gaskets, nuts, bolts etc. shall be of tested quality and correlating test certificates for chemical and mechanical properties shall be furnished.

5.06.00 **Rubber Lining (as applicable)**

Rubber lining shall be subjected to surface crack test, 100% spark and hardness tests and shall be checked for layer thickness, defects etc.

5.07.00 **Flanges**

5.07.01 Chemical and mechanical test certificates shall be furnished for flange materials.

5.07.02 In case of fabricated flanges, all the welds shall be subjected to 100% radiography as per ASME B&PV code, Section VIII, Division 1.

5.07.03 In case of forged flanges, ultrasonic testing shall be carried out as per ASTM-A 388.

5.07.04 If the thickness of the plate used for flanges is 40mm or more, the same shall be checked ultrasonically as per ASTM-A435 to demonstrate the absence of lamination and lack of fusion etc.

5.07.05 Flanges shall be checked for edge preparation, fit up and satisfactory working with matching parts.

36 6 2

5.08.00 **Dimensional Checks.**

Dimensional checks for various equipments/components of the tube cleaning system shall be carried out as per assembly drawing approved by BHEL. Alignment and fit up of movable parts shall be checked.

5.09.00 **Hydrostatic Test**

Hydrostatic test shall be conducted on various assemblies / equipments / components of the tube cleaning system at a pressure of 1.5 times and design pressure. The duration of the test shall be minimum 30 minutes.

5.10.00 **Leakage Test**

Leakage test shall be conducted at the design pressure on all assemblies of the tube cleaning system to demonstrate that the assemblies are leak tight and no water seepage shall take place at various nozzles and valve connections.

5.11.00 **Performance Test on Recirculating Pump**

Performance test on recirculating pump with drive motor shall be conducted as per BS-599 / ASME PTC 8.0. Performance curves i.e., discharge flow Vs head, discharge flow Vs power consumption and discharge flow Vs efficiency shall be plotted and acceptance norms shall be as per BS-599 / ASME PTC 8.0. Vibration and noise shall be measure and acceptance norms shall be as per Hydraulic Institute (USA) standard.

5.12.00 **Functional Tests**

Various assembles / equipments / components of the tube cleaning system shall be subjected to functional tests and the following shall be checked.

5.12.01 Smooth and free operation of all movable parts.

5.12.02 Interlock and sequential operation.

5.12.03 Satisfactory operations of ball monitoring system.

5.12.04 Satisfactory operations of actuators torque switches, limit switches etc.

6.00.00 **TESTING AT SITE**

After completion of installation at site, the tube cleaning system will be tested to check that the tube cleaning system performance meets the requirements of this specification. Rectification of all defects shall have to be done by the supplier at no extra cost to the owner / purchaser. However, the owner / purchaser reserves the right to reject the equipments / parts not meeting the requirement if the deficiency still persists.

7.0.0 Performance Guarantee and Bid Evaluation criteria for Condenser on Load Tube Cleaning System.

The Tube Cleaning Systems shall be guaranteed to meet the performance requirements specified in Section-D , Data Sheet A and Guarantee schedule and also for trouble free operation after commissioning. Schedule of performance guarantees (enclosed in Volume III) duly filled and signed shall be furnished with the bid.

The Performance guarantees of equipments shall stand valid till the satisfactory completion of performance testing & its acceptance by BHEL/ Customer. If the guarantee period specified in the Commercial Specification is higher, same shall prevail.

7.01.00 Performance Parameters to be guaranteed by bidders shall be as under :

i) Pressure drop in ball separator in clean condition viz. after back washing.

ii) Percentage recovery of balls (min. 95% recovery)

iii) Life of Sponge Rubber Ball (Min. 4 weeks)

7.02.00 Bidder to note that bids shall be evaluated on account of pressure drop across ball collecting strainer (in clean condition) and liquidated damages on account of not meeting the same during PG test shall be in accordance with following :

A) Bid Evaluation Criteria & Liquidated Damages:

The bids received shall be evaluated for Pressure drop across balls collecting strainers :

- The permissible limit of pressure drop across balls collecting strainers in clean condition shall be 0.15 MWC.
- If the pressure drops quoted are higher than above limit, the bids shall be technically loaded @ indicated in Data Sheet A .
- However no advantage shall be given for pressure drops quoted less than above permissible limit.
- The maximum acceptable limit for pressure drop across balls collecting strainer shall be (with technical loadings) 0.2 MWC.

The bids will be technically rejected for pressure drops quoted higher than above maximum limit.

- The guaranteed pressure drops shall be demonstrated at site by bidder and if found higher shall be subject to LD @ twice the bid evaluation factor as above.

7.03.00 **OtherGuaranteed Parameters to be demonstrated at site**

i) Life of sponge rubber balls shall be minimum 4 weeks.
ii) Percentage recovery of balls shall be minimum 95%.

38 64

Any deviation to above balls life and percentage recovery will not be accepted.

Bidder to indicate the life of sponge rubber ball and nos. of balls lost during 1000 hours of plant operation in the Guarantee schedule and shall demonstrate same at site.

In case the successful bidder fails to demonstrate any of these parameters he shall carry out modifications at his own cost, to purchasers approval.

In case bidder fails to demonstrate above parameters to purchaser's satisfaction even after modification carried by him at site, the purchaser has the right to reject the equipment out rightly.

8.00.00 **QUALITY ASSURANCE & QUALITY PLAN**

8.01.00 The tube cleaning system and other accessories to be supplied, shall have assured quality and workmanship.

8.02.00 Typical quality plans are enclosed herewith this specification for bidder's guidance. The bidder shall furnish his own quality plan based on materials, equipments and components of the tube cleaning system being offered.

9.00.00 **NAME PLATE AND TAG NUMBERS**

9.01.00 Ball separator, recirculating pump, ball collector shall be provided with a permanently attached brass or stainless steel plate indicating the following details :-

a) Design and maximum flow rates.
b) Design and test pressures.
c) Design temperature.
d) Empty and operating weights.

9.02.00 Each valve in the tube cleaning system shall be provided with a name plate indicating the following :-

a) Service.
b) Design and test pressures.
c) Maximum flow and flow direction.
d) Size.
e) Tag Number.

Tag Numbers will be indicated on the drawings submitted for approval during contractstage.

9.03.00 Each motor shall be provided with a name plate indicating the following details :

a) Supply conditions.
b) KW Rating.
c) Make.

	TITLE : STANDARD TECHNICAL SPECIFICATION CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)	SPECIFICATION NO.PE-TS-999-165-N001	
		VOLUME : II B	
		SECTION : D	
		REV. NO. 00	DATE :27.09.07
		SHEET 14 OF 14	

10.00.00 **DRAWING, DATA & INFORMATION TO BE SUBMITTED AFTER THE AWARD OF CONTRACT.**

The drawings, data and other documents as required in Data Sheet-C shall be furnished after the award of contract.

~~40~~ 66

1.00.00 **DRAWING, DATA & INFORMATION TO BE SUBMITTED AFTER THE AWARD OF CONTRACT.**

After the award of contract, the following drawings, data and information is to be submitted for review / approval of BHEL as per the distribution schedule given in Section - C.

1.01.00 Within 2 (two) weeks of the date of LOI, the following shall be submitted,

1.01.01 Data sheet (s) - B.

1.01.02 Final versions of the following drawings to enable BHEL to finalise the layout and to design foundations and structures :-

a) General arrangement / installation drawings of ball separator, ball recirculating unit, control panel each complete with all accessories, incorporating the principal dimensions and weights of equipment offered, size and location of various nozzle connection, supporting arrangement (wherever applicable) and scope of supply etc.

b) Foundation arrangement drawings (wherever applicable) showing load data on supports, size and location of anchor bolts etc.

c) General arrangement drawing indicating the layout of the equipments and interconnecting piping with pipe supports.

1.01.03 Bar chart and inspection schedule.

1.02.00 Within the stipulated time period as per Vendor's drawing /document list, the following shall be submitted.

1.02.01 Cross Sectional/ detailed drawing of ball separator, recirculating pump, ball collector, differential pressure measuring system, ball monitoring system distributors, injection nozzles actuators, motors, control panel etc, indicating bill of quantities and materials of construction.

1.02.02 Final versions of calculations and basis for selection of cleaning balls circulation quantity, type, size, hardness, cleaning frequency etc.

12.2.03 Flow and control logic diagrams for various operations of the tube cleaning system.

1.02.04 Detailed schedule of valves indicating Tag numbers, type, make size, pressure and temperature ratings, materials etc.

1.02.05 Detailed schedule of instruments indicating tag numbers, type, make, materials , of construction, range and accuracy etc.

1.2.6 Detailed schedule of piping and fittings indicating sizes, materials, maximum working pressure and temperatures etc.

1.02.07 Control panel layout and list of instruments provided on control panel.

4467

BHEL	TITLE : DATA SHEET - C CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)	SPECIFICATION NO.PE-TS-999-165-N001	
		VOLUME : II B	
		SECTION : D	
		REV. NO. 05	DATE :29.07.2007
		SHEET2 OF 2	

1.02.08 List of annunciations, protections and interlocks provided.

1.02.09 Detailed drawings of flanges.

1.02.10 Ball recirculating pump performance characteristic curves.

1.02.11 Write-up and instruction manuals for erection, operation and maintenance.

1.02.12 Storage instructions.

1.02.13 Vendor to send 3 sets of final documents (O&M manual, GA drg, P&ID) direct to site under intimation to PEM.

G:\MSE\ASH\STSCOTCS.RTF

4268

Manufacturer's Name & Address	STANDARD QUALITY PLAN		BHEL Doc No.:	PE- V1 -XXX- 165-N008
	INDEX	Vendor Q.P. NO.	PROJECT:	
		PACKAGE : COLTCS	CUSTOMER:	
		Date :	PURCHASER:	
		Page 01 of 15	CONSULTANT:	
			P.O. No.	

SL. NO.	DESCRIPTION	PAGE NO.
1	BALL SEPARATOR	2 TO 5
	WORM GEAR	6
	ACTUATORS	6
2	BALL RECIRCULATION SKID	7
	BALL VESSEL	7,8
	BALL INJECTION NOZZLE	8
	BALL RECIRCULATING PUMP	9
	BALL VALVE	10
	RECIRCULATING PUMP MOTOR	11
3	V - PIECE	11
4	BALL OVERSIZE MONITOR	12
5	PRESSURE GAUGE,DP GAUGE,DP SWITCH & DP TRANSMITTER	13
6	CLEANING BALLS	13
7	ALL COMPONENT & EQUIPMENT	13
8	STARTER PANEL	14
9	FASTENERS	15

Note :Items not included in quality plan to be inspected as per approved data sheet/drawings

ANNEXURES

DRY RUN TEST PROCEDURE FOR BALL SEPERATOR

HYDRO STATIC TEST PROCEDURE

LEAK TIGHTNESS TEST PROCEDURE

PACKING PROCEDURE

LEGEND

* Records indentified with "STAR" shall be essentially included by contractor in QA Documentation.

** M :Manufacturer / Manufacturer's Sub-contractor

C Contractor | O Owner

Indicate "P" - Perform, "W" - Witness and "V" - Verification

Manufacturer / Sub-Contractor	Contractor	Reviewed By	Name & Sign. Of approving authority & Seal
Signature			

43 69

		Manufacturer's Name & Address				STANDARD QUALITY PLAN			BHEL Doc No.:		PE V1 356 165 N 008			
						Item : Ball Separator	Vendor Q.P. NO:		PROJECT:					
		P.O. No.					PACKAGE : COLTCS		CUSTOMER:					
							Date :		PURCHASER:					
							Page 02 of 15		CONSULTANT:					
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency			Remarks	
										M	C	O		
1	2	3	4	5	6	7	8	9	D*	**	10		11	
1.0.0	Ball Separator													
1.1.0	Raw Material													
(a)	Housing Shell, Nozzle flanges	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / Lab test report/Raw material flow sheet	*	P	V	V		
		Surface defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report/ Raw material Flow sheet	-	P	V	V		
		Sub Surface Defects	Major	Ultrasonic test	100%	ASME SA 435	ASME SA 435	Inspection report	*	P	V	V	Plates > 20mm Thk only (UT - Full Volume)	
(b)	Nozzle Pipes	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / Lab test report/Raw material flow sheet	*	P	V	V		
		Surface defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report/ Raw material Flow sheet	-	P	V	V		
		Leak Tightness	Major	Hydrostatic test	100%	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate	*	P	V	V		
(c)	Main Flange	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Manufacturer's Test Certificate	*	P	V	V		
		Heat treatment (Normalising)	Major	Verification	HT Chart	Approved drg/Data sheet	Approved drg/Data sheet	Manufacturer's Test Certificate	*	P	V	V	If casting	
		Surface defects	Critical	Magnetic particle test	100%	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report	*	P	V	V	If casting	
		Sub-surface defects	Critical	Ultrasonic test	100%	ASME SA609 / SA 435	ASME SA609 Level II / SA 435 / SA 388	Inspection report	*	P	V	V		
(d)	Screen Shell	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / Lab test report/Raw material flow sheet	*	P	V	V		

LEGEND

* Records indentified with "STAR" shall be essentially included by contractor in QA Documentation.

** M :Manufacturer / Manufacturer's Sub-contractor

C . Contractor | O . Owner

Indicate : "P" - Perform, "W" - Witness and "V" - Verification

Manufacturer / Sub-Contractor	Contractor		Reviewed By	Name & Sign. Of approving authority & Seal
Signature				

44 70

Manufacturer's Name & Address		STANDARD QUALITY PLAN		BHEL Doc No.:	PE- V1 -XXX- 165-N008
P.O. No.		Item : Ball Separator	Vendor Q.P. NO:	PROJECT:	
			PACKAGE : COLTCS	CUSTOMER:	
			Date :	PURCHASER:	
			Page 03 of 15	CONSULTANT:	

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	D*	Agency M	Agency C	Agency O	Remarks
1	2	3	4	5	6	7	8	9	D*	**	10		11
		Surface defects on machined area	Critical	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V	
		Sub-surface defects	Critical	Ultrasonic test	100%	ASME SA745	ASME SA745	Inspection report	*	P	V	V	
[e]	Screen ribs	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample / heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / Lab test report/Raw material flow sheet	*	P	V	V	
		Corrosion Resistance	Major	IGC	One/Heat	ASTM A 923	ASTM A 923	Test Report/Lab test report	*	P	V	V	
		Surface Defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report/ Raw material Flow sheet	-	P	V	V	
[f]	Ball Extraction Nozzle Pipe [Duplex Stainless Steel]	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample / cast/heat/ batch	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / Lab test report/Raw material flow sheet	*	P	V	V	
		Surface Defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report/ Raw material Flow sheet	-	P	V	V	
		Leak Tightness	Major	Hydrostatic Test	100%	Approved drg/Data sheet	Approved drg/Data sheet	Manufacturer's Test Certificate	*	P	V	V	
1.2.0	Inprocess Quality Control												
1.2.1	Welding procedure specification	Correctness	Critical	Scrutiny	100%	ASME Sec.IX	ASME Sec.IX	QW 482 of ASME Sec.IX	*	P	V	V	
1.2.2	Welding procedure qualification	Weld soundness	Critical	Physical test	100%	ASME Sec.IX	ASME Sec.IX	QW 483 of ASME Sec.IX	*	P	V	V	Welding procedure already approved by BHEL/LRQA/GL/DNV/TUV shall be employed for this job.
1.2.3	Welder performance qualification	Weld soundness	Critical	Radiography	100%	ASME Sec.IX	ASME Sec.IX	QW 484 of ASME Sec.IX	*	P	V	V	Welders already qualified by BHEL/LRQA/GL/DNV/TUV shall be employed for this job.
1.2.4	Fit-up of butt weld	Alignment and dimensions	Major	Template, visual	100%	Manufacturing Drawing	ASME Sec VIII Div.1	Log book		P	W/V	-	BHEL to witness > 20mm thick butt joint
1.2.5	Fit-up of shell flange and nozzle assembly to shell	Orientation, alignment and dimensions	Major	Template, visual	100%	Manufacturing Drawing	ASME Sec VIII Div.1	Log book		P	-	-	

LEGEND

* Records indentified with "STAR" shall be essentially included by contractor in QA Documentation.

** M :Manufacturer / Manufacturer's Sub-contractor

C : Contractor | O : Owner

Indicate "P" - Perform, "W" - Witness and "V" - Verification

Manufacturer / Sub-Contractor	Contractor	Reviewed By	Name & Sign. Of approving authority & Seal
Signature			

45 71

Manufacturer's Name & Address		STANDARD QUALITY PLAN		BHEL Doc No.:	PE- V1 -XXX- 165-N008
			Vendor Q.P. NO:	PROJECT:	
P.O. No.		Item : Ball Separator	PACKAGE : COLTCS	CUSTOMER:	
			Date :	PURCHASER:	
			Page 04 of 15	CONSULTANT:	

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	D*	Agency** M	Agency** C	Agency** O	Remarks
1	2	3	4	5	6	7	8	9	D*	**	10		11
1.2.6	Weld quality for Pressure Parts												
	[a] Root run	Surface defects	Major	Penetrant test / Visual	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Operation Process Sheet	–	P	V	V	
1.2.7	[a] Completed butt welds	1.Surface defects	Major	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V	
		2.Sub-surface defects	Critical	Radiography test	10% of total weld length & 100% T Joints	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 4 / UW 52	Radiographs & Inspection report	*	P	V	V	RT films will be reviewed by BHEL
	[b] Completed fillet welds	Surface defects	Major	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V	
1.2.8	Fabricated Shell (Prior to sand blasting)	1.Dimensions, Orientation	Major	Measurement by visual	100%	Manufacturing Drawing	Manufacturing Drawing	Inspection report	*	P	V	V	
		2. Hydro test	Critical	Hydrostatic Pr. @ 1.5 times design pr. (positive) Duration 30 minutes	100%	ASME Sec.VIII Div.1	No Leakage	Inspection report	*	P	W	V	
1.2.9	Picking and Passivation	Protection Layer	Major	Visual	100%	IS : 10117	IS : 10117	Log Book	–	P	–	–	
1.2.10	Final tests (completed equipments) - After assembly	1.Dimensions, orientation, workmanship & finish	Major	Measurement by visual	100%	G.A drawing	G.A drawing	Inspection report	*	P	W	W	
		2.Leak tightness for assembly	Critical	Leak Tightness @ design pr. (positive) Duration 30 minutes	100%	ASME Sec.VIII Div.1	No Leakage	Inspection report	*	P	W	W	
		3.Dry function test for Ball Separator	Critical	Operational test	100%	Approved procedure	Approved procedure	Inspection report	*	P	W	W	

LEGEND

* Records indentified with "STAR" shall be essentially included by contractor in QA Documentation.

** M :Manufacturer / Manufacturer's Sub-contractor

C Contractor | O : Owner

Indicate : "P" - Perform, "W" - Witness and "V" - Verification

Manufacturer / Sub-Contractor	Contractor	Reviewed By	Name & Sign. Of approving authority & Seal
Signature			

46 72

Manufacturer's Name & Address	STANDARD QUALITY PLAN			BHEL Doc No.:	PE- V1 -XXX- 165-N008
		Vendor Q.P. NO:		PROJECT:	
P.O. No.	Item : Ball Separator	PACKAGE : COLTCS		CUSTOMER:	
		Date :		PURCHASER:	
		Page 05 of 15		CONSULTANT:	

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	D*	Agency M **	Agency C	Agency O	Remarks
1	2	3	4	5	6	7	8	9	D*	**	10		11
1.3.0	Rubber Lining for ball Separator Shell, V-Piece & skid IC Pipe.												
1.3.1	Rubber formulation	Tensile elongation and hardness	Major	Physical test	One per lot	Manufacturer's procedure	BS 6374/Equivalent	Manufacturer's test certificate		P	V	V	
		Polymer Identification	Major	Flame test	One per lot	For Semi Ebonite	For Semi Ebonite	Inspection report	*	P	V	V	
						Ebonite Polymer catches fire; catches fire and On removal from fire & continues to burn	Ebonite Polymer catches fire; catches fire and On removal from fire & continues to burn						
		% Change in weight after 24 hrs immersion in sea water at 70 degrees	Major	Immersion test (bleeding test)	One per lot	ASTM D 471	+ / - 1 %	Inspection report	*	P	V	V	
1.3.2	Surface preparation of items to be lined	Free from rust scale, dust and grease	Major	Visual	100%	SA 2.5	SA 2.5	Manufacturer's Internal Inspection		P	-		
1.3.3	Vulcanising	Temperature, Pressure and time	Major	Process monitoring	100%	Manufacturer's procedure	Manufacturer's procedure	Process Procedure		P	-	-	
1.3.4	Vulcanised rubber lined items	a) Chip test	Major	Chip test	One per lot	Approved drawing and BS 6374/Equivalent	BS 6374/Equivalent	Inspection report	*	P	V	V	
		b)Adhesion, Visual defects, thickness and hardness	Major	Measurement,visual inspection	100% visual. Thickness0hardness at random	Approved drawing and BS 6374/Equivalent	BS 6374/Equivalent	Inspection report	*	P	V	V	
		c)Spark test for Pin holes at 5 kv/mm	Major	Spark test for Pin holes	100%	Approved drawing and BS 6374/Equivalent	BS 6374/Equivalent	Inspection report	*	P	V	V	

LEGEND
* Records indentified with "STAR" shall be essentially included by contractor in QA Documentation.
** M : Manufacturer / Manufacturer's Sub-contractor
C : Contractor O : Owner
Indicate : "P" - Perform, "W" - Witness and "V" - Verification

Manufacturer / Sub-Contractor	Contractor	Reviewed By	Name & Sign. Of approving authority & Seal
Signature			

4773

Manufacturer's Name & Address		STANDARD QUALITY PLAN						BHEL Doc No.:		PE- V1 -XXX- 165-N008		
P.O. No.		Item : WORM GEAR & ACTUATORS		Vendor Q.P. NO:				PROJECT:				
				PACKAGE : COLTCS				CUSTOMER:				
				Date :				PURCHASER:				
				Page 06 of 15				CONSULTANT:				
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	Agency			Remarks
									D*	M	C	O	
1	2	3	4	5	6	7	8	9		**	10		11
1.4.0	Complete Unit of Worm gear	Reduction Ratio	Critical	Functional Test	100%	Approved Data Sheet	Approved Data Sheet	Manufacturer test certificate	*	P	V	V	
		Angle of Rotation											
		Input Torque											
		Output Torque											
		Degree of protection	Critical	Water & Dust ingress tests	Type test	Approved Data Sheet	Approved Data Sheet	Type test certificate	*	V	V	V	
1.5.0	Actuators	Routine Test	Major	Electrical test	100%	Supplier catalogue	Supplier catalogue / ADS	Manufacturer TC	*	V	V	V	Review of TCs
		Make, Range, Model	Major	Visual	100%	Supplier catalogue	Supplier catalogue / ADS	Inspection Report	-	P	-	-	
		Assembly check alongwith ball valves	Major	Visual	100%								
		Functional check alongwith settings/auxiliary contacts	Major	Visual	100%								

Note. ADS - APPROVED DATA SHEET

LEGEND
* Records indentified with "STAR" shall be essentially included by contractor in QA Documentation.
** M :Manufacturer / Manufacturer's Sub-contractor
C : Contractor | O : Owner
indicate "P" - Perform, "W" - Witness and "V" - Verification

Manufacturer / Sub-Contractor	Contractor	Reviewed By	Name & Sign. Of approving authority & Seal
Signature			

48 ~~48~~ 74

	Manufacturer's Name & Address		STANDARD QUALITY PLAN		BHEL Doc No.:	PE- V1 -XXX- 165-N008
				Vendor Q.P. NO:	PROJECT:	
	P.O. No.		Item : Ball Recirculation Skid & Ball Vessel	PACKAGE : COLTCS	CUSTOMER:	
				Date :	PURCHASER:	
				Page 07 of 15	CONSULTANT:	

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	D*	Agency M**	Agency C	Agency O	Remarks
1	2	3	4	5	6	7	8	9	D*	**	10		11
2.0.0	Complete Skid												
	Recirculating Skid with ball vessel and ball oversize monitor	Completeness, Correctness, Orientation, Dimensions	Major	Visual & Measurement	100%	Approved Drawing	Approved Drawing	Inspection report	*	P	V	V	
	Ball Vessel												
2.1.0	Raw Material												
[a]	Housing Shell, Nozzle flanges and dished end	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / lab test report / raw material flow sheet	*	P	V	V	
		Surface defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Mill TC/Inspection report	*	P	V	V	
		Sub-surface defects	Major	Ultrasonic test	100%	ASME SA 435	ASME SA 435	Inspection report	-	P	V	V	Plates > 20mm Thk only (UT - Full Volume)
2.2.0	Inprocess Quality Control												
2.2.1	Welding procedure specification	Correctness	Critical	Scrutiny	100%	ASME Sec.IX	ASME Sec.IX	QW 482 of ASME Sec.IX	*	P	V	V	
2.2.2	Welding procedure qualification	Weld soundness	Critical	Physical test	100%	ASME Sec.IX	ASME Sec.IX	QW 483 of ASME Sec.IX	*	P	V	V	Welding procedure already approved by BHEL/LRQA/GL/DNV/TUV shall be employed for this job.
2.2.3	Welder performance qualification	Weld soundness	Critical	Radiography	100%	ASME Sec.IX	ASME Sec.IX	QW 484 of ASME Sec.IX	*	P	V	V	Welders already qualified by BHEL/LRQA/GL/DNV/TUV shall be employed for this job.
2.2.4	Dished end for ball vessel	Dimensions	Major	Template	100%	Manufacturing Drawing	ASME Sec VIII Div.1	Inspection report	-	P	V	V	
		Surface defects	Critical	Penetrant test	100%	ASME Sec VIII Div.1	ASME Sec VIII Div.1 Appendix 8	Inspection report	-	P	V	V	

LEGEND
* Records indentified with "STAR" shall be essentially included by contractor in QA Documentation.
** M : Manufacturer / Manufacturer's Sub-contractor
C : Contractor | O : Owner
Indicate "P" - Perform, "W" - Witness and "V" - Verification

Manufacturer / Sub-Contractor	Contractor	Reviewed By	Name & Sign. Of approving authority & Seal
Signature			

49 75

		Manufacturer's Name & Address			STANDARD QUALITY PLAN				BHEL Doc No.:		PE- V1 -XXX- 165-N008		
							Vendor Q.P. NO:		PROJECT:				
		P.O. No.			Item : Ball Vessel & Ball Injection Pipe		PACKAGE : COLTCS		CUSTOMER:				
							Date :		PURCHASER:				
							Page 08 of 15		CONSULTANT:				
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency			Remarks
										M	C	O	
1	2	3	4	5	6	7	8	9	D*	**	10		11
2.2.5	Fit-up of butt weld	Alignment and dimensions	Major	Measurement	100%	Manufacturing Drawing	ASME Sec VIII Div.1	Log book	–	P	W/V	–	BHEL to witness >20mm thick butt joint.
2.2.6	Fit-up of shell flange and nozzle assembly to shell	Orientation, alignment and dimensions	Major	Template, visual	100%	Manufacturing Drawing	ASME Sec VIII Div.1	Log book	–	P	–	–	
2.2.7	Weld quality for Pressure Parts												
	(a) Root run	Surface defects	Major	Penetrant test / Visual	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Operation Process Sheet	*	P	V	V	
2.2.8	(a) Completed butt welds	1.Surface defects	Major	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V	
		2.Sub-surface defects	Critical	Radiography test	10% of total weld length & 100% T Joints	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 4 / UW 52	Radiographs and Inspection report	*	P	V	V	RT films will be reviewed by BHEL
	(b) Completed fillet welds	Surface defects	Major	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V	
2.2.9	Fabricated Shell	1.Dimensions, Orientation	Major	Measurement	100%	Manufacturing Drawing	Manufacturing Drawing	Inspection report	*	P	V	V	
		2. Hydro test for Ball Vessel	Critical	Hydrostatic Pr. @ 1.5 times design pr. (positive) [Duration 30 minutes]	100%	ASME Sec.VIII Div.1	No leakage	Inspection report	*	P	W	V	Hydrostatic test shall be conducted along with Recirculating skid Assly for Ball Vessel.
2.2.10	Pickling and Passivation	Protection Layer	Major	Visual	100%	IS : 10117	IS : 10117	Log Book		P	–	–	
2.2.11	Ball Injection Pipe	Chemical & Physical properties	Major	Chemical & mechanical tests	One sample/heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / lab test report / raw material flow sheet	*	P	V	V	
		Surface defects	Minor	Visual	100%	Approved drg/ Data sheet	Approved drg/ Data sheet	MTC / Inspection report	–	P	V	V	
		Leak Tightness	Major	Hydrostatic test	100%	Approved drg/Data sheet	Approved drg/Data sheet	Manufacturer's Test Certificate	*	P	V	V	

LEGEND

* Records indentified with "STAR" shall be essentially included by contractor in QA Documentation.

** M : Manufacturer / Manufacturer's Sub-contractor

C : Contractor | O : Owner

Indicate : "P" - Perform, "W" - Witness and "V" - Verification

Manufacturer / Sub-Contractor Signature	Contractor	Reviewed By	Name & Sign. Of approving authority & Seal

50 76

		Manufacturer's Name & Address		STANDARD QUALITY PLAN					BHEL Doc No.:		PE- V1 -XXX- 165-N008		
							Vendor Q.P. NO:		PROJECT:				
		P.O. No.		Item : RECIRCULATING PUMP			PACKAGE : COLTCS		CUSTOMER:				
							Date :		PURCHASER:				
							Page 9 of 15		CONSULTANT:				
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	Agency				Remarks
									D*	M	C	O	
1	2	3	4	5	6	7	8	9	**		10		11
2.3.0	Raw material control												
2.3.1	Casing	Chemical,Physical properties	Major	Chemical & Physical analysis	One Sample/Cast / Heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Manufacturer's Test Certificate	*	P	V	V	
		Surface defects	Minor	Visual	100%	Approved drg/ Data sheet	Approved drg/ Data sheet	MTC / Inspection report	–	P	V	V	
2.3.2	Impeller, Sleeve	Physical and Chemical properties	Major	Physical and Chemical analysis	One Sample/Cast / Heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Manufacturer's Test Certificate	*	P	V	V	
2.3.3	Shaft	Physical and Chemical properties	Major	Physical and Chemical analysis	One Sample/Cast / Heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Manufacturer's Test Certificate	*	P	V	V	
		Sub-Surface defects	Major	Ultrasonic Test	100%	ASME SA 745	ASME SA 745	MTC / Inspection report	*	P	V	V	Only for shaft >= 50mm
2.3.4	In-process control												
2.3.5	Casing	Leak tightness	Critical	Hydro.test @ 1.5times design pr. (positive) (Duration 30 minutes)	100%	Manufacturing Standard	No Leakage	Inspection report	*	P	V	V	
2.3.6	Shaft	Surface defects	Critical	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V	
2.3.7	Impeller	Residual static, dynamic unbalance	Major	Static,dynamic balancing	100%	ISO:1940	ISO:1940, Gr 6.3	Inspection report	*	P	V	V	
2.3.8	All components	Workmanship, finish and dimensions	Major	Measurement, visual examination	100%	Manufacturing drawing	Manufacturing drawing	Log book / job card	–	P	–	–	
2.3.9	Assembly, control, final inspection / test												
	Performance Test	a) Q Vs. Head, Q Vs. Pumps efficiency / overall efficiency, Q Vs. Power, Vibration and Noise	Critical	Performance test	100%	Approved curve, approved data sheet, IS:5120	Approved data sheet	Inspection report, plotted curves	*	P	V	V	
		b) Dimensions, workmanship and finish	Major	Measurement, visual	100%	Data sheet	Data sheet						
		c) Noise level	Major	–	–	–	85 db at 1 meter distance						
2.3.10	Complete pump	Completeness, correctness, cleanliness	Major	Visual examination	100%	Approved data sheet / Mfg. Drg.	Approved data sheet / Mfg. Drg.	Check list / Inspection report	*	P	V	V	

LEGEND
* Records indentified with "STAR" shall be essentially included by contractor in QA Documentation.
** M. Manufacturer / Manufacturer's Sub-contractor
C. Contractor   O: Owner
Indicate "P" - Perform, "W" - Witness and "V" - Verification

Manufacturer / Sub-Contractor Signature	Contractor	Reviewed By	Name & Sign. Of approving authority & Seal

51 77

	Manufacturer's Name & Address				STANDARD QUALITY PLAN				BHEL Doc No.:		PE- V1 -XXX- 165-N008		
							Vendor Q.P. NO:		PROJECT:				
		P.O. No.			Item : BALL VALVES		PACKAGE : COLTCS		CUSTOMER:				
							Date :		PURCHASER:				
							Page 10of 15		CONSULTANT:				
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	D*	Agency M	Agency C	Agency O	Remarks
1	2	3	4	5	6	7	8	9	D*	**	10		11
2.4.0	Ball valves												
2.4.1	Materials												
	Body and Tail end pieces	Chemical,Physical properties	Major	Chemical & Physical analysis	One Sample/Cast /heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Manufacturer's T.C.	*	P	V	V	
2.4.2	Ball	Chemical,Physical properties	Major	Chemical & Physical analysis	One Sample/Cast /heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Manufacturer's T.C.	*	P	V	V	
2.4.3	Stem	Chemical,Physical properties	Major	Chemical & Physical analysis	One Sample/Cast /heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Manufacturer's T.C.	*	P	V	V	
2.4.4	In-process Inspection												
2.4.5	Machining of body, end, pieces, ball	Dimension	Major	Measurement	100%	Approved drg/Data sheet	Approved drg/Data sheet	Log book	–	P	V	V	
2.4.6	Ball	a) Surface defects	Critical	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V	
		b) Hardness	Major	Hardness testing	Random	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report	*	P	V	V	
2.4.7	Assembly	a) Dimensions	Major	Measurement	100%	EN ISO 17292	EN ISO 17292	Manufacturer's T.C.	*	P	V	V	
		b) Opening / Closing	Major	Operation	100%	–	As per approved data sheet	–	–	P	V	V	Test at works for opening / closing time of actuator operated valves.
2.4.8	Testing												
	[a] Body	Leakage	Critical	Hydraulic test	100%	EN 12266-1&2/API 598/Appd data sheet	EN 12266-1&2/API 598 & Appd. Data sheet	Manufacturer's T.C.	*	P	V	V	
	[b] Seat test	Leakage	Critical	Hydraulic test	100%	EN 12266-1&2/API 598/Appd data sheet	EN 12266-1&2/API 598 & Appd. Data sheet	Manufacturer's T.C.	*	P	V	V	
	[c] Seat	Leakage	Critical	Air test	100%	EN 12266-1&2/API 598/Appd data sheet	EN 12266-1&2/API 598 & Appd. Data sheet	Manufacturer's T.C.	*	P	V	V	

LEGEND

* Records indentified with "STAR" shall be essentially included by contractor in QA Documentation.

** M: Manufacturer / Manufacturer's Sub-contractor

C : Contractor O. Owner

Indicate . "P" - Perform, "W" - Witness and "V" - Verification

Manufacturer / Sub-Contractor	Contractor		Reviewed By	Name & Sign. Of approving authority & Seal
Signature				

52 78

Manufacturer's Name & Address	STANDARD QUALITY PLAN		BHEL Doc No.:	PE- V1 -XXX- 165-N008
		Vendor Q.P. NO:	PROJECT:	
P.O. No.	Item : RECIRCULATING PUMP MOTOR	PACKAGE : COLTCS	CUSTOMER:	
	V PIECE	Date :	PURCHASER:	
		Page 11 of 15	CONSULTANT:	

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	D*	Agency M	Agency C	Agency O	Remarks
1	2	3	4	5	6	7	8	9	D*	**	10		11
2.5.0	Motor	Routine test. No Load test & IR	Major	Electrical test	100% test	IS:325	IS:325	Manufacturer test certificate	*	P	V	V	Review of supplier TC
		Make , Rating	Major	Verification	100%	Appd drg/Data sheet	Appd drg/Data sheet	Inspection report	*	V	V	V	
		Degree of Protection	Critical	Verification	Type test	IP 55	IP 55	Manufacturer's test Certificate	*	V	V	V	
3.1.0	V - Piece												
	Raw material inspection	Chemical & Physical properties	Major	Chemical & mechanical tests	One sample/heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / lab test report / raw material flow sheet	*	P	V	V	
	In process inspection	b) Surface defects	Major	Visual	100%	Approved drg/ Data sheet	Approved drg/ Data sheet	MTC / Inspection report	*	P	V	V	
		c)Sub-surface defects	Critical	Radiography test	10% of total butt weld length	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 4	Radiographs and inspection report	*	P	V	V	
		d) Hydro Static Test	Critical	Hydrostatic Pr. @ 1.5 times design pr. (positive) [Duration 30 minutes]	100%	ASME Sec.VIII Div.1	No leakage	Inspection report	*	P	V	V	

LEGEND

* Records indentified with "STAR" shall be essentially included by contractor in QA Documentation.

** M Manufacturer / Manufacturer's Sub-contractor

C : Contractor | O . Owner

Indicate "P" - Perform. "W" - Witness and "V" - Verification

Manufacturer / Sub-Contractor Signature	Contractor	Reviewed By	Name & Sign. Of approving authority & Seal

53 79

		Manufacturer's Name & Address			STANDARD QUALITY PLAN				BHEL Doc No.:		PE- V1 -XXX- 165-N008		
							Vendor Q.P. NO:		PROJECT:				
		P.O. No.			Item : Balil Monitoring System (Ball Oversize Monitor)		PACKAGE : COLTCS		CUSTOMER:				
							Date :		PURCHASER:				
							Page 12 of 15		CONSULTANT:				
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	Agency				Remarks
									D*	M **	C	D	
1	2	3	4	5	6	7	8	9			10		11
4.1.0	**Raw Material** Housing shell, Flanges	Chemical properties	Major	Chemical Analysis	One sample/heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill test Certificate / lab test report/raw material flow sheet	*	P	V	V	If fabricated type
		Physical properties	Major	Physical test	One sample / cast/heat/ batch	Approved drg/Data sheet	Approved drg/Data sheet	Mill test Certificate / lab test report/raw material flow sheet	*	P	V	V	
		Surface defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate/Inspection report	*	P	V	V	
		Sub-surface defects	Major	Ultrasonic test	100%	ASME SA 435	ASME SA 435	Mill Test Certificate	*	P	V	V	Plates > 20mm Thk only (UT - Full Volume)
4.2.0	Inprocess Quality Control												
4.2.1	Welding procedure specification	Correctness	Critical	Scrutiny	100%	ASME Sec.IX	ASME Sec.IX	QW 482 of ASME Sec.IX	*	P	V	V	
4.2.2	Welding procedure qualification	Weld soundness	Critical	Physical test	100%	ASME Sec.IX	ASME Sec.IX	QW 483 of ASME Sec.IX	*	P	V	V	Welding procedure already approved by BHEL/LRQA/GL/DNV/TUV shall be employed for this job.
4.2.3	Welder performance qualification	Weld soundness	Critical	Radiography	100%	ASME Sec.IX	ASME Sec.IX	QW 484 of ASME Sec.IX	*	P	V	V	Welders already qualified by BHEL/LRQA/GL/DNV/TUV shall be employed for this job.
4.2.4	Fabricated Shell	1.Surface defects (fillet welds)	Major	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V	
		2.Dimensions, Orientation	Major	Measurement by visual	100%	Approved doc./ Data sheet	Approved documents / Data sheets	Inspection report	*	P	V	V	
		3. Hydro test	Critical	Hydrostatic Pr. @ 1.5 times design pr. (positive) (Duration 30 minutes)	100%	ASME Sec.VIII Div.1	No leakage	Inspection report	*	P	W	V	Hydrostatic test shall be conducted alongwith Recirculating skid assembly
		4. Functional Test	Major	Functional	100%	Approved procedure	Approved procedure	-	-	P	V	V	Functional test to be done at site

LEGEND
* Records indentified with "STAR" shall be essentially included by contractor in QA Documentation.
** M :Manufacturer / Manufacturer's Sub-contractor
C :Contractor | O : Owner
Indicate "P" - Perform, "W" - Witness and "V" - Verification

Manufacturer / Sub-Contractor Signature	Contractor		Reviewed By	Name & Sign. Of approving authority & Seal

54 80

Manufacturer's Name & Address	STANDARD QUALITY PLAN		BHEL Doc No.:	PE- V1 -XXX- 165-N008
		Vendor Q.P. NO:	PROJECT:	
	Item : Pressure Gauge, DP Gauge, DP Switch, DP Transmitter	PACKAGE : COLTCS	CUSTOMER:	
P.O. No.		Date :	PURCHASER:	
			CONSULTANT:	
	Cleaning Balls			
	All components & Equipments	Page 13 of 15	PACKAGE : COLTCS	

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	D*	Agency M**	Agency C	Agency O	Remarks
1	2	3	4	5	6	7	8	9		10			11
5.0.0	In process quality control	Make, Range and Model	Critical	Visual	100%	Approved Data Sheet	Approved Data Sheet	Manufacturer test certificate	*	P	V	V	
		Calibration	Critical	Calibration test	100%	Approved Data Sheet	Approved Data Sheet	Manufacturer test certificate	*	V	V	V	
		Degree of Protection	Critical	-	Type.Test Certificate	Approved Data Sheet	Approved Data Sheet	Manufacturer test certificate	*	V	V	V	For Pressure guage, DP Guage, DP Switch
6.0.0	Cleaning Balls – Normal balls – Abrasive balls	Dimensions Type Size	Critical	Measurement	Random	Approved Data Sheet	Approved Data Sheet	Manufacturer's test certificate	*	P	V	V	Quantity and type of balls to be checked with datasheets
7.0.0	All Components / Equipments	Painting Dry film thickness and visual	Major	Measurement	Random	Painting schedule	Painting schedule	Inspection report	*	P	V	V	
		Packing	Major	Measurement	100%	MFG. Procedure	MFG. Procedure	Inspection report	*	P	V	-	

LEGEND
* Records indentified with "STAR" shall be essentially included by contractor in QA Documentation.
** M :Manufacturer / Manufacturer's Sub-contractor
C : Contractor | O : Owner
Indicate : "P" - Perform, "W" - Witness and "V" - Verification

Manufacturer / Sub-Contractor	Contractor	Reviewed By	Name & Sign. Of approving authority & Seal
Signature			

55 8

		Manufacturer's Name & Address			STANDARD QUALITY PLAN					BHEL Doc No.:	PE- V1 -XXX- 165-N008	
					Item : Starter Panel		Vendor Q.P. NO:			PROJECT:		
		P.O. No.					PACKAGE : COLTCS			CUSTOMER:		
							Date :			PURCHASER:		
							Page 14 of 15			CONSULTANT:		

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency M **	Agency C 10	Agency O	Remarks 11
1	2	3	4	5	6	7	8	9					
8.0.0	**Starter panel**												
08.1.0	**Incoming Material**												
08.1.1	Fabricated & Painted Panel	Dimension	Major	Measurement	100%	Approved Drgs.	Approved Drgs.	Inspection report	-	P	--	--	
		Panel G.A.	Major	Measurement	100%	Approved Drgs.	Approved Drgs.	Inspection report	-	P	--	--	
		Paint colour	Major	Visual	100%	Approved Drgs.	Approved Drgs.	Inspection report	-	P	--	--	
		Paint thickness	Major	Measurement	100%	Approved Drgs.	Approved Drgs.	Inspection report	-	P	--	--	
		Paint Shade, Adhesion	Major	Visual	Sample	Approved Drgs.	Approved Drgs.	Inspection report	-	P	--	--	
08.1.2	Wire	Size / Colour / Rating / Surface Defects	Major	Visual / Dimension	Sample	IS 694	Specification / drawings	Inspection report	-	P	--	--	ISI Marked wire
08.1.3	Panel Mounting	Make, Functional, Type & Rating	Major	Visual / Electrical	100%	Approved BOM	Approved BOM	---		P	V	V	
08.2.0	**In Process Inspection**												
10.2.1	Name Plate, Component Mounting, Etc.	Workmanship, Finish, Correctness	Major	Visual	100%	Approved Drgs.	Approved drawings	Inspection report	-	P	--	--	
08.2.2	Electrical Wiring of Panels	Continuity, Colour of wires, Bunching and Grouping	Major	Visual	100%	Mounting Drawing	Approved drawings	Inspection report	-	P	--	--	
08.2.3	Ferruling of Cables	Start & End	Major	Visual	100%	Manufacturer's drawing	Manufacturer's drawing	Inspection report	-	P	--	--	
08.3.0	**Final Inspection**									P	--	--	
08.3.1	Workmanship, Finish & Paint shade / Thickness	Visual	Major	Visual	100%	G.A Drawing	Approved drgs.	Inspection report	*	P	W	V	
08.3.2	Overall Dimension, G.A of starter panel	Measurement	Major	Visual	100%	G.A Drawing	Approved drgs.	Test Certificate	-	P	W	V	
08.3.3	Component Identification	Visual	Major	Visual	100%	G.A Drawing	Approved drgs.	Inspection report	-	P	W	V	
08.3.4	Degree of Protection	Ingress Protection IP55	Critical	Environmental	Verification	Approved drgs.	IS 2147	Inspection Report		P	V	V	for enclosure
08.3.5	IR - HV - IR	Electrical	Critical	Electrical	100%	Approved Procedure	Approved Pocedure	Inspection report	-	P	V	V	
08.3.6	Functional & Continuity	Functional	Major	Functional	100%	Appd Drawing	Appd Drawing	Inspection report	*	P	W	W	

LEGEND

* Records identified with "STAR" shall be essentially included by contractor in QA Documentation.

** M : Manufacturer/ Sub-contractor C : BHEL O Owner

Indicate : "P" - Perform, "W" - Witness and "V" - Verification

Manufacturer / Sub-Contractor Signature	Contractor	Name & Sign. Of approving authority & Seal

56 82

	Manufacturer's Name & Address				STANDARD QUALITY PLAN				BHEL Doc No.:		PE- V1 -XXX- 165-N008		
							Vendor Q.P. NO:		PROJECT:				
	P.O. No.				Item : FASTENERS		PACKAGE : COLTCS		CUSTOMER:				
							Date :		PURCHASER:				
							Page 15 of 15		CONSULTANT:				
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency			Remarks
										M	C	O	
1	2	3	4	5	6	7	8	9	D*	**	10		11
9.1.0	Internal Fasteners (Duplex Steel)	Chemical & Physical properties	Major	Chemical & Mechanical analyse	1 Per heat/HT Batch	Approved drg/Data sheet	Approved drg/Data sheet	Mfr TC / Lab report	*	P	V	V	
		Visual & workmanship finish	Major	Visual	Sample	Approved drg/Data sheet	Approved drg/Data sheet		–	P	V	V	
		Dimensions	Major	Measurement	Sample	Approved drg/Data sheet	Approved drg/Data sheet		–	P	V	V	
9.2.0	Main Fasterners	Visual	Major	Visual	Sample	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report / Mfr TC	*	P	V	V	
		Dimensions	Major	Measurement	Sample	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report / Mfr TC	*	P	V	V	
		Chemical & Physical properties	–	Chemical & Physical test a) Tensile b) Yield c) Elongation d) Proof load	1 sample per heat	Approved drg/Data sheet	Approved drg/Data sheet	Mfr TC/Lab report	*	P	V	V	

LEGEND
* Records indentified with "STAR" shall be essentially included by contractor in QA Documentation.
** M :Manufacturer / Manufacturer's Sub-contractor
C . Contractor | O . Owner
Indicate "P" - Perform, "W" - Witness and "V" - Verification

Manufacturer / Sub-Contractor Signature	Contractor	Reviewed By	Name & Sign. Of approving authority & Seal

57 8 3

1	**GENERAL**		
1.1	Nos. of tube cleaning systems sets required for station	NOS.	Two (02) nos. for one unit viz. total four (4) nos. for both unit. Viz. one independent set common for each half of two condensers placed in series. There are 2 nos. condensers per unit in series i.e. Balls from one separator/collector has to pass through two nos. condenser placed in series.
1.2	Liquid handled		*Clarified Water as per Analysis* Attached along with project information in section B.
1.3	Size of COLTCS	Nb	*2500 NB*
2.0	**DESIGN**		
2.1	Operating pressure at Condenser inlet flange	kg/cm2 (g)	Approx 1.5 to 2.0
2.2	Design Pressure for ball separator	kg/cm2 (g)	5.0 kg/cm² (g) & vacuum 0.1 kg/cm² (abs)
2.3	Design Mechanical Temperature	Deg. C	60
2.4	Condenser Details		
	a) Type of condenser		*Single Pass*
	b) No. of Condenser sections	Nos.	2 (Two)
	c) No. of passes per condenser section (viz. condenser half)	Nos.	1 (One)
	d) No. of tubes per condenser	Nos.	2 X 29755
	• Top two rows		2 X 2082
	• Remaining		2 X 27673
	e) Tube Dia. OD x Thickness		
	• Top two rows	mm x mm	25.4 X 0.889,
	• Remaining	mm x mm	25.4 X 0.7112
	f) Length of tubes between ends.	mm	*14630*

	g) Tube material		*SA 249 TP 304 (Welded)*
	h) Pressure drop across condenser - At Normal flow (between Inlet and Outlet flanges of condenser)	MWC	*2 X 2.8 MWC (excl. interconnection pipes b/w two condensers)* *(However the actual value can vary +/-10% of the design value)*
2.5	CW flow rate through each ball separator		
	- Normal	cu.m/hr	39800
	- Maximum	cu.m/hr	47760
2.6	Design differential pressure for ball separator strainer/screen	$Kg/cm^2(g)$	0.2
2.7	Pressure drop across ball separator i.e. between inlet & outlet flanges in clean condition at normal flow.	MWC	0.15
2.8	Pressure drop across ball separator in choked condition when strainer backwashing starts	MWC	Not to exceed 0.30
2.9	No. of balls required for COLTCS per condenser section	Nos.	Minimum 10% of number of condenser tubes
3	**CONNECTING PIPE DETAILS**		
3.1	Condenser inlet pipe		
	a) Material		*Carbon Steel to IS – 2062 Gr. B*
	b) O.D. X Thickness	mm x mm	*2540x20*
3.2	Condenser outlet pipe		
	a) Material	CS	*Carbon Steel to IS – 2062 Gr. B*
	b) O.D. X Thickness	mm x mm	*2540x20*
3.3	Manhole		Manhole :Yes, 600 NB size Drain : 150NB drain stub inside the body of COLTCS
4.0	**MATERIALS OF CONSTRUCTION**		

4.1	BALL SEPARATOR		
	a) Body / housing		Carbon Steel to IS -2062 Gr.B. with epoxy painted inside (with minimum housing thickness same as connecting pipe thickness) Provision for future installation of cathodic protection with sacrificial anodes shall be provided.
	b) Screen / Strainer		SS-316
	c) Strainer shaft		SS-316
	e) Internal Hardware including nuts, bolts , etc.		SS-316
	f) Site Glass provision		Yes
4.2	BALL RECIRCULATING PUMP		Non Clog type
	a) Casing		2.5% Ni. CI to IS 210 FG 260
	b) Impeller		SS-316
	c) Shaft		SS-410
4.3	**BALL COLLECTOR**		
	a) Body / housing		Carbon steel-IS 2062 Gr. B with epoxy painted inside
	b) Screen / Strainer		SS-316
	c) Site Glass Provision		Yes
4.4	Differential pressure measuring system		SS-316
4.5	Injection nozzle		SS-316
4.6	Valves		
4.6.1	Check Valves (all sizes)		For size 50 NB and below-Piston type For sizes 65 NB and above-Swing check type or dual plate type.

	a) Body & Bonnet		CI, IS 210, Gr.FG 260 / BS 1452 Gr. 14, Flanged Ends
	b) Seating surface & rings		13% Chromium Steel
	c) Disc for Check Valve		CI, IS 210 Gr. FG 260/ BS 1452 Gr. 14
	d) Hinge Pin for Check Valve		AISI-316
	e) Backseat for check valve		13% Chromium Steel
4.6.2	Globe Valves 50 Nb & Below		
	Body, Bonnet & trim		Gun metal as per IS 318 Gr. 2, screwed ends
4.6.3	➢ BF/Gate Valves (65 Nb & above)		
	➢ Body & Disc		2% Ni CI as per IS 210, FG 260, epoxy coated
	➢ Shaft		SS – 410 / BS 970 431 S-291
	➢ Seal		Nitrile rubber
	➢ Sealing, Retaining segment & internals		18 – 8 SS
	➢ Bearings		Self lubricating
	➢ Companion Flange		IS 2062, Gr. B

	C) Ball valves i) Body ii) Ball iii) Stem		 SA 351 CF8M SA 351 CF8M SS 316
4.7	Interconnecting Piping		By Bidder
	Material		a) Upto 150NB - Carbon steel ERW, IS:1239 (Heavy Grade) b) Greater than 150NB – CS to IS 2062 Gr. B, rolled & butt welded, conforming to IS 3589
5	**COUNTER FLANGES for Ball Separator**		
	a) Flanges		Carbon Steel to IS 2062 Gr. B or eq for thickness, drilling etc refer Annexure II in section C1 (In Purchaser's scope)
	b) Fasteners		A 193 & A 194 (In Bidder's scope)
	c) Gaskets		Min 4 mm thick rubber
6	**OTHER COUNTER FLANGES (for interconnecting piping)**		In Bidder's scope
6.1	MATERIALS		
	a) Flanges		Carbon Steel to IS 2062 Gr. B
	b) Fasteners		A 193 & A 194

	c) Gaskets		Min 4 mm thick rubber
7.0	Material of Other components not specified above		Suitable for intended duty and shall be subject to Purchasers approval during detailed engg. In the event of order.
8.0	**PAINTING**		
8.1	**INTERNAL SURFACE**		
	a) Surface preparation		SA - 2.5 of Swedish Specn. SIS-05-59-00-1967
	b) Primer		Two coat of Epoxy Resin based Zinc Phosphate primer
	c) Final paint		Adequate no. of coats of coal tar epoxy paint to achieve total dry film thickness of 200 to 250 microns
8.2	**EXTERNAL SURFACE**		
	a) Surface preparation		SA-2.5 of Swedish Specn. SIS-05-5900-1967
	b) Primer		Two coat of Epoxy resin based zinc phosphate primer
	a) Intermediate		Epoxy based TiO2 pigmented coat
	d) Final paint		Synthetic enamel paint to achieve total DFT of 175 to 200 microns. Colour- code shall be as per IS 9404 (Appendix - A)
9.0	Adequate provision for future installation of cathodic protection (Sacrificial type anodic protection by Purchaser)		YES
10.0	Flow straightner for streamlining the CW flow in ball collecting strainer		If required as per bidder's design – the same to be incorporated by bidder in its constructional feature.
11.0	Performance Guarantee & Bid Evaluation		
11.1	Performance Parameters to be Guaranteed		

	❖ Pressure drop in ball separator in clean condition		As per Guarantee schedule of bidder
	❖ Percentage recovery of balls		Min. 90 % recovery
	❖ Life of sponge Rubber Balls		Min. 3 weeks
11.2	Bid evaluation Criteria & Liquidated damages		As per clause no 8.00.00 of Section C1
11.3	Bid evaluation rate		@. Rs 8.0 Lacs per 0.05 MWC pr. drop across each balls collecting strainer
11.4	Liquidated damages		@. Rs 11.5 Lacs per 0.05 MWC pr. drop across each balls collecting strainer
12.0	The tube cleaning system shall be designed for following operation modes		
	a) Automatic start up initiated by push button		YES
	b) Automatic shut down with ball collection effected by : i. Push button ii. Adjustable timer iii. Ball monitoring system		YES
	c) Automatic backwashing of ball seperator with ball collection effected by : a. Push button b. Adjustable timer c. Diff. Pressure measuring system		YES
	d) Automatic emergency backwashing of ball seperator effected by diff. Pressure measuring system		YES

	e) Automatic ball sorting initiated by push button		YES
	f) Provision for manual operation of complete tube cleaning system in case of control system failure		YES
	g) Whether the contacts for DPG, DPS and DPT are independent		YES
	h) Timer for Backwashing		YES
	i) Whether the ball monitoring system is designed to perform the following functions : i. Continuously counting the balls in circulation and giving an alarm calling for investigation of ball losses when the number of balls falls below a set value ii. Continuously measuring the size of the balls in circulation and initiating the shutdown of the tube cleaning system with alarm calling for replacement of balls when the no. of oversized balls falls below a set value		YES
	j) Whether the electronic processor of the ball monitoring system is provided with the following : i. Indicators for required basic ball charge ii. Indicators for recirculating ball quantity iii. Indicators for oversized ball quantity iv. Time counters for total cleaning system operating hours v. Time counters for cleaning system operating hours with sufficient no. of oversized balls vi. Recorders for ball consumption		YES

	k) Whether provision for self testing and self caliberation are made		YES
13.0	Mandatory Spares to be supplied under this specification.		1. Sponge rubber balls for condenser on-load tube cleaning system -50000 Nos. (a. 20% -Abrasive Balls- 10000 Nos). (b. 80%- Normal Balls – 40000 No). 2. Ball Recirculating Pump (Set Consisting of Shaft, Rotor, bearings, Seals, Gland Package shafts sleeves for Complete replacement in one Pump)--- 1 set.
14.0	Documents enclosed for bidder's reference		
	❖ Water Analysis		Indicated in project information in Section B.
	❖ GA of CW piping in TG hall		Attached in Annexure-III

SECTION D2

STANDARD TECHNICAL SPECIFICATION FOR ELECTRICAL SYSTEMS

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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

1.0 INTENT OF SPECIFIATION

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

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

2.0 CODES AND STANDARDS

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

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

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

3.0 DESIGN REQUIREMENTS

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

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

3.3 Starting Requirements

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

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

The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.

ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)

iii) Motors for coal conveyor and coal crusher application shall be suitable fro three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be sutable fro mimimum 20,000 starts during the life time of the motor

3.4 **Running Requirements**

3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

3.5 **Stress During bus Transfer**

3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechnical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 **CONSTRUCTIONAL FEATURES**

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled

4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.

4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.

4.5 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.

4.6 In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.

4.7 **Terminals and Terminal Boxes**

4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.

Unless otherwise statedin Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".

4.7.2 Unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.

4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or V W & V respectively.

4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.

4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.

4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.

4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.

4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.

4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.

4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.9 **General**

4.9.1 Motors provided for similar drives shall be interchangeable.

4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.

4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.

4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.

4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

4.9.6 Name plate with all particulars as per IS: 325 shall be provided

4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

5.0 **INSPECTION AND TESTING**

5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.

5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.

5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.

5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

6.0 **DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT**

a) OGA drawing showing the position of terminal boxes, earthing connections etc.
b) Arrangement drawing of terminal boxes.
c) Characteristic curves:
(To be given for motor above 55 kW unless otherwise specified in Data Sheet).

i) Current vs. time at rated voltage and minimum starting voltage.
ii) Speed vs. time at rated voltage and minimum starting voltage.
iii) Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

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 equipments 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, equipments, 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 The auxiliary AC voltage supply arrangement shall have 11kV, 3.3 kV and 415V systems and DC voltage shall be 220 V. It shall be designed to limit voltage variations as given below under worst operating condition :

(a) 11kV, 3.3 kV +/- 6%

(b) 415/240V +/- 10%

(c) 220 V DC -15% to +10%. However the nominal continuous DC power supply shall be 242V.

1.06.00 The voltage level for motors shall be as follows :-

a) Upto 0.2KW : Single phase 240V AC / 3 phase 415V AC

b) Above 0.2KW and upto 200KW : 3 phase 415V AC

c) Above 200KW and upto 1500 KW: 3.3 kV

d) Above 1500 KW : 11 kV

1.07.00 Fault level shall be limited to 40kA RMS for 1 second for 11kV & 3.3 kV system and 45 kA RMS 1 second for 415V system. 415V system shall be solidly grounded and 220 VDC system shall be isolated type.

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

1.09.00 The responsibility of coordination with electrical agencies and obtaining all necessary clearances shall be of the contractor.

CLAUSE NO.	TECHNICAL REQUIREMEN S	एनटीपीसी NTPC
1.10.00	Degree of Protection Degree of protection for various enclosures as per IS:4691, 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:325, IEC:60034 2) Single phase AC motors : IS:996, IEC:60034 3) Crane duty motors : IS:4177, IEC:60034 4) DC motors/generators. : IS:1722 5) Energy Efficient motors : IS 12615, IEC:60034-30	
3.00.00	**TYPE**	
3.01.00	**AC Motors:** a) Squirrel cage induction motor suitable for direct-on-line starting. b) Continuous duty LT motors upto 160 KW Output rating (at 50 deg.C ambient temperature), shall be Energy Efficient motors, Efficiency class-Eff 1, conforming to IS 12615, or High efficiency (IE2) as per IEC:60034-30. c) Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement.	
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 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 80 MVA.
5.00.00	**TEMPERATURE RISE**
	Air cooled motors
	70 deg. C by resistance method for both thermal class 130(B) & 155(F) insulation.
	Water cooled
	80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method for both thermal class 130(B) & 155(F) insulation.
6.00.00	**OPERATIONAL REQUIREMENTS**
6.01.00	**Starting Time**
6.01.01	For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.
6.01.02	For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.
6.01.03	For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.
6.01.04	Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.
6.02.00	**Torque Requirements**
6.02.01	Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor 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) 85% below 110 KW
	(b) 80% from 110 KW to 200 KW

(c) 85% above 200 KW to 1000 KW

(d) 80% from 1001 KW to 4000 KW

(e) 75% above 4000KW

Except AOP & JOP motors running on D.G emergency supply, starting voltage shall be 80%.

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 termi al 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). CW motors can be screen protected drip proof (SPDP) type. 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 Presure Impregnated i.e resin poor -method. The lightning Impulse & intertum insulation surge withstand level shall be as per IEC-60034 part-15

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

7.04.00 Motors rated above 1000KW shall have insulated bearings 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 90dB(A). Vibration shall be limited within the limits prescribed in IS:12075 / IEC 60034-14 . Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads.
7.07.00	In HT motors, at least four numbers simplex / two numbers duplex . platinum resistance type temperature detectors shall be provided in each phase stator winding. Each bearing of HT motor shall be provided with dial type thermometer 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	HT motors can be offered with either elastimould termination or dust tight phase separated double walled (metallic as well as insulated barrier) cable boxes. In case elastimould terminations are offered, then protective cover and trifurcating sleeves shall also be provided. In case cable box is offered, then Employer shall provide termination kit. 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 in case of cable boxes.
7.10.00	The spacing between gland plate & centre of terminal stud shall be as per Table-I.
7.11.00	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.
7.12.00	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.
7.13.00	For motors rated 2000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.
7.14.00	11kV and 3.3 kV motor Terminal Box shall be suitable for fault level of 750MVA for 0.12 sec and 250 MVA for 0.12 sec respectively. Elastimould termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.
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.
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) Below 110KW : 10.0
	(b) From 110 KW & upto 200 KW : 9.0
	(c) Above 200 KW & upto 1000KW : 10.0
	(d) From 1001KW & upto 4000KW : 9.0
	(e) Above 4000KW : 6 to 6.5
10.00.00	**TYPE TEST**
10.01.00	**HT MOTORS**
10.01.01	The 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 owner 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 owner 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 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

~~293~~ 104

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

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.

(f) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15

(g) Surge-withstand test on interturn insulation shall be as per clause no. 4.2 of IEC 60034, part-15

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.

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 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.

CLAUSE NO.	TECHNICAL REQUIREMENTS
	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 owner either at third party lab or in presence of client/owners 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. Overspeed test. 12. Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1
10.03.00	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

CLAUSE NO.	TECHNICAL REQUIREMENTS
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:

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

B - 3

L.T. POWER CABLES

LARA SUPER THERMAL POWER PROJECT, STAGE-I (2X800 MW) DARLIPALI SUPER THERMAL POWER PROJECT, STAGE-I (2X800 MW) GAJMARA SUPER THERMAL POWER PROJECT, STAGE-I (2X800 MW) KUDGI SUPER THERMAL POWER PROJECT, STAGE-I (3X800 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI PART-B

LT POWER CABLES

1.00.00 CODES & 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. In case of conflict between this specification and those (IS : codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:

IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.
IS : 3961	Recommended current ratings for cables
IS : 3975	Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.
IS : 5831	PVC insulation and sheath of electrical cables.
IS:7098 (Part -I)	Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100V.
IS : 8130	Conductors for insulated electrical cables and flexible cords.
IS : 10418	Specification for drums for electric cables.
IS : 10810	Methods of tests for cables.
ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics.
IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables.
IEC-332	Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).

CLAUSE NO.	TECHNICAL REQUIREMENTS
2.00.00	**TECHNICAL REQUIREMENTS**
2.01.00	The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.
2.02.00	Cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses developed under steady state and transient operating conditions as specified elsewhere in this specification.
2.03.00	Aluminium conductor used in power cables shall have tensile strength of more than 100 N/ sq.mm. Conductors shall be stranded.
2.04.00	XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250 deg C. PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.
2.05.00	The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS : 5831.
2.06.00	For single core armoured cables, armouring shall be of aluminium wires/ formed wires. For multicore armoured cables, armouring shall be of galvanised steel as follows :

Calculated nominal dia. of cable under armour	**Size and Type of armour**
Upto 13 mm	1.4mm dia GS wire
Above 13 & upto 25mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire
Above 25 & upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire
Above 40 & upto 55mm	1.4 mm thick GS formed wire /2.5mm dia GS wire
Above 55 & upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire
Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire

~~330~~ 111

CLAUSE NO.	TECHNICAL REQUIREMENTS
2.06.01	The aluminium used for armouring shall be of H4 grade as per IS: 8130 with maximum resistivity of 0.028264 ohm mm^2 per meter at 20 deg C. The sizes of aluminium armouring shall be same as indicated above for galvanized steel.
2.06.02	The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface of G.S.wire/ formed wire.
2.07.00	Outer sheath shall be of PVC as per IS: 5831 & black in colour. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties. (a.) Oxygen index of min. 29 (as per IS 10810 Part-58). (b.) Acid gas emission of max. 20% (as per IEC-754-I). (c.) Smoke density rating shall not be more than 60 % (as per ASTMD-2843).
2.08.00	Cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted: 1 core - Red, Black, Yellow or Blue 2 core - Red & Black 3 core - Red, Yellow & Blue 4 core - Red, Yellow, Blue and Black
2.09.00	For reduced neutral conductors, the core shall be black.
2.10.00	In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath. (a.) Cable size and voltage grade - To be embossed (b.) Word 'FRLS' at every 5 metre - To be embossed (c.) Sequential marking of length of the cable in metres at every one metre -To be embossed / printed The embossing shall be progressive, automatic, in line and marking shall be legible and indelible.

CLAUSE NO.	TECHNICAL REQUIREMENTS
2.11.00	All cables shall meet the fire resistance requirement as per Category-B of IEC 332 Part-3.
2.12.00	Allowable tolerances on the overall diameter of the cables shall be +\-2 mm maximum, over the declared value in the technical data sheets.
2.13.00	In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.
3.00.00	**Cable selection & sizing**
3.01.00	LT Power cables shall be sized based on the following considerations: (a) Rated current of the equipment (b) The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage (c) Short circuit withstand capability This will depend on the feeder type. For a fuse protected circuit, cable should be sized to withstand the let out energy of the fuse.For breaker controlled feeder, cable shall be capable of withstanding the system fault current level for total breaker tripping time inclusive of relay pickup time. (d) The minimum conductor size shall be 6 sqmm for aluminium conductor cables and 2.5 sqmm for copper conductor cables. The constructional details of copper conductor cables shall be same as indicated for copper control cable.
302.00	Derating Factors Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes: a) Variation in ambient temperature for cables laid in air b) Grouping of cables c) Variation in ground temperature and soil resistivity for buried cables.
3.03.00	Cable lengths shall be considered in such a way that straight through cable joints are avoided.
3.04.00	Cables shall be armoured type if laid in switchyard area or directly buried.

302 (1)

3.05.00	All LT power cables of sizes more than 120 sq.mm. shall be XLPE insulated and preferable sizes are 1Cx150, 1Cx300, 1Cx630, 3Cx150 & 3Cx240 sq.mm.
4.00.00	**CONSTRUCTIONAL FEATURES**
	(a.) **1.1 KV grade XLPE power cables** shall have compacted aluminium conductor, XLPE insulated, PVC inner sheathed (as applicable), armoured/ unarmoured, FRLS PVC outer sheathed conforming to IS:7098. (Part-I).
	(b.) **1.1KV grade PVC power cables** shall have aluminium conductor (compacted type for sizes above 10 sq.mm), PVC Insulated, PVC inner sheathed, armoured/ unarmoured, FRLS PVC outer sheathed conforming to IS:1554 (Part-I).
5.00.00	**CABLE DRUMS**
	(a) Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.
	(b) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stencilled on both sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.
	(c) The standard drum length for power cables shall not be less than 500 meters. The length per drum shall be subjected to a maximum tolerance of +/- 5% of the standard drum length. The Employer shall have the option of rejecting cable drum with shorter lengths. For each size, the variance of total quantity, adding all the supplied drum lengths, from the ordered quantity, shall not exceed +/- 2%.
5.00.00	**TYPE TESTS**
5.01.00	General
	All equipments to be supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the

date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

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

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

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.

5.02.00 **Type Tests**

5.02.01 The reports for the following type tests shall be submitted for one size each of LT XLPE and LT PVC Power cables. Size shall be decided by the employer during detailed engineering :

S.No.	Type test	Remarks
	For Conductor	
1.	Resistance test	
2.	Tensile test	For circular non-compacted conductors only
3.	Wrapping test	For circular non-compacted only
	For Armour Wires/ Formed Wires	
4.	Measurement of Dimensions	
5.	Tensile Test	
6.	Elongation test	

304 115

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	7.	Torsion test	For round wires only
	8.	Wrapping test	For aluminium wires / formed wires only.
	9.	Resistance test	
	10(a)	Mass of zinc coating test	For GS Formed wires/wires only
	10(b)	Uniformity of zinc coating	For GS Formed wires /wires only
	11.	Adhesion test	For GS Formed wires/wires only
		For PVC/XLPE insulation & PVC Sheath	
	12.	Test for thickness	
	13.	Tensile strength & elongation tests	before ageing and after ageing
	14.	Ageing in air oven	
	15.	Loss of mass test	For PVC insulation and sheath only
	16.	Hot deformation test	For PVC insulation and sheath only
	17.	Heat shock test	For PVC insulation and sheath only
	18.	Shrinkage test	
	19.	Thermal stability test	For PVC insulation and sheath only
	20.	Hot set test	For XLPE insulation only
	21.	Water absorption test	For XLPE insulation only
	22.	Oxygen index test	For outer sheath only
	23.	Smoke density test	For outer sheath only

	24.	Acid gas generation test	For outer sheath only
		For completed cables	
	25.	Insulation resistance test	
		(Volume resistivity method)	
	26.	High voltage test	
	27.	Flammability test as per IEC-332 Part-3 (Category-B)	
5.02.02	**Acceptance Tests** (as per QA table)		
5.02.03	**Routine Tests** (as per QA table)		

B - 4

L.T. CONTROL CABLES

LARA SUPER THERMAL POWER PROJECT, STAGE-I (2X800 MW) DARLIPALI SUPER THERMAL POWER PROJECT, STAGE-I (2X800 MW) GAJMARA SUPER THERMAL POWER PROJECT, STAGE-I (2X800 MW) KUDGI SUPER THERMAL POWER PROJECT, STAGE-I (3X800 MW) STEAM TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI PART-B

LT CONTROL CABLES

1.00.00 CODES & 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. In case of conflict between this specification and those (IS : codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes :

IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.
IS : 3961	Recommended current ratings for cables
IS : 3975	Low carbon galvanised steel wires, formed wire and tapes for armouring of cables.
IS : 4905	Methods for random sampling.
IS : 5831	PVC insulation and sheath of electrical cables.
IS : 8130	Conductors for insulated electrical cables and flexible cords.
IS : 10418	Specification for drums for electric cables.
IS : 10810	Methods of tests for cables.
ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics.
IEC-754 (Part-I)	Test on gases evolved during combustion of electric cables.
IEC -332	Tests on Electric cables under fire conditions Part-3 : Tests on bunched wires or cables (category - B)

2.00.00 TECHNICAL REQUIREMENTS

2.01.00 The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground burried installation with chances of flooding by water.

CLAUSE NO.	TECHNICAL REQUIREMENTS
2.02.00	Cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady state and transient operating conditions as specified elsewhere in this specification.
2.03.00	Conductor of control cables shall be made of multi stranded, plain annealed copper.
2.04.00	PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.
2.05.00	The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS : 5831.
2.06.00	For multicore armoured cables, the armouring shall be of galvanised steel as follows :-

	Calculated nominal dia of cable under armour	**Size and Type of armour**
1)	Upto 13 mm	1.4mm dia GS wire
2)	Above 13 upto 25 mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire
3)	Above 25 upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire
4)	Above 40 upto 55mm	1.4 mm thick GS formed wire/ 2.5mm dia GS wire
5)	Above 55 upto 70.mm	1.4mm thick GS formed wire / 3.15mm dia GS wire
6)	Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire

	The gap between armour wire / formed wire shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface.
2.07.00	Outer sheath shall be of PVC(grade as applicable) and grey in colour . In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties.

CLAUSE NO.	TECHNICAL REQUIREMENTS
	(a) Oxygen index of min. 29 (As per IS:10810 (part-58)) (b) Acid gas emission of max. 20% (As per IEC-754-I). (c) Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTMD-2843.
2.08.00	Cores of the cables of upto 5 cores shall be identified by colouring of insulation. Following colour scheme shall be adopted. 1 core - Red, Black, Yellow or Blue 2 core - Red & Black 3 core - Red, Yellow & Blue 4 core - Red, Yellow, Blue and Black 5 core - Red, Yellow, Blue, Black and Grey
2.09.00	For cables having more than 5 cores, core identification shall be done by numbering the insulation of cores sequentially, starting by number 1 in the inner layer (e.g. say for 10 core cable, core numbering shall be from 1 to 10). The number shall be printed in Hindu-Arabic numerals on the outer surfaces of the cores. All the numbers shall be of the same colour, which shall contrast with the colour of insulation. The colour of insulation for all the cores shall be grey only. The numerals shall be legible and indelible. The numbers shall be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. When the number is a single numeral, a dash shall be placed under neath it. If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. The spacing between consecuture numbers shall not exceed 50 mm.
2.10.00	In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath : (a) Cable size and voltage grade - To be embossed (b) Word 'FRLS' at every 5 metre - To be embossed (c) Sequential marking of length of the cable in metres at every one metre. - To be embossed / printed. The embossing / printing shall be progressive, automatic, in line and marking shall be legible and indelible.

~~310~~ 121

CLAUSE NO.	TECHNICAL REQUIREMENTS
2.11.00	All cables shall meet the fire resistance requirement as per Category-B of IEC 332 Part -3.
2.12.00	Allowable tolerances on the overall diameter of the cables shall be +\-2 mm maximum over the declared value in the technical data sheets.
2.13.00	In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.
2.14.00	**Cable selection & sizing**
2.14.01	LT Control cables shall be sized based on the following considerations: (a) Rated current of the equipment (b) The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage (c) Short circuit withstand capability This will depend on the feeder type. For a fuse protected circuit, cable should be sized to withstand the let out energy of the fuse.For breaker controlled feeder, cable shall be capable of withstanding the system fault current level for total breaker tripping time inclusive of relay pickup time. (d) The minimum size of conductor shall be 1.5 sqmm
2.14.02	Derating Factors Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes: a) Variation in ambient temperature for cables laid in air b) Grouping of cables c) Variation in ground temperature and soil resistivity for buried cables.
2.14.03	Cable lengths shall be considered in such a way that straight through cable joints are avoided.
2.14.04	Cables shall be armoured type if laid in switchyard area or directly buried.

~~311~~ 122

CLAUSE NO.	TECHNICAL REQUIREMENTS
3.00.00	**CONSTRUCTIONAL FEATURES**
3.01.00	**1.1 KV Grade Control Cables** Control Cables shall have stranded copper conductor multicore PVC insulated, PVC inner-sheathed, armoured / unarmoured, PVC outer-sheathed conforming to IS:1554. (Part-I).
3.02.00	**Cable Drums** (a) Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof layer. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS : 10418. (b) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stencilled on both the sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled. (c.) The standard drum length for control cables shall not be less than 1000 metres. The length per drum shall be subjected to a maximum tolerance of +/- 5% of the standard drum length. The Employer shall have the option of rejecting cable drums with shorter lengths. For each size, the variance of total quantity, adding all the supplied drum lengths, from the ordered quantity, shall not exceed +/- 2%.
4.00.00	**TESTS**
4.01.00	**GENERAL** All equipments to be supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

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

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

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.

4.02.00 **TYPE TESTS:**

4.02.01 The Type tests reports for the following shall be submitted for one size of LT control cable :

S. No.	Type Test	Remarks
a)	**For Conductor**	
1.	Resistance test	
b)	**For Armour Wires / Formed wires**	
2.	Measurement of Dimensions	
3.	Tensile Test	
4.	Elongation test	
5.	Torsion test	For round wire only
6.	Winding test	For Formed wires
7.	Resistance test	
8.	Zinc Coating test	For G.S. conductors only.
c)	**For PVC Insulation & PVC Sheath**	
9.	Test for thickness	

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	10. Tensile strength and elongation test before ageing and after ageing	
	11. Ageing in air oven	
	12. Loss of mass test	For PVC insulation and sheath only
	13. Hot deformation test	For PVC insulation and sheath only
	14. Heat shock test	For PVC insulation and sheath only
	15. Shrinkage test	
	16. Thermal stability test	For PVC insulation and sheath only
	17. Oxygen index test	For outer sheath only
	18. Smoke density test	For outer sheath only
	19. Acid gas generation test	For outer sheath only
	d) **For completed cables**	
	20. Insulation resistance test (Volume resistivity method)	
	21. High voltage test	
	23. Flammability test as per IEC - 332 Part-3 (Category-B)	
4.02.02	**Acceptance Tests** (as per QA table)	
4.03.00	**Routine Tests** (as per QA table)	

CLAUSE NO.	LT SWITCHGEAR (Starter Panel).	
1.00.00	CODES AND STANDARDS	
	IEC : 947, IS : 13947	
2.00.00	TYPE	
	Circuit Breakers	Shall be air break, three pole, spring charged, horizontal drawout type, suitable for electrical operation.
	Switchgear	Fully drawout type single front
	MCC	Fully drawout type single front/Double front.
	ACDB/DCDB	Fixed type single front
3.00.00	SYSTEM PARAMETERS	
	415VAC +/- 10 % (SOLIDLY GROUNDED)	
	50 Hz +3%/-5%	
	45KA RMS / 1 SEC (FAULT LEVEL)	
	220V DC NOMINAL (190V DC-240V DC) ISOLATED TYPE	
4.00.00	TEMPERATURE RISE	
	The temperature rise of the horizontal and vertical busbars and main bus link including all power drawout contacts when carrying 90% of the rated current along the full run shall in no case exceed 55 deg. C with silver plated joints and 40 deg. C with all other types of joints over an ambient of 50 deg C.	
5.00.00	OPERATIONAL REQUIREMENTS	
5.01.00	Breakers	
5.01.01	Breakers shall have anti-pumping feature.	
5.01.02	The incomer and bus coupler breakers for switchgear shall be electrically operated with over current releases or relays.	
5.01.03	Breakers shall have inherent fault making and breaking capacities. They shall have shunt trip coils. In case releases are offered, the same shall have contact for energisation of lockout relay. All breakers Shall have built in interlocks for equipment and personnel safety.	
5.01.04	Paralleling of two supplies shall be avoided by interlocking except for switchgear where auto-changeover is provided. Breaker contact multiplication, if required, shall be through latch relay.	

AUSE NO.	LT SWITCHGEAR
01.05	Mechanical tripping shall be through red 'Trip' push button outside the panels for breakers, and through control switches for other circuits.
01.06	Provision of mechanical closing of breaker only in 'Test' and 'Withdrawn' position shall be made. Alternatively, mechanical closing facility should be normally inaccessible, accessibility rendered only after deliberate removal of shrouds.It shall be possible to close the door with breaker in test position.
01.07	Clear status indication for each circuit shall be provided through lamps, switch positions or other mechanical means.
01.08	Supervision relay shall be provided for trip coil monitoring.
02.00	Switches, Contactors and Fuses
02.01	Incomers for MCCs and DBs rated upto 630A could be load break isolators.
02.02	Motor starter contactors shall be of air break, electromagnetic type suitable for DOL starting of motor, and shall be of utilisation category AC-3 for ordinary and AC-4 for reversing starters. DC contactor shall be of DC-3 utilisation category.
02.03	Fuses shall be HRC type with operation indicator. Isolating switches shall be of AC 23A category when used in motor circuit, and AC 22A category for other applications. Fuse switch combination shall be provided wherever possible.
02.04	Isolating switches and MCCBs shall have door interlocks and padlocking facility.
03.00	Panels
03.01	All switchgears, MCCs, DBs, panels, modules, local starters and push buttons shall have prominent engraved indentification plates.
03.02	Local push button stations shall have metal enclosure of die cast aluminium or rolled sheet steel of 1.6mm thickness & shall have DOP of IP-55. Push buttons shall be of latch type with mushroom knobs.
03.03	Where breaker/starter module front serves as compartment cover, suitable blanking covers, one for each size of modules per switchboard shall be supplied for use when carriage is withdrawn.
03.04	All non-current carrying metal work of boards/panels shall be effectively bonded to earth bus of galavanised steel, extending throughout the switchboard/MCC/DB. Positive earthing shall be maintained for all positions of chassis and breaker frame.
03.05	Suitable trolley arrangement shall be provided for breaker/starter modules. Two trolleys per switchgear room shall be provided so that top most breaker module of all types, sizes and rating can be withdrawn on trolley and lowered for maintenance purpose.
03.06	The incoming connection to transformer of more than 1000KVA and inter-connecting sections between switchboards shall preferably be of busducts.The busduct enclosure

CLAUSE NO.	LT SWITCHGEAR
	f) hand reset lockout relay with a blue lamp for monitoring.
	3) Incomers/bus coupler/outgoing breaker feeders other than motor feeders
	a) Definite time delay short circuit protection
	b) Hand reset lockout relay with a blue lamp
	4) Incomer From DG Set.
	a) Differential Protection (87) - Three Pole
	b) Reverse Power Protection.
	c) Overload Alarm on one phase
	d) Earth Fault Detection Relay (64)
	e) Voltage controlled overcurrent relay
	e) Generator under/over voltage Protection
	f) Hand Reset/Lockout Relay with a blue lamp.
	g) 3 Phase Energy Meter having accuracy of 1.0 class.
5.04.05	Meters / instruments
	All meters/ instrument shall be flush mounted on front panel, at least 96 sq.mm. size with 90 degree linear scales and accuracy class of 2.0.
5.04.06	All motors of 30kW and above shall have an Ammeter. Bus-section shall have bus VT, voltmeter with selector switch, and other relay and timers required for protection. Adequate control and selector switches, push buttons and indicating lamps shall be provided. Thermostatically controlled space heaters with switches shall be provided to prevent condensation.
5.04.07	In case of remote controlled breaker panels,following shall be ensured.
	Each ieeder shall have local/remote selector switch. Closing from local shall be possible only in test possition whereas closing from remote shall be possible in either service or test position.Tripping from local shall be possible only when local/remote selector switch is in local position.Tripping from remote shall be either breaker in service position or selector switch being in remote position.
05 00	Control from Remote
	Necessary hardware shall be provided in the switchgear panel like coupling relays(24V DC,with max burden 2.5VA), auxiliary relays, current & voltage transducers(4-20 mA, dual output) etc. to effect interlocks, exchange information / status and exercise control from remote.

CLAUSE NO.	LT SWITCHGEAR
6.00.00	DESIGN AND CONSTRUCTIONAL FEATURES
6.01.00	All 415V switch gear motor control centers (MCCs), AC & DC distribution boards (DBs), etc shall have following features :

1) Shall be of metal enclosed, indoor, floor mounted and free standing type.

2) All frames and load bearing members shall be fabricated using mild steel structural sections or pressed and shaped cold rolled sheet steel of thickness not less than 2mm.

3) Frame shall be enclosed in cold rolled sheet steel of thickness not less than 1.6mm.Doors and covers shall also be of cold rolled sheet steel of thickness not less than 1.6 mm.Stiffeners shall be provided whereever necessary. Removable gland plates of thickness 3mm (hot/cold rolled sheet steel) or 4 mm (non-magnetic material) shall be provided for all panels.

4) All switchboards/panels shall be of dust and vermin proof. All cutouts shall have synthetic rubber gaskets.

5) For motors above 160kW, remote controlled electrical circuit breakers, and for smaller motors, switch-fuse contactor feeders shall be provided. The other outgoing feeders would be switch-fuse units or moulded case circuit breakers.

6) All switchboards, MCCs and DB s shall have following distinct vertical sections.

   a) Completely enclosed bus bar compartment for horizontal and vertical bus bars.

   b) Completely enclosed switchgear compartments (one for each circuit housing circuit breakers, motor starter or switch-fuse feeder).

   c) Compartment for cable alley or cable box for power and control cables

      In case of cable box, they shall be segregated with complete shrouding for individual feeders at the rear for direct termination of cables.

   d) For cable connection to circuit breaker, a separatelly enclosed cable compartment shall also be acceptable.

   e) Compartment for relays and other control devices associated with a circuit breaker, wherever necessary.

   f) The switchboards/MCC/DBs of 1600A & above rating shall be of DOP IP42 & of IP52 for less than 1600A rating

   g) All 415V switchgears,MCC's, AC & DC distribution boards etc. shall be painted by powder coating process Paint shade shall be as follows

CLAUSE NO.	LT SWITCHGEAR
	(i) Front & Back : RAL 9002 (ii) Extreme end covers : RAL 5012
	7) Busbars shall be of high conductivity aluminium alloy or copper.
	8) Minimum air clearance in air between phases and phase-earth shall be 25 mm for busbars and cable terminations. For all other components, the Clearances shall be at least 10mm. Wherever above is not possible except for horizontal and vertical busbars, insulation shall be provided by anti tracking sleeving or barriers. However for horizontal and vertical busbars, clearances specified above shall be maintained even when busbars are insulated/sleeved. In case of DC DBs/ fuse boards, the busbar system shall be insulated or physically segregated with barriers to prevent interpole short circuit.
	9) Busbar insulators shall be of track-resistant high strength non-hygro-scopic, non-combustible type and suitable to withstand stresses due to over-voltages and short circuit current. Insulators and barrier of inflammable material such as Hylam shall not be accepted.
	10) All types of relays and timer shall be subject to Employer's approval. They shall be flush mounted with connections from inside, and shall have transparent & dust tight cover, removable from front, drawout construction for easy replacement and testing facility. The auxiliary relays and timer may be provided in fixed cases.
	11) Maxi terminal /cage clamp type terminal blocks shall be provided for signals to be interfaced with DDCMIS/PLC.
	12) The switchgears/MCC shall be designed to offer adequate level of safety to operating/maintenance personnel. Means shall be provided to prevent access to the live part to avoid accidents during service as well as maintenance period. Bidder shall bring out the safety means provided to achieve above. A detailed instruction plate suitable for wall mounting shall be provided for each switchgear/MCC room discribing various safe operating procedure/safety precautions for safe operation and maintenance of switchgear/MCC.
	13) All current and voltage transformers as required for metering & protection specified shall be completely encapsulated, cast resin insulated type. Incomers from transformers shall have CTs for transformer REF protection. All current and voltage transformers as required for metering and protection specified shall be completely encapsulated, cast resin insulated type. Incomers from transformers shall have CTs for transformer restricted earth fault protection. The accuracy shall be as follows:

	CTs	PTs
Protection	5P20	3P
Metering	1.0	1.0
REF	PS	

	TITLE	SPECIFICATION NO.
BHEL	MOTOR DATA SHEET - C	VOLUME II B SECTION D REV NO. 00 DATE 28.01.10 SHEET 1 OF 2

S. No.	Description	Data to be filled by successful bidder
A.	**General**	
1	Manufacturer & country of origin	
2	Motor type	
3	Type of starting	
4	Name of the equipment driven by motor & Quantity	
5	Maximum Power requirement of driven equipment	
6	Rated speed of Driven Equipment	
7	Design ambient temperature	
B.	**Design and Performance Data**	
1	Frame size & type designation	
2	Type of duty	
3	Rated Voltage	
4	Permissible variation for	
5	a Voltage	
6	b Frequency	
7	c) Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)	
9	Synchronous speed & Rated slip	
10	Minimum permissible starting voltage	
11	Starting time in sec with mechanism coupled	
12	a) At rated voltage	
13	b) At min starting voltage	
14	Locked rotor current as percentage of FLC (including IS tolerance)	
15	Torque	
	a) Starting	
	b) Maximum	
16	Permissible temp rise at rated output over ambient temp & method	
17	Noise level at 1.0 m (dB	
18	Amplitude of vibration	
19	Efficiency & P.F. at rated voltage & frequency	
	a) At 100% load	
	c) At 75% load	

NAME OF VENDOR				REV.	
NAME	SIGNATURE	DATE	SEAL		

	TITLE	SPECIFICATION NO.
बीएचईएल BHEL	MOTOR DATA SHEET - C	VOLUME II B SECTION D REV NO. 00 DATE 28.01.10 SHEET 2 OF 2

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	**Constructional Features**	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	**Characteristic curves/ drawings** (To be enclosed for motors of rating ≥ 55KW)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR				REV.	
NAME	SIGNATURE	DATE	SEAL		

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
	SHEET 1 OF 2	BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-006/0	SPECIFICATION TITLE
		SYSTEM	ITEM AC ELECT. MOTORS BELOW 75KW (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	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	3	-	-	
2.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	3	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	3	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	3	-	-	
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	3	2,1	2,1	NOTE -1
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	

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-006/0	SPECIFICATION : TITLE :
	SHEET 2 OF 2	SYSTEM	ITEM AC ELECT. MOTORS BELOW 75KW (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
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	3	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.

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

SECTION D3

STANDARD TECHNICAL SPECIFICATION FOR C&I SYSTEMS

FORM NO. PEM-6666-0

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-SS-394-145-I007
		VOLUME II B
		SECTION D
		REV. NO. 00 DATE: 01.08.13
		SHEET 1 OF 3

Data Sheet A & B

		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL*	* PROJECT	2X800 MW GADARWARA-TG	
	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 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. **FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM.**	
HANDWHEEL	* REQUIRED	☐ YES ☐ NO	
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED	
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.		
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY	
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY	
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT-INCLUSIVE OF I.S. TOLERANCE	
	ACTUATOR APPLICABLE WIRING DIAGRAM	■ ENCLOSED (BIDDER TO CONFIRM) A: ☐ DRG. NO. 3-V-MISC-24227 R00 B: ☐ DRG. NO. 3-V-MISC-24550 R00 C: ■ DRG. NO. 3-V-MISC-24283 R00 D: ☐ DRG. NO. 4-V-MISC-90271 R11 E: ☐ For Thyristor based integral starter, Bidder/Vendor to furnish wiring diagram	
	COLOUR SHADE	■ BLUE (RAL 5012) ☐	
	PAINT TYPE (## Refer Notes)	■ ENAMEL ☐ EPOXY ☐	
	SHAFT RPM	BIDDER TO SPECIFY	
	OLR SET VALUE	BIDDER TO SPECIFY	
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY	
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY	
	@ PWR SUPP TO MTR / STARTER	415V, 3PH,3 wire, 50Hz AC	
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ☐ 110 V	

FORM NO. PEM-6666-0

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR	SPECIFICATION NO.: PE-SS-394-145-I007	
		VOLUME II B	
		SECTION D	
		REV. NO. 00	DATE: 01.08.13
		SHEET 2 OF 3	

Data Sheet A & B

		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	@ ENCLOSURE CLASS OF MOTOR	☐ IP 67 ☐ FLAME PROOF	
	@ 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		
	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) **($$ Refer Notes)**	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN / CLOSE	■1 No. ☐2Nos. / ■1 No. ☐2Nos	
	CONTACT TYPE	2 NO + 2 NC	
	RATING	5A 240V AC AND 0.5A 220V DC	
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE	
	ACCURACY	+3% OF SET VALUE	
LIMIT SWITCH (Not Applicable for Smart Actuator) **($$ Refer Notes)**	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN : INT : CLOSE	■1 No ☐2 Nos. / 2 Nos. (ADJ.) / ■1 No. ☐2Nos.	
	CONTACT TYPE	2 NO + 2 NC	
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC	

FORM NO. PEM-6666-0

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR	SPECIFICATION NO.: PE-SS-394-145-I007
		VOLUME II B
		SECTION D
		REV. NO. 00 DATE: 01.08.13
		SHEET 3 OF 3

Data Sheet A & B

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

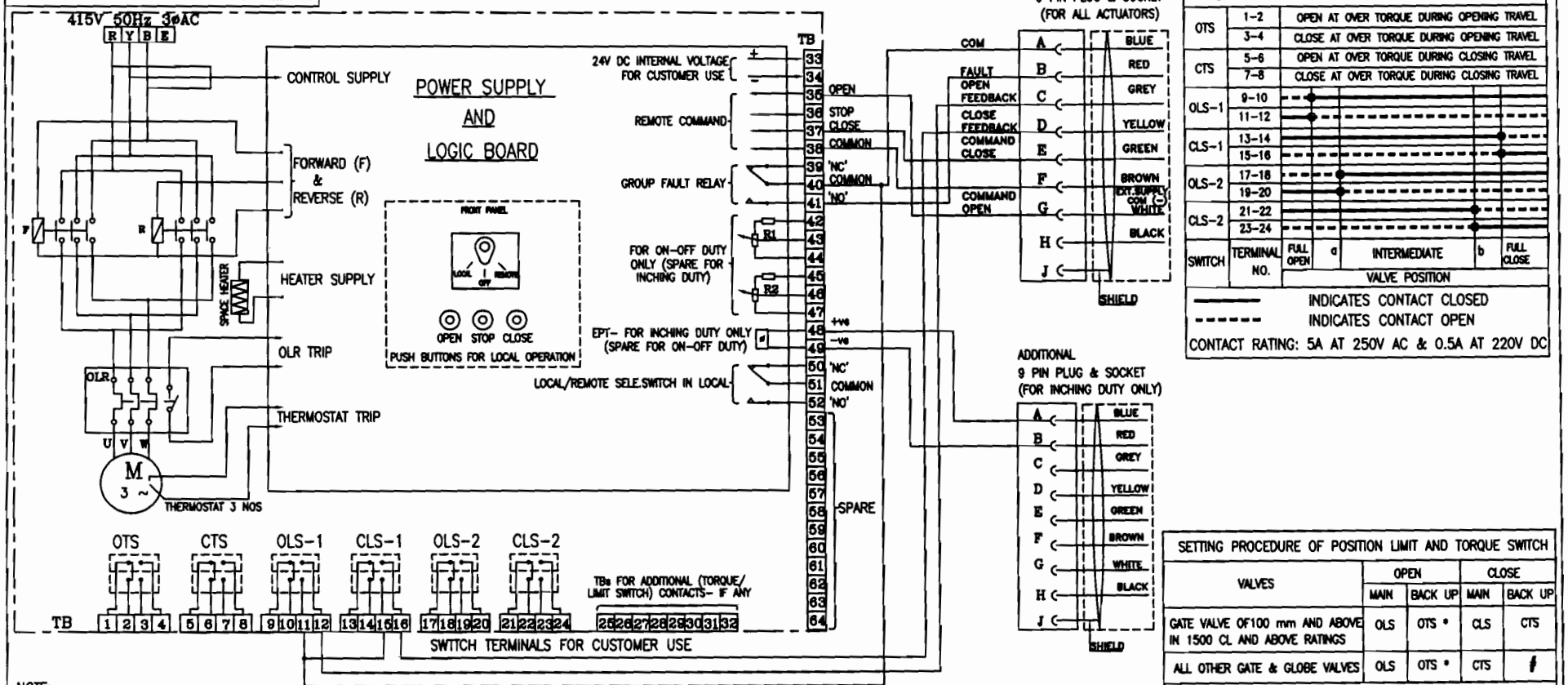
**EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.**

	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
NAME	ANUJ WADHWA	CHETAN MALIK	M.A.MANSOORI	NAME
SIGNATURE				SIGNATURE
DATE	20.06.2013	20.06.2013	20.06.2013	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

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF100 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)

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 TRAMSMITTER (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.

REV	DATE	ALTERED
		CHD & APPD

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

	NAME	SIGN	DATE	NO.OF VAR.
DRN	N.P.ESWAR	N.P	17.03.05	-
CHD	D.DINAKARAN	D.D	17.03.05	
APPD	K.ARUNACHALAM	K.A	17.03.05	

DEPT	SCALE	WEIGHT (KG).	REFERENCE INFORMATIONS	NO. OF ITEMS
VL	NTS	-		-
CODE -				

TITLE: WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER WITH PLUG & SOCKET FOR NTPC PROJECTS

CARD CODE: U 01

DRAWING NO.: 3-V-MISC-24283

REV: 0

Size A3

FORM NO. PEM-6666-0

बीएचईएल	**DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE**	SPECIFICATION NO.: VOLUME SECTION REV. NO. / DATE: SHEET 1 OF 2 Data Sheet No.: **PE-DC-999-145-I026-A**

	TECHNICAL REQUIREMENTS FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE (TO BE FILLED BY PURCHASER)		TO BE FILLED-UP /CONFIRMED BY BIDDER
GENERAL	MANUFACTURER		
	MODEL NUMBER		
TECHNICAL	SENSING ELEMENT	☐ BOURDON ☐ DIAPHRAGM (BOURDON FOR HIGH PRESS AND DIAPHRAGM FOR LOW PRESS APPLICATION)	
	MATERIAL	SENSING ELEMENT – AISI 316 SS MOVEMENT – AISI 304 SS CASING – ■ DIE CAST AL ☐ SS	
	ENCLOSURE	CLASS: ■ IP-55 ☐ IP-65 ☐ EXPL PROOF PAINT: ■ ENAMEL ☐ EPOXY	
	DIAL	SIZE: 150 MM COLOR: WHITE NUMERALS: BLACK SCALE: LINEAR, 270° ARC GRADUATED IN METRIC UNITS	
	CASE	COLOUR : BLACK	
	SPAN/ ZERO ADJUSTMENT	INT. MICRO SCREW	
	RANGE SELECTION	SHOULD COVER 125% OF OPRATING PARAMETER	
	OVER RANGE PROTECTION	1.5 TIMES OF FSD	
	BLOW OUT DISC	REQUIRED	
	SWITCHING FACILITY (IF APPLICABLE)	NOT REQUIRED	
	TYPE	☐ MICRO SWITCH ☐ OTHER	
	NO. / TYPE OF CONTACTS	2 NOS. SPDT	
	CONTACT RATING	5A 230V AC, 0.25A 220V DC	
	SETTING RANGE	FIELD ADJUSTABLE OVER FULL RANGE	
	REPEATABILITY	± 1% OF FSR	
	POWER SUPPLY	☐ 230V AC ☐ 110V AC	
PERFORMANCE	ACCURACY	± 1% OR BETTER OF FULL SCALE DEFLECTION	
CONNECTION	PROCESS	☐ M20 x 1.5 (M) ■ ½" NPT (M) ☐ ½" NPT (F) ☐ OTHER	
	LOCATION	BOTTOM	
ACCESSORIES	NAME PLATE / METAL TAG	SS	
	OTHER	SIPHON FOR STEAM, SNUBBER FOR PUMP DISCHARGE, CHEMICAL SEAL DIAPHRAGM FOR CORROSSIVE, OIL SERVICES and SLURRY APPLICATION TO BE PROVIDED	
OTHER REQUIREMENT	INSTRUMENT LIST	INSTRUMENT LIST COMPRISING OF TAG NO., SERVICE, DESIGN/OPERATING PRESSURE & TEMPERATURE TO BE ATTACHED	
QUALITY REQUIREMENT	CHECK LIST FOR PG/DPG	REFER CHECK LIST NO PE-CL-999-145-I 026-0	

NOTE - Wherever capillary is applicable, length of the capillary shall be 5 metres.

FORM NO. PEM-6666-0

BHEL	**CHECK LIST FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE (Mechanical Auxiliary Packages)**	SPECIFICATION NO.: VOLUME SECTION REV. NO. / DATE: SHEET 2 OF 2 Data Sheet No.: **PE-CL-999-145-I026-0**

SL NO	TESTS/CHECKS	QUANTM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS	AGENCY P	AGENCY W	AGENCY V	REMARKS
1.0	CHECK FOR		APPROVED TECHINCAL REQUIREMENT/ DATA SHEET				MFR TO CARRY OUT ROUTINE TEST ON 100%. WHEN MATL CORELATION ARE NOT AVAILABLE MFR'S COMPLIANCE TO BE PROVIDED
	1.1 DIAL SIZE	100%		M	C	C	
	1.2 MODEL NO/TAG NO	100%		M	C	C	
	1.3 RANGE/SCALE	100%		M	C	C	
	1.4 END CONNECTION	100%		M	C	C	
	1.5 SWITCH CONTACT RATING & NOS	100%		M	C	C	
2.0	CALIBRATION						
	2.1 ACCURACY	100%		M	C	B	
	2.2 REPEATABILITY (FOR SWITCH)	100%		M	C	B	
	2.3 SET POINT ADJUSTMENT FOR SWITCH	100%		M	C	C	
3.0	OVER PRESSURE & LEAK TEST	100%		M	C	C	
4.0	OPERATION OF PR. RELEIF DEVICE	ONE PER TYPE		M	C	C	
5.0	REVIEW OF T.C. FOR MATERIAL OF–						
	5.1 SENSOR	FOR LOT		-	-	B	
	5.2 MOVEMENT			-	-	B	
	5.3 PROCESS CONNECTION			-	-	B	
	5.4 HOUSING			-	-	B	
6.0	REVIEW OF T.C. FOR DEGREE OF PROTECTION	TYPE TEST		-	-	B	
7.0	REVIEW OF T.C. FOR CONTACT RATING OF SWITCH	ONE PER TYPE		-	-	B	
8.0	ACCESSORIES AS APPLICABLE	100%		M	C	C	

LEGEND:
M: MANUFACTURER/ SUB CONTRACTOR, C: CONTRACTOR/ NOMINATED INSP AGENCY, B: BHEL. P: PERFORM, W: WITNESS, V: VERIFICATION.

NOTE:
CONTRACTOR TO PROVIDE COMPLIANCE CERTIFICATE FOR TESTS/CHECKS VERIFIED BY CONTRACTOR AND SUBMIT THE SAME ALONGWITH TEST CERTIFICATES TO BE VERIFIED BY BHEL.

FORM NO. PEM-6666-0

BHEL	**TECHNICAL REQUIREMENTS FOR PRESSURE /DIFFERENTIAL PRESSURE SWITCH (Mechanical Auxiliary Packages)**	SPECIFICATION NO.: VOLUME SECTION REV. NO. / DATE: SHEET 1 OF 2

Data Sheet No.: **PE-DC-999-145-I031-0A**

		TECHNICAL REQUIREMENT FOR PRESSURE / DIFFERENTIAL PRESSURE SWITCH (TO BE FILLED BY PURCHASER)	TO BE FILLED BY THE BIDDER
GENERAL	MANUFACTURER		
	MODEL NUMBER		
TECHNICAL	PRESSURE ELEMENT	☐ DIAPHRAGM ☐ BELLOW (for low range) ☐ PISTON ☐ BOURDON (for high range)	
	MATERIAL	ELEMENT: ■ AISI 316 SS ☐ Ph. Br. CASING : DIE CAST AL WITH EPOXY COATING	
	ENCLOSURE	☐ IP-55 ■ IP-65 ☐ EXPL. PROOF	
	SWITCH TYPE	☐ MICRO ☐ ENCLOSURE HERMETICALLY SEALED	
	SWITCH CONTACT	TWO NOS. SPDT	
	SWITCH RATING	5A 230V AC, 0.25A 220V DC	
	SET POINT	ADJUSTABLE THROUGHOUT THE RANGE	
	DIFFERENTIAL	☐ FIXED ■ ADJUSTABLE OVER WIDE RANGE	
	MOUNTING	■ DIRECT ☐ PANEL OR RACK	
	OVER RANGE PROTECTION	150% OF FSD	
PERFORMANCE	REPEATABILITY	± 0.5 %	
	DIAPHRAGM SEAL	DIAPHRAGM WITH CHEMICAL SEAL FOR CORROSSIVE & OIL SERVICES TO BE PROVIDED	
	NAME PLATE/METAL TAG	SS	
CONNECTION	PROCESS	½" NPT (F) AT BOTTOM	
	ELECTRICAL	PLUG IN SOCKET	
OTHER REQUIREMENT	INSTRUMENT SCHEDULE	INSTRUMENT LIST COMPRISING OF TAG NO., SERVICE, RANGE, MEDIUM, STATIC PRESSURE, DESIGN/OPERATING PRESSURE & TEMPERATURE TO BE ATTACHED	
QUALITY REQUIREMENT	CHECKLIST FOR PS/DPS	REFER CHECK LIST NO. PE-CL-999-145-I031-0	

NOTE - Wherever capillary is applicable, length of the capillary shall be 5 metres.

FORM NO. PEM-6666-0

	CHECK LIST FOR PRESSURE / DIFFERENTIAL PRESSURE SWITCH (Mechanical Auxiliary Packages)	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 2 OF 2
		Data Sheet No.: PE-CL-999-145-I031-0

SL NO	TESTS/CHECKS	QUANTUM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS	AGENCY P	AGENCY W	AGENCY V	REMARKS
1.0	CHECK FOR		APPROVED TECHINCAL REQUIREMENT/ DATA SHEET/ RELEVANT STANDARD / MANUFACTURER CATALOGUE				MFR TO CARRY OUT ROUTINE TEST ON 100%.
	1.1 MODEL NO/TAG NO	100%		M	C	C	
	1.2 RANGE/SCALE	100%		M	C	C	
	1.3 END CONNECTION	100%		M	C	C	
	1.4 SWITCH CONTACT RATING & NOS	100%		M	C	C	
2.0	CALIBRATION						
	2.1 REPEATABILITY	100%		M	C	B	
	2.2 DIFFERENTIAL	100%		M	C	B	
	2.3 SET POINT ADJUSTMENT	100%		M	C	B	
3.0	OVER PRESSURE & LEAK TEST	100%		M	C	C	
4.0	REVIEW OF T.C. FOR MATERIAL OF–						WHEN TC FOR MATERIAL FOR THE PROJECT NOT AVAILABLE , COMPLIANCE CERTIFICATE TO BE PROVIDED BY THE MANUFACTUR ER.
	5.1 SENSOR	FOR LOT		-	-	B	
	5.2 MOVEMENT			-	-	B	
	5.3 HOUSING			-	-	B	
5.0	REVIEW OF T.C. FOR DEGREE OF PROTECTION	TYPE TEST		-	-	B	
6.0	REVIEW OF T.C. FOR MICRO SWITCH	FOR LOT		-	-	B	
7.0	ACCESSORIES AS APPLICABLE	100%		M	C	C	

LEGEND:
M: MANUFACTURER/ SUB CONTRACTOR, C: CONTRACTOR/ NOMINATED INSP AGENCY, B: BHEL. P: PERFORM, W: WITNESS, V: VERIFICATION.

NOTE:
CONTRACTOR TO PROVIDE COMPLIANCE CERTIFICATE FOR TESTS/CHECKS VERIFIED BY CONTRACTOR AND SUBMIT THE SAME ALONGWITH TEST CERTIFICATES TO BE VERIFIED BY BHEL.

FORM NO. PEM-6666-0

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 1 OF 3

TAG No. ..... Qty..... Data Sheet No.: **PES-145-01-DS1-** A

Data Sheet A & B

		DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL	MANUFACTURER		
	MODEL NUMBER		
TECHNICAL	TYPE	TRANSMITTER OF MICROPROCESSOR BASED 2 WIRE TYPE ,HART PROTOCOL COMPATIBLE	
	TRANSMITTER MEASUREMENT	☐ PRESSURE ■ DIFF. PRESSURE	
	OUTPUT RANGE	SIGNAL 4-20MA DC (ANALOG) along WITH SUPERIMPOSED DIGITAL SIGNAL (BASED ON HART PROTOCOL)	
	TURN DOWN RATIO	10:1 FOR VACUUM /VERY LOW PRESSURE APPLICATION 30:1 FOR OTHER APPLICATION	
	ACCURACY	± 0.1% OF CALIBRATED SPAN(MINIMUM)	
	STABILITY	± 0.1% OF CALIBRATED SPAN FOR 6 MONTHS FOR RANGE UPTO AND INCLUDING 70 Kg/cm2 ± 0.25% OF CALIBRATED SPAN FOR 6 MONTHS FOR RANGE MORE THAN 70 Kg/cm2	
	LOAD IMPEDANCE	500 OHM (MIN)	
	RESPONSE TIME (TIME TAKEN FROM CHANGE IN PHYSICAL PARAMETER INPUT CHANGE TO TRANSMITTER , OUTPUT REACHING 63.2 % OF IT'S TOTAL CHANGE INCLUDING THAT TIME)	100 ms OR BETTER	
	HOUSING	IP 55(with corrosion resistance epoxy coating)	
	OVER PRESSURE	150 % OF MAX OPERATING PRESSURE	
	CONNECTION (ELECTRICAL)	PLUG & SOCKET TYPE	
	PROCESS CONNECTION	1" , 150# RF	
	ZERO DRIFT & SPAN DRIFT	+/- 0.015 PER DEG C AT AT MAX SPAN +/- 0.11 PER DEG C AT AT MAX SPAN	
	SPAN & ZERO	CONTINOUS TEMPER PROOF,REMOTE AS WELL AS ADJUSTABLY MANUAL FROM INSTRUMENT WITH ZERO SUPPRESSION & ELEVATION FACILITY	
	DAIGNOSTICS	SELF INDICATING FEATURE	
	POWER SUPPLY	24 V DC ± 10%	

FORM NO. PEM-6666-0

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 2 OF 3

TAG No. ..... Qty..... Data Sheet No.: PES-145-01-DS1- A

Data Sheet A & B

DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
ADJUSTMENT/CALIBRATION/MAINTENANCE	HAND HELD CALIBRATOR/HART .	
ACCESSORIES	DIAPHRAGM SEAL,PULSATIONS DAMPENERS,SYPHON ETC AS REQUIRED BY SERVICE & OPERATING CONDITION, 2 VALVE MANIFOLD FOR ABSOLUTE PRESSURE TRANSMITTER (3 –VALVE MANIFOLD FOR GAUGE /VACUUM PRESSURE TRANSMITTER)AND 5 VALVE MANYFOLD FOR DP /LEVEL/FLOW TRANSMITTER	

NOTE - Wherever capillary is applicable, length of the capillary shall be 5 metres.

FORM NO. PEM-6666-0

	CHECK LIST FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER (Mechanical Auxiliary Packages)	SPECIFICATION NO.:	
		VOLUME	
		SECTION	
		REV. NO.	DATE:
		SHEET 3 OF 3	

Data Sheet No.: PE-CL-999-145-I026-0

SL NO	TESTS/CHECKS	QUANTM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS	AGENCY			REMARKS
				M	C	B	
1.0	CHECKS FOR VISULA, MODEL TAG NO.	SEE NOTE-1 BELOW	APPROVED TECHINCAL REQUIREMENT/ DATA SHEET	P	W	V	MFR TO CARRY OUT ROUTINE TEST ON 100%. WHEN MATERIAL CORELATION ARE NOT AVAILABLE MFR'S COMPLIANCE TO BE PROVIDED
2.0	PROCESS CONNECTION	-do-		P	W	V	
3.0	ACCURACY	-do-		P	W	V	
4.0	REPEATEABILITY	-do-		P	W	V	
5.0	HYSTERISIS	-do-		P	W	V	
6.0	EFFECT OF TEMP VARIATION ON ACCURACY	-do-		P	W	V	
7.0	SPAN /ZERO ADJUSTMENT	ONE/TYPE		P	W	V	
8.0	EFFECT OF SUPPLY VOLTAGE VARIATION	ONE/TYPE		P	W	V	
9.0	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
10.0	BURN IN TEST	ONE/TYPE		P	W	V	
11.0	DEGREE OF PROTECTION	ONE/TYPE		P	W	V	

LEGEND:
M: MANUFACTURER/ SUB CONTRACTOR, C: CONTRACTOR/ NOMINATED INSP AGENCY, B: BHEL. P: PERFORM, W: WITNESS, V: VERIFICATION.

NOTE:

1. QUANTUM OF CHECK SHALL BE AS BELOW
   100 % - BY MANUFACTURER
   RANDOM FOR EACH TYPE – BY BHEL & CUSTOMER
2. MANUFACTURER TO MAINTAIN CALIBRATED INSTRUMENT HAVING BETTER ACCURACY THAN THE ITEM UNDER TEST. INSPECTING ENGINEER SHALL CHECK THE SAME.
3. IN CASE OF IMPORTED ITEMS CONTRACTORS SHALL REVIEW TC's AND NOT INSPECT.

CONTRACTOR TO PROVIDE COMPLIANCE CERTIFICATE FOR TESTS/CHECKS VERIFIED BY CONTRACTOR AND SUBMIT THE SAME ALONGWITH TEST CERTIFICATES TO BE VERIFIED BY BHEL.

LIST OF SUBVENDORS

NTPC	PROJECT : BULK TENDER (9 x 800 MW)	LIST OF ITEMS REQUIRING QP	REF. NO :
	PACKAGE : TG PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR : BHEL	VENDOR AS APPROVED BY	DATE : 05/07/2011
	CONTRACT NO :		

No.	Major Equipment	QP Inspection Category	QP No. 9575-110/ 9586-110-QVI-Q	QP Sub	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		I				Dressor Masoneilan	France	A			
		I				HORA	Germany	A			
6	Control valve(For severe service application)	I				CCI	USA/Sweden /Korea	A			
		I				Dressor Masoneilan	France	A			
		I				HORA	Germany	A			
		I				EMERSON (Fisher)	USA/France /Japan	A			
		•				LESLIE	USA	DR			
		•				WEAR VALVES & Controls	UK	DR			
		•				KOSO	COIMBATORE	DR			
7	Control valve(other than severe service application) - up to 600 ANSI CLASS	I				MIL	Alwaye	A			Vendors at sl no 5 & 6 are also acceptable. For Sr. No. 7, higher rating of approval of sub supplier to be decided based on valve application and references during detail engineering.
		I				IL	Palghat	A			
		I				Fisher Sanmar	Chennai	A			
		I				Dressor	Coimbatore	A			
		II				Copes Vulcan	UK	A			
		•				Forbes Marshall	Pune	DR			
8	Conduits/Pipe(GI)	III				BIS Approved Sources		A			
9	Electronic transmitters (pressure, DP & flow)	II				EMERSON (Rosemount)	USA/pawane	A			
		II				FUJI ELECTRIC	JAPAN	A			
		II				YOKOGAWA	JAPAN	A			Testing and Calibration at M/s YIL, Bangalore is also acceptable.
		I				ABB	FARIDABAD	A			Model - 2600 T
		II				ABB	GERMANY	A			Model - 2600 T

NTPC	PROJECT : BULK TENDER (9 x 800 MW)	LIST OF ITEMS REQUIRING QP	REF. NO :
	PACKAGE : TG PACKAGE	APPROVAL & ACCEPTABLE	REVISION NO : 00
	CONTRACTOR : BHEL	VENDOR AS APPROVED BY	DATE : 05/07/2011
	CONTRACT NO :		

No.	Major Equipment	QP Inspection Category	QP No. 9575-110/ 9586-110-QVI-Q	QP Sub	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
10	Thermocouples, RTD & Thermowell	II				HERAUS SENSOR	GERMANY	A			
		II				WISE Control	Korea	A			
		I				Tempsens	Udaipur	A			
		I				Pyroelectric	Goa	A			
		I				Detriv Instrumentation & Electro	Mumbai	A			
		II				Minco	USA	A			
		II				OKAZAKI	JAPAN	A			
		II				Yamari	JAPAN	A			
		II				ABB(SENSYCON)	Germany	A			
		II				EMERSON (Rosemount)	Germany	A			
		II				EMERSON (Rosemount)	pawane	A			Imported from Emerson, Germany (make)
		I				GIC(Thermal Instruments)	Savantwadi	A			
11	Ultrasonic type level Transmitter	III				E & H	Aurangabad/ Germany	A			
		III				EMERSON	pawane	A			
		III				SIEMENS MILTRONICS	CANADA	A			
		•				Khrone	France	DR			
12	Orifice plate assembly	III				Instrumentation Limited	Palghat	A			
		III				Microprecision	Faridabad	A			
		III				Starmech	Pune	A			
		•				Engg. Specialities	Kolkata	DR			
		•				MINCO	GOA	DR			
		•				BALIGA	CHENNAI	DR			
13	Pressure, DP Gauge	III				BUDENBERG	UK	A			

NTPC	PROJECT : BULK TENDER (9 x 800 MW)						LIST OF ITEMS REQUIRING QP			REF. NO :	
	PACKAGE : TG PACKAGE						APPROVAL & ACCEPTABLE			REVISION NO : 00	
	CONTRACTOR : BHEL						VENDOR AS APPROVED BY			DATE : 05/07/2011	
	CONTRACT NO :										
No.	Major Equipment	QP Inspection Category	QP No. 9575-110/ 9586-110-QVI-Q	QP Sul	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		III				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			Not for MS & FW application
		III				A.N. Instruments	Kolakatta	A			Not for MS & FW application
		III				GIC(Gauge Bourdon)	Panvel	A			Not for MS & FW application
		III				Manometer	Mumbai	A			Not for MS & FW application
		III				Goa Thermostatic	GOA	A			Not for MS & FW application
		III				GLUCK	Mumbai	A			Not for MS & FW application
		III				Switzer	Chennai	A			Not for MS & FW application - only for DP Indicator
		III				PTCI	Kolkata	A			Not for MS & FW application
		II				Waaree	Vapi	A			Not for MS & FW application
		*				Forbes Marshall	Hyderabad	DR			* - Inspection category to be decided during vendor evaluation.
		III				Ashcroft	Gandhinagar	A			Not for MS & FW application - for Mass brand

238

104

4 of

NTPC	PROJECT : BULK TENDER (9 x 800 MW)						LIST OF ITEMS REQUIRING QP			REF. NO :	
	PACKAGE : TG PACKAGE						APPROVAL & ACCEPTABLE			REVISION NO : 00	
	CONTRACTOR : BHEL						VENDOR AS APPROVED BY			DATE : 05/07/2011	
	CONTRACT NO :										
No.	Major Equipment	QP Inspection Category	QP No. 9575-110/ 9586-110-QVI-Q	QP Sul	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		III				H Guru	Rishra/Muzaffarpur	A			Not for MS & FW application
14	Level gauge (Transparent & Reflex, Tubular type)	III				Nihon Klingage Co.,Ltd	Japan	NOTED			Up to 40 Kg/cm2
		III				Bunkabokei Kogyo Co., Ltd	Japan	NOTED			Up to 40 Kg/cm2
		III				tokyo keiso	Japan	NOTED			Up to 40 Kg/cm2
		III				Samil industries Inc.	Korea	NOTED			Up to 40 Kg/cm2
		III				HITROL	Korea	NOTED			Up to 40 Kg/cm2
		III				Levcon	Kolkatta	NOTED			Up to 40 Kg/cm2
		III				Sigma	Mumbai	NOTED			Up to 40 Kg/cm2
		III				SBEM	Pune	NOTED			Up to 40 Kg/cm3
		III				Chemtrol	GOA	NOTED			Up to 40 Kg/cm4
		III				ASIAN INDUSTRIAL VALVES	CHENNAI	NOTED			Up to 40 Kg/cm5
		III				D.K.Instruments	Kolkotta	NOTED			Up to 40 Kg/cm2
		III				Flow Star	Faridabad	NOTED			Up to 40 Kg/cm2
		III				V-Automat	NewDelhi	NOTED			Up to 40 Kg/cm2
15	Press. DP, Vaccum Switch	II				SOR	USA	A			
		II				DRESSOR (ASHCROFT)	USA/Germany	A			
		II				ITT BARTON	USA	A			
		II				HERION	GERMANY	A			
		II				BARKSDALE	GERMANY	A			
		II				Switzer	Chennai	$			Up to 40kg/cm2 & not for Compound Switch and except 900 series
		I				Trafag	Ranipet	$			Up to 40kg/cm2 & not for Compound Switch
		II				Indfos	Ghaziabad	$			Up to 40kg/cm2 & not for Compound Switch

239

105

NTPC	PROJECT : BULK TENDER (9 x 800 MW)					LIST OF ITEMS REQUIRING QP			REF. NO :	
	PACKAGE : TG PACKAGE					APPROVAL & ACCEPTABLE			REVISION NO : 00	
	CONTRACTOR : BHEL					VENDOR AS APPROVED BY			DATE : 05/07/2011	
	CONTRACT NO :									

No.	Major Equipment	QP Inspection Category	QP No. 9575-110/ 9586-110-QVI-Q	QP Sub	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		III				Aura INC	New Delhi	A			¼" to 1/2" up to 5 wey with Pressure rating up to 4000 Psi
		III				HP Valves and fittings	CHENNAI	A			
		III				HYD AIR	LONAVALA	A			
		III				Fluid control	Mumbai	A			
		III				Microprecision	Faridabad	A			
		III				Parker	USA	A			
		III				Swagelock	USA	A			
		III				Baldota	Mumbai	A			
28	Local Instrument Enclosure/Rack	I				Pyrotech	Udaipur	A			
		I				IL	Kota	A			
		I				Sajas electrical	Trichurapalli	A			
		*				Forbes Marshall	Pune	DR			
		I				ECIL	Hyderabad	DR *			Record updation - See footnotes
		I				Prammen	Puddukottai	A			
		I				Chemin	Pondicherry	A			
29	Instrument Cables	I				Paramount	Khuskhera	A			PVC,FRLS type,RQP
		I				Polycab	pawane	A			PVC,FRLS type,RQP
		I				Delton	Faridabad	A			PVC,FRLS type,RQP
		I				KEI	Bhiwadi	A			PVC,FRLS type
		I				Elkey Telelinks	Faridabad	A			PVC,FRLS type
		I				CORDS	Bhiwadi	A			PVC,FRLS type,RQP
		I				RELIANCE	Bangalore	DR*			PVC,FRLS type,RQP Record updation - See footnotes

244

110

NTPC	PROJECT : BULK TENDER (9 x 800 MW)					LIST OF ITEMS REQUIRING QP			REF. NO :	
	PACKAGE : TG PACKAGE					APPROVAL & ACCEPTABLE			REVISION NO : 00	
	CONTRACTOR : BHEL					VENDOR AS APPROVED BY			DATE : 05/07/2011	
	CONTRACT NO :									

No.	Major Equipment	QP Inspection Category	QP No. 9575-110/ 9586-110-QVI-Q	QP Sub	QP Approval SCH	Proposed Sub Supplier	Country	SS Approval Status	SS Detail Sub.SCH	SS Approval SCH	Remark
		I				Nicco	Kolkata	A			PVC,FRLS type
		II				TEW & C	USA	A			
		II				Habia cables	Sweeden	A			
		II				Kerpen cables	Germany	A			
		II				Lapp cables	Germany	A			
		II				Thermo elecrta Bv	Netherland	A			
		I				Universal Cable	Satna	A			PVC,FRLS type
30	Electrical actuator	II				Auma	Germany	A			
		II				Limitorque	USA	A			
		II				Rotorq	UK	A			
		I				Limitorque	Faridabad	A			
		II / I				Rotork	Chennai/ Bangalore	A			For Bangalore - CAT - I
		II				Nippon gear	Japan	A			
		II				Auma	Bangalore	A			
31	Flow nozzle assembly	II				Microprecision	Faridabad	A			Except P-91 Material
		II				SEKO	Austria	A			
		II				TECHNOMATIC	Italy	A			
		II				ABB/ H&B	UK	A			
		II				IL	Palghat	A			
		II				Daniel	USA	A			
		II				Starmech	Pune	A			Except P-91 Material
		*				MINCO	GOA	DR			
		*				Engg. Specialities	Kolkata	DR			
32	HIGH Temp. cable (PTFE/FEP)	III				Habia cables	Sweden	A			
		III				Lapp cables	Germany	A			
		III				Kerpen cables	Germany	A			

245

111

NTPC	PROJECTS: BULK ORDER (6X800MW) CONTACTOR: BHEL-PEM CONTRACT NO:- 9548/9549/9566/9573-110-2	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-CONTRACTORS APPROVAL	Ref. No.9548/9549/9566/9573-110-2 Revision No. 00 DATE :

SR NO	ITEM	QP /INSPN CAT	QP NUMBER	QP SUB MISSION SCH	QP APPL SCH	PROPOSED SUB-SUPPLIER	PLACE	SS APPL STATUS/ CAT	SS DETAIL SUB SCH	SS APPL SCHEDULE	REMARK
2	MISC PUMPS -HORIZONTAL CENTRIFUGAL	I				SULZER PUMPS INDIA	MUMBAI	A			CAP UPTO 1900 M3/HR
		I				WPIL	GAZIABAD	A			CAPACITY REF NTPC LTR DTD 03.03.08
		I				BDK MARKETING	HUBLI	DR			
		I				SAM	COIMBATORE	A			CAPCITY UPTO 1350 M3/HR
		I				JYOTI PUMPS	VADODRA	A			CAP UPTO 2350 M3/HR
		I				BEST & CROMPTON(BEACON WEAR)	CHANNAI	A			
		I				VOLTAS	MUMBAI	A			

NTPC	PROJECT: BULK ORDER (9X500MW) CONTACTOR: BHEL-PEM CONTRACT NO:- 9548/9549/9568/9573-110-2	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-CONTRACTORS APPROVAL	Ref. No.9548/9549/9568/9573-110-2 Revision No. 00 DATE :

SR NO	ITEM	QP INS-PN CAT	QP NUMBER	QP SUB MISSION SCH	QP APPL SCH	PROPOSED SUB-SUPPLIER	PLACE	SS APPL STATUS/ CAT	SS DETAIL SUB SCH	SS APPL SCHEDULE	REMARK
2	MISC PUMPS -HORIZONTAL CENTRIFUGAL	I				KBL	PUNE	A			
		I				FLOWMORE	GAZIABAD	A			CAPACITY UPTO 2000 M3/HR
		I				KSB	PUNE	A			
		I				MATHER & PLATT	PUNE	A			

NTPC	PROJECTS: BULK ORD&R (6X800MW) CONTACTOR: BHEL-PEM CONTRACT NO:- 9548/9549/9565/9573-110-2	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-CONTRACTORS APPROVAL	Ref. No.9548/9549/9565/9573-110-2 Revision No. 00 DATE :

SR NO	ITEM	QP INSPN CAT	QP NUMBER	QP SUBMISSION SCH	QP APPL SCH	PROPOSED SUB-SUPPLIER	PLACE	SS APPL STATUS/ CAT	SS DETAIL SUB SCH	SS APPL SCHEDULE	REMARK
13	CCS VALVES OTHER THAN BHEL TRICHY	I				FOURESS ENGG.	AURANGABAD	A			
		I				AUDCO(L&T)	CHENNAI	A			
		I				BDK	HUBLI	A			REFER NTPC LETTER DATED 24/02/00 :01/CQA/3520-001/C-04
		I				FEDERAL HARDWARE ENGG	SINGAPUR	DR			UPTO 250 NB -600CL ; & 400NB -300 CL.; 600NB - 150 CL

NTPC	PROJECTS: BULK ORDER (6X500MW) CONTACTOR: BHEL-PEM CONTRACT NO:- 9548/9549/9566/9573-110-2	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-CONTRACTORS APPROVAL	Ref. No.9548/9549/9566/9573-110-2 Revision No. 00 DATE :

SR NO	ITEM	QP /INSPN CAT	QP NUMBER	QP SUBMISSION SCH	QP APPL SCH	PROPOSED SUB-SUPPLIER	PLACE	SS APPL STATUS/ CAT	SS DETAIL SUB SCH	SS APPL SCHEDULE	REMARK
13	CCS VALVES OTHER THAN BHEL TRICHY	I				STEEL STRONG	NAVI MUMBAI	A			AS PER NTPC APPROVAL LETTER.
		I				KSB	COIMBATORE	A			UPTO 250 NB -600CL ; & 400NB -300 CL.; 600NB - 150 CL
		I				KBL	PUNE	A			GATE /GLOBE UPTO 300 NB - 600 CL;600 NB-150 CL:CH
		I				LEADER ENGG. WORKS	JULLUNDHAR	A			GATE UPTO 300 NB-600CL;600 NB-150 CL:GLOBE / CHECK 250
		I				PETROL VALVE	ITALY	A			REFER NTPC LETTER DATED 24/02/00 :01/CQA/3520-001/C-04
		I				BABCOCK POWER	SPAIN	A			GATE /GLOBE UPTO 300 NB - 600 CL;600 NB-150 CL:CH
		I				NITON	MUMBAI	A			APPROVAL AS PER NTPC LETTER FOR BARH-II
14	CI VALVES (GATE , GLOBE , NRV)	I				LEADER ENGG. WORKS	JULLUNDHER	A			UPTO 600 NB -PN1.5
		I				BANKIM	KOLKATTA	A			UPTO 600 NB -PN1.5
	CI VALVES (GATE, GLOBE , NRV)	I				H SARKAR	KOLKATTA	A			UPTO 600 NB -PN1.5
	CI VALVES (GATE , GLOBE , NRV)	I				KBL	KONDHAPURI	A			UPTO 600 NB -PN1.5

NTPC	PROJECTS: BULK ORDER (6X800MW) CONTACTOR: BHEL-PEM CONTRACT NO:- 9548/9549/9566/9573-110-2	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-CONTRACTORS APPROVAL	Ref. No.9548/9549/9566/9573-110-2 Revision No. 00 DATE :

SR NO	ITEM	QP /INS-PN CAT	QP NUMBER	QP SUBMISSION SCH	QP APPL SCH	PROPOSED SUB-SUPPLIER	PLACE	SS APPL STATUS/ CAT	SS DETAIL SUB SCH	SS APPL SCHEDULE	REMARK
15	BALL VALVES (NON FIRE SAFE TYPE)	I				PEC	NASIK	A			UPTO 400 NBX150#
		I				FLOWCHEM	AHMEDABAD	A			UPTO 350 NBX150#
		I				BDK	HUBLI	A			UPTO 400 NBX150#
		I				LEADER	JALANDHAR	A			UPTO 50 NB.
		I				AUDCO(L&T)	CHANNAI / KANCHIPURAM	A			
		I				AKAY INDUSTRIES	HUBLI	A			UPTO 50 NB.
		I				VAAS AUTOMATION	CHENNAI	DR			
		I				MICROFINISH VALVES	HUBLI	A			UPTO 400NB, #300

NTPC	PROJECTS: BULK ORDER (6X800MW) CONTACTOR: BHEL-PEM CONTRACT NO:- 9548/9549/9566/9573-110-2	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-CONTRACTORS APPROVAL	Ref. No.9548/9549/9566/9573-110-2 Revision No. 00 DATE :

SR NO	ITEM	QP /INS-PN CAT	QP NUMBER	QP SUB MISSION SCH	QP APPL SCH	PROPOSED SUB-SUPPLIER	PLACE	SS APPL STATUS/ CAT	SS DETAIL SUB SCH	SS APPL SCHEDULE	REMARK
18	CRH-7,8,9, DEAERATOR PEGGING VALVES	I				PETROL VALVES	ITALY	A			
19	ANGLE VALVES	I				REINEKE	GERMANY	A			
		I				SAMPELL AG	GERMANY	A			
		I				IL	PALGHAT	A			UP TO 2 INCH SIZE
		I				H P VALVE	NETHERLAND	A			
		I				VELAN INC	CANADA	A			UP TO 2 INCH SIZE
20	BUTTERFLY VALVESIN CI / CCS / CONST(UPTO PN 10 & SUBJECT TO LIFE CYCLE TEST).	I				AUDCO	CHENNAI	A			UPTO 1800NB
		I				TYCO	HALOL	A			UPTO 2200NB
		I				KBL	KONDHAPURI	A			UPTO 2600 MM SIZE
		I				INTERVALVE	PUNE	A			UPTO 1400 NB
		I				IL	PALGHAT	A			UPTO 2200NB

NTPC	PROJECTS: BULK ORDER (9X500MW) CONTACTOR: BHEL-PEM CONTRACT NO:- 9548/9549/9566/9573-110-2	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-CONTRACTORS APPROVAL	Ref. No.9548/9549/9566/9573-110-2 Revision No. 00 DATE :

SR NO	ITEM	QP /INS-PN CAT	QP NUMBER	QP SUB MISSION SCH	QP APPL SCH	PROPOSED SUB-SUPPLIER	PLACE	SS APPL STATUS/ CAT	SS DETAIL SUB SCH	SS APPL SCHEDULE	REMARK
20	BUTTERFLY VALVESIN CI / CCS / CONST(UPTO PN 10 & SUBJECT TO LIFE CYCLE TEST).	I				STAFFORD CONTROLS	PUNE	DR			
		I				BDK PROCESS CONTROL	HUBLI	A			UPTO 1050 MM SIZE
		I				FOURESS ENGG.	BANGALORE	A			UPTO 2600NB
		I				R&D MULTIPLE	VALSAD	A			UPTO 1000 NB
21	AIR RELEASE VALVES	III									BHEL APPROVED SOURCES
22	CHEMICAL DOSING (LP)	I				VK PUMPS	THANE	A			
		I				MILTON ROY	CHENNAI	A			
		I				SWELLORE	AHEMDABAD	A			
		I				TECHNO STRENGTH	HYDERABAD	DR			
		I				PSI	CHENNAI	A			
		I				TECHNO CONSULTANT	MUMBAI	A			

एनटीपीसी NTPC	PROJECT: BULKSPPLY(9X800MW) Package: TG & AUXILIARY CONTRACTOR: BHEL-[illegible] P&M CONT NO:	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB SUPPLIER APPROVAL SUB SYSTEM: ELECTRICAL	Ref No: 9548/9549/9566/9573-110 Revision No: 00 Date: 11-03-10	

SR NO	ITEM	QP /INS-PN CAT	QP NO. 2250-186	QP SUB-MISSION SCHEDU-LE	QP APPL SCHED ULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB-SCHEDU LE	SS APPL SCHED ULE	REMARKS
1	LT MOTOR (Ref NOTE 2)	1				CGL	AHMEDNA GAR	A			RQP
		1				KEC	BANGLORE/ HUBLI*	A			*upto 90kw,RQP
		1				JYOTI	VADODARA	A			
		1				NGEF	BANGALOR E	A			UPTO 15 KW
		1				LHP	SOLAPUR	A			UPTO 120 KW
		1				ABB	FARIDABA D*/BANGAL ORE	A			* RQP& UPTO 55 KW
		1				SIEMENS	MUMBAI	A			RQP
		1				BHARAT BIJLEE	MUMBAI	A			UPTO 160 KW
		1				MARATHON	KOLKATA	A			RQP(UP TO 690 V & 600 KW)
2	CONTROL PANEL(NON PLC) FOR MECHANICAL SYSTEM & GENERATOR,AC & DC MOTOR STARTER AUXILIARY SYSTEM	1									
		1				SCHEINDER	NASHIK	A			
		1				JOLLY ENGG	KOLKATA	A			
		1				ELECHMECH	AHMEDABA D	A			
		1				SWITCHING CIRCUIT	KOLKATA	A			
		1				L&T	MUMBAI/C OIMBATOR E	A			
		1				CONTROL & SWITCHGEAR	NOIDA/HAR DWAR	A			

NO	ITEM	/INS-PN CAT	NO. 2250-186	MISSION SCHEDULE	APPL SCHEDULE	SUB SUPPLIER		APPL STATUS / CAT	DETAIL SUB-SCHEDULE	APPL SCHEDULE	
2	CONTROL PANEL(NON PLC) FOR MECHANICAL SYSTEM & GENERATOR,AC & DC MOTOR STARTER AUXILIARY SYSTEM	I				JACKSON	G.NOIDA	A			
		I				MILTON ROY	KOLKATAA	A			WITH PUMP OF MILTON RAY-CHENNAI
		I				POSITRONICS	BARODA	A			
		I				UNILEC	GURGAON	A			
		I				Amnay control	Pune	A			WITH PUMP OF KISHOR PUMP-PUNE
		I				GEII	BANGLORE	A			
		I				MPP	BANGLORE	A			WITH PUMP OF GEA-BGR-CHENNAI
		I				SIEMENS	MUMBAI	A			
		I				PYROTECH	UDAIPUR	A			
		I				CONTROL DEVICES	KOLKATA	A			
		I				PROCON	BANGLORE	A			
3	1.1 KV XLPE POWER CABLE	I				TORRENT	NADIAD	A			
		I				UNIVERSAL CABLE	SATNA	A			RQP
		I				POLYCAB	DAMAN	A			RQP
		I				INCAB	PUNE	A			
		I				HVPL	FARIDABAD	A			
		I				NICCO	SHYAMNAGAR	A			
		I				RADIANT	HYDERABAD	A			
		I				PARAMOUNT	KHUSHKHERA	A			
		I				HAVELL	ALWAR	A			

FORMAT NO.: QS-01-QAI-P-1/F3-R0

ENGG. DIV / QAI

SR NO	ITEM	QP /INS-PN CAT	QP NO. 2250-186	QP SUB-MISSION SCHEDU-LE	QP APPL SCHED ULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB-SCHEDU LE	SS APPL SCHED ULE	REMARKS
3	1.1 KV XLPE POWER CABLE	I				KEI	BHIWADI	A			
		I				RALLISON	BHIWADI	A			
		I				CORDS	BHIWADI	A			
		I				DELTON	FARIDABAD	A			Armoured cable up to 3.5 CX 240 sqmm
		I				GEMSCAB	BHIWADI	A			
		I				SRIRAM CABLE	BHIWADI	DR			
		I				SPECIAL CABLE	DELHI	DR			
4	1.1 KV PVC POWER CABLE	I				KEI	BHIWADI	A			
		I				NICCO	SHYAMNAGAR	A			
		I				HVPL	FARIDABAD	A			
		I				TORRENT	NADIAD	A			
		I				UNIVERSAL CABLE	SATNA	A			RQP
		I				HAVELL	ALWAR	A			
		I				POLYCAB	DAMAN	A			RQP
		I				GEMSCAB	BHIWADI	A			
		I				DELTON	FARIDABAD	A			Armoured cable up to 3.5 CX 240 sqmm
		I				INCAB	PUNE	A			
		I				CORDS	BHIWADI	A			
		I				RALLISON	BHIWADI	A			
		I				PARAMOUNT	KHUSKHERA	A			
		I				RADIANT CABLE	HYDERABAD	A			
5	1.1 KV CONTROL CABLE	I				KEI	BHIWADI	A			
		I				DELTON	FARIDABAD	A			RQP

NO		-PN CAT	2250-186	SCHEDU-LE	SCHED ULE			STATUS / CAT	SUB-SCHEDU LE	SCHED ULE	
5	1.1 KV CONTROL CABLE	I				GEMSCAB	BHIWADI	A			
		I				UNIVERSAL CABLES	SATNA	A			RQP
		I				TORRENT	NADIAD	A			
		I				POLYCAB	DAMAN	A			RQP
		I				PARAMOUNT CABLES	ALWAR	A			RQP
		I				NICCO	SHYAMNAGAR	A			
		I				HVPL	FARIDABAD	A			
		I				RADIANT	HYDERABAD	A			
		I				CORDS CABLE	BHIWADI	A			
		I				ELKAY TELELINK	BHIWADI	A			
		I				HAVELL	ALWAR	A			
		I				RALLISON	BHIWADI	A			
		I				SUYOG ELECTRICAL	BARODA	DR			
		I				THERMO CABLE	HYDERABAD	DR			
6	CABLE TRAY	I				INAR PROFILES LTD	ANKAPALLY	A			GALVANISING AT VISAKHA STEEL-ANAKAPALLI
		I				INDIANA GRATINGS	PUNE	A			SQP,GALVANISING AT POONA GALVANISER-PUNE
		I				JAMNA METALS	DELHI	A			SQP
		I				MJ ENGG	DELHI	A			SQP
		I				INDIA ELECTRIC SYNDICATE	KOLKATA	A			SQP,GALVANISING AT NTPC APPR. SOURCES

SR NO	ITEM	QP /INS-PN CAT	QP NO. 2260-186	QP SUB-MISSION SCHEDULE	QP APPL SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB-SCHEDULE	SS APPL SCHEDULE	REMARKS
6	CABLE TRAY	I				RATAN ENGG	KOLKATA	A			SQP,GALVANISING AT NTPC APPR. SOURCES
		I				VATCO	MUMBAI	A			SQP,GALVANISING AT SIGMA MUMBAI
		I				INDIANA	MUMBAI	A			SQP,GALVANISING AT KARAMTARA
		I				TECHNO ENGG	CHANDIGARH	A			SQP
		I				ANAND UDYOG	THANE	A			SQP
		I				INDUSTRIAL PERFORATION	KOLKATA	A			SQP,GALVANISING AT UNISTAR
		I				STEELITE	MUMBAI	A			SQP
		I				PATNY SYSTEM	HYDERABAD	DR			
		I				UNITECH FABRICATOR	KOLKATA	DR			
7	CABLE GLAND	III				SUNIL & CO	KOLKATA	A			
		III				QUALITY PRECISION	KOLKATA	A			
		III				ARUP ENGG	KOLKATA	A			
		III				COMET	MUMBAI	A			
8	LUGS	III				CHETNA	NASHIK	A			
		III				3D	UMBERGAON	A			
		III				DOWELLS	MUMBAI	A			
9	GALVANISEDJB &EARTHING MATERIAL	III				BHEL APPROVED SOURCES					GALVANISING AT NTPC APPROVED SOURCES
10	ELEVATOR	I				KONE	CHENNAI	A			
		I				SAMUEL TEC	KOREA	A			
		I				TECHNO INDUCTRIES	AHMEDABAD	A			

SR NO	ITEM	/INS-PN CAT	NO. 2250-166	MISSION SCHEDULE	APPL SCHEDULE	SUB SUPPLIER	PLACE	APPL STATUS / CAT	DETAIL SUB-SCHEDULE	APPL SCHEDULE	REMARKS
10	ELEVATOR	I				OTIS	MUMBAI	A			
		I				JOHSON	CHENNAI	DR			
		I				OMEGA INDUSTRIESL	AHMEDABAD	DR			
		I				ECS	GHAZIABAD	DR			
11	NG RESISTOR	I				SR NARKHEDE	PUNE	A			
		I				RESITECH ELECTRICALS	KOLKATA	A			
		I				SR NARKHEDE	PUNE	A			
		I				RSI SWITCHGEAR	GURGAON	A			
		I				LACHHMAN ELECTRONICS	DELHI	A			
		I				SPEED -O - CONTROLS	MUMBAI	DR			
12	FQP of ELECTRICAL EQUIPMENT- RECEIPT , STORAGE & ERECTION	I									

SR. NO	ITEM	QP /INS-PN CAT	QP NO. 2250-186	QP SUB-MISSION SCHEDULE	QP APPL SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB-SCHEDULE	SS APPL SCHEDULE	REMARKS

NOTE 1 : NOMENCLATURES USED
CAT-I QP APPROVAL AND INSPECTION BY NTPC: CAT-II QP APPROVAL BY NTPC INSPECTION BY TEL
CAT-III INSPECTION AS PER TEL QUALITY SYSYTEM
A: APPROVED VENDOR : DR: DETAILS REQUIRED : DR* VENDOR HISTORICALLY APPROVED, UPDATION OF DATA REQUIRED.

NOTE 2: A) MOTORS Less than 30 KW
Accaptance of Motor lass than 30 KW is based on COC of the Manufacturer and 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 7 NTPC specification

B) Between 30 KW and 50KW
Acceptance of Motor reting between 30 KW and 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 and the Contractor confirming as follows:
It is hereby confirmed that the abova 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, apace heater and tested in accordance with approved drawing /data sheets. FOR MOTORS ABOVE 50 KW: AS PER NTPC APPROVED QUALITY PLAN

NOTE3 : IN CASE OF GALVANISED JB EARTHING MATL GALVANISATION TO BE CARRIED OUT AT NTPC APPROVED GALVANISER INDICATED FOR CABLE TRAY
NOTE 4:ELECTRICAL SUB VENDOR LIST UNDER HYDROGEN PLANT SHALL BE FINALIZED AFTER FINALIZATION OF VENDOR FOR HYDROGEN PLANT. NOTE 5: ITEMS NOT REFERED IN ABOVE SHALL BE INTIMATED TO NTPC FOR APPROVVAA

NTPC